GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous institution affiliated to VTU, Belagavi.
Accredited by NAAC with 'A' grade,
NBA Accredited CS, E&C, E&E, MECH and IS branches)
Ideal Homes Township,
Raja Rajeshwari Nagar, Bengaluru-560098.

Department of Artificial Intelligence and Data Science

2022 BATCH

3RD TO 8TH SEMESTER SCHEME & SYLLABUS

Head of the Department
Dept. of Artificial Intelligence & Data Science
Global Academy of Technology
Bengaluru - 560 098.

Dean Academic
Global Academy of Technology,
Rajarajeshwarinagar, Bengaluru-98

B.E. in Artificial Intelligence and Data Science
Scheme of UG Autonomous Program – 2022 batch

III SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22MAT31A	Discrete Mathematics – I	BS	MAT	2	2	0	50	50	100	3
2	22ADS32	Data Structures using C	IPC	Respective Department	3	1	2	50	50	100	4
3	22ADS33	Database Management System	IPC		3	1	2	50	50	100	4
4	22ADS34	Foundations of Data Science	PC		2	2	0	50	50	100	3
5	22ADS35	Python for Data Science	ETC		3	0	0	50	50	100	3
6	22ADS36	Operating System	AEC		3	0	0	50	50	100	3
							Total	**300**	**300**	**600**	**20**

B.E. in Artificial Intelligence and Data Science
Scheme of UG Autonomous Program – 2022 batch

IV SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hou			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22MAT41A	Probability and Linear Algebra	BS	MAT	2	2	0	50	50	100	3
2	22ADS42	Design & Analysis of Algorithms	IPC	Respective Department	3	1	2	50	50	100	4
3	22ADS43	Machine Learning-I	IPC		3	1	2	50	50	100	4
4	22ADS44	Soft computing techniques	PC		2	2	0	50	50	100	3
5	22ADS45	Image Processing	ETC		2	2	0	50	50	100	3
6	22ADS46	Programming in Java	AEC		2	0	2	50	50	100	3
				Total				**300**	**300**	**600**	**20**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – III

DISCRETE MATHEMATICS – I

(Common for CSE/ISE/AI&DS /AI&ML)

Course Code:	**22MAT31A**	**CIE Marks:**	**50**
Hours/Week (L: T: P)	**2:2:0**	**SEE Marks:**	**50**
No. of Credits:	**03**	**Examination Hours:**	**03**

Course Objectives: To enable students to apply the knowledge of Mathematics in fields of computer science and allied branches by making them to learn:

1	Counting Principles
2	Mathematical Logic and Set Theory
3	Well ordering principle and Properties of Integers.
4	Probability and Random Variables

Sl. No	Course Learning Objectives (CLO)
1	To understand the concept of pointers and, allocate and deallocate memory dynamically to pointers.
2	To understand working principle of different types of data structures
3	To identify and apply the appropriate data structure to solve a given problem.
4	To develop applications using data structure algorithms.

Module 1	No. of Hours	RBT Level
The Rules of Sum and Product, The Pigeon-hole Principle, Permutations, Combinations, The Binomial Theorem, Combinations with Repetition.	**08**	**L3**
Module 2		
Sets and Subsets, Set operations and Laws of Set Theory. Counting and Venn Diagrams. Probability, Conditional probability and Bayes Theorem.	**08**	**L3**
Module 3		
Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implications: Rules of Inference. Quantifiers, Definitions, and the Proofs of Theorems.	**08**	**L3**
Module 4		
The Well-Ordering Principle, Mathematical Induction, Recursive Definitions, The division algorithm, Euclidian algorithm, Fundamental theorem of arithmetic.	**08**	**L3**
Module 5		
Random Variable, Binomial, Poisson, Exponential and Normal distributions. Joint distributions, Expectation and Covariance.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Use computational techniques essential for the study of mathematical logic, set operations, counting principles and properties of integers.
CO2	Solve problems associated with random variables using probability distributions

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1									3		
CO2	3	2	1									3		
Average	3	2	1									3		

High-3: Medium-2: Low-1

Text Books:

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2020.
2. T Veerarajan, Probability, Statistics and Random Processes for Engineers, Tata McGraw Hill, 3rd Edition, 2008

Reference Books:

1. Kenneth H. Rosen: Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007
2. Richard H Williams, Probability, Statistics and Random Processes for Engineers, Cengage Learning, 1st Edition, 2003

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – III

DATA STRUCTURES USING C

Semester:	**03**	**CIE Marks:**	**50**
Course Code:	**22ADS32**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:1:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): C programming language.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand the concept of pointers and, allocate and deallocate memory dynamically to pointers.
2	To understand working principle of different types of data structures
3	To identify and apply the appropriate data structure to solve a given problem.
4	To develop applications using data structure algorithms.

Module 1	No. of Hours	RBT Level
Introduction: Data Structures, Classifications (Primitive & Non Primitive), Data structure Operations **Sorting:** Insertion Sort, Radix sort, Address Calculation Sort. **Dynamic Memory Allocation:** Introduction, Dynamic Memory Allocation, Allocating a Block of Memory: malloc, Allocating a Multiple Blocks of Memory: calloc, Releasing the Used Space: Free, Altering the size of Block: realloc.	**10**	**L2**
Module 2		
The Stack: Definition and Examples— Primitive operations, examples **Representing Stacks in C**: Implementing the POP operation, testing for exceptional conditions, implementing the PUSH operation An Example: Infix, Postfix, and Prefix – Basic definitions and examples **Stack Applications** – Recursive Definition and Processes, Tower of Hanoi, conversion of infix to prefix and postfix, Evaluating a postfix expression	**10**	**L2**
Module 3		
Queues: The Queue and its Sequential Representation: C Implementation of Queues, primitive operations on Queue, Array Implementation of a Priority Queue, circular Queue, Priority Queue, double ended queue	**10**	**L2**
Module 4		
Linked Lists: Introduction and definition, representation of linked list in memory, primitive operations on linked list, Linked Implementation of Stacks, getnode and free node Operations, Linked Implementation of Queues **Other list structures** - Circular lists and it's primitive operations, Doubly linked lists and it's primitive operations, Applications of linked lists: Addition of long positive integers, addition of Polynomials. **Hashing:** Hash tables, Hash function, Overflow handling: Open Addressing, Chaining.	**10**	**L2**

Module 5		
Binary Trees: Introduction and definition, Node Representation of Binary Trees, Internal and External Nodes, Implicit Array Representation of Binary Trees, Primitive operations on Binary Tree, Threaded binary tree, Binary search tree and its primitive operations, General Expressions as Trees, evaluating an expression tree, constructing a Tree.	**10**	**L2**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Explain different types of data structures along with couple of sorting techniques.
CO2	Explain and implement the operational aspects of stacks in problem solving.
CO3	Explain and implement the operational aspects of queues in problem solving.
CO4	Explain and implement operations on linked lists and demonstrate their applications
CO5	Explain and implement various operations on trees

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3		2				2	1		2	3	
CO2	3	3	3		2				3	1		2	3	
CO3	3	3	3		2				2	1		2	3	
CO4	3	3	3		2				2	1	2	2	3	
CO5	3	3	3		2				2	1	2	2	3	
Average	3	3	3		2				2	1	2	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Fundamentals of Data Structures in C, Ellis Horowitz, Sartaz Sahni, Anderson, Freed, Second edition, University press, 2008, Reprinted 2016, **ISBN:**978-81-7371-605-8
2. Data Structures with C, Seymour Lipschutz, Schaum's Outlines, McGraw Hill, Special Indian Edition, Thirteenth Reprint 2015. **ISBN:**978-0-07-070198-4

Reference Books:

1. Data Structures using C, Aaron Tanenbaum, Yedidyah Langsam and Moshe Augenstein, Pearson, Thirteenth Impression, 2014. **ISBN:**978-81-317-0229-1
2. Data Structures A Pseudo code approach with C, Richard F. Gilberg and Behrouz A. Forouzan, Thomson, 2005. **ISBN:**978-81-315-0314-0
3. Data Structures & Program Design in C, Robert Kruse & Bruce Leung, Pearson Education, 2007.
4. Data Structures using C, Reema Thareja, Second edition, Oxford University press, 2104

E-Books / Web References:

1. Notes on Data Structures and Programming Techniques (CPSC 223, Spring 2021) http://www.cs.yale.edu/homes/aspnes/classes/223/notes.pdf
2. Fundamental Data Structures

   https://en.wikipedia.org/wiki/Book:Fundamental_Data_Structures
3. Algorithms and Data Structures http://www.inr.ac.ru/~info21/ADen/

MOOCs:

1. https://www.coursera.org/specializations/data-structures-algorithms
2. https://www.edx.org/course/introduction-to-data-structures

Prog. No.	Lab Programs	No. of Hours/ RBT levels
1	Develop a menu driven program to implement primitive operations of stack - a) Push b) Pop c) Display. The program should print appropriate messages for stack overflow, stack underflow	**02 L3**
2	Write a program to demonstrate: a) Tower of Hanoi problem and b) Ackermann's function	**02 L3**
3	Develop a program to convert INFIX notation to POSTFIX	**02 L3**
4	Develop a program for evaluation of POSTFIX notation.	**02 L3**
5	Develop a menu driven program for QUEUE that performs following primitive operations: insert, delete and display	**02 L3**
6	Develop a menu driven program for CIRCULAR QUEUE that performs following primitive operations: insert, delete and display	**02 L3**
7	Develop a menu driven program to perform primitive operations on single linked list	**02 L3**
8	Develop a program to reverse a single linked list	**02 L3**
9	Develop a program to traverse a tree using in-order, pre-order and post-order.	**02 L3**
10	Develop a program to perform insertion, deletion and traversal of a binary search tree	**02 L3**

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –III

DATABASE MANAGEMENT SYSTEM

Semester:	**03**	**CIE Marks**	**50**
Course Code:	**22ADS33**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:1:2**	**Duration of SEE (hours):**	**03**
Type of Course	**IPC**	**Credits**	**04**

Prerequisites (if any): NA

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Explain the concept of databases, database management systems, database structures, and how they work.
2	Make use of Entity-Relationship modeling for creating simple databases from teal-world scenarios.
3	Write structured query language (SQL) statements.
4	Normalize a database using Normalization Rules.
5	Describe database design concepts and algorithms.

Module 1	No. of Hours	RBT Level
Databases and Database Users - Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications, Data base System Applications, Purpose of Database Systems, View of Data – Data Abstraction, Instances and Schemas. **Database System Concepts and Architecture -** Data Models, Database Languages–DDL, DML, database Access for applications Programs, Transaction Management, Data Storage and Querying, – data base Users and Administrator, data base System Structure, History of Data base Systems. **Data Modeling Using the Entity – Relationship (ER) Model** - Using High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database, ER Diagrams, Naming Conventions, and Design Issues, Example of Other Notation: UML Class Diagrams, Relationship Types of Degree Higher than Two, Another Example: A UNIVERSITY Database **The Relational Data Model and Relational Database Constraints** - Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations.	**10**	**L3**
Module 2		
The Relational Algebra and Relational Calculus - Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra, The Tuple Relational Calculus, The Domain Relational Calculus. **Relational Database Design by ER- and EER-to-Relational Mapping** - Relational Database Design Using ER-to-Relational Mapping, Mapping EER Model Constructs to Relations. **Basic SQL -** SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE Statements in SQL, Additional Features of SQL.	**10**	**L3**

More SQL: Complex Queries, Triggers, Views, and Schema Modification - More Complex SQL Retrieval Queries, Specifying Constraints as Assertions and Actions as Triggers, Views (Virtual Tables) in SQL, Schema Change Statements in SQL.		
Module 3		
Basics of Functional Dependencies and Normalization for Relational Databases - Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form. **Relational Database Design Algorithms and Further Dependencies -** Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover, Properties of Relational Decompositions, Algorithms for Relational Database Schema Design, About Nulls, Dangling Tuples, and Alternative Relational Designs, Further Discussion of Multivalued Dependencies and 4NF, Other Dependencies and Normal Forms.	**10**	**L3**
Module 4		
Overview of Transaction Management - The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL, Introduction to Crash Recovery. **Concurrency Control -** 2PL, Serializability, and Recoverability, Introduction to Lock Management, Lock Conversions, Dealing With Deadlocks, Specialized Locking Techniques, ConClurency Control without Locking. **Crash Recovery -** Introduction to ARIES, The Log, Other Recovery-Related Structures, The Write-Ahead Log Protocol, Checkpointing, Recovering from a System Crash, Media Recovery, Other Approaches and Interaction with Concurrency Control.	**10**	**L3**
Module 5		
Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk, Operations on Files, Files of Unordered Records (Heap Files),Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Identify and Apply the concept of databases, database management systems, ER modeling for designing simple databases.
CO2	Solve database queries using relational algebra.
CO3	Write database queries using Structured Query Language (SQL).
CO4	Design and develop databases from the real world by applying the concepts of Normalization.
CO5	Apply Transaction Processing and Recovery techniques, basic database storage structures and access techniques on real world application.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3		2					2		2	3	
CO2	3	3	3		2		2			2		2	3	
CO3	3	3	3		2		2			2		2	3	
CO4	3	3	3		2		2			2		2	3	
CO5	3	3	3		2		2			2		2	3	
Average	3	3	3		2		2			2		2	3	

High-3: Medium-2: Low-1

Text Books:

1. Fundamentals of Database Systems by Ramez Elmasri and Shamkant B. Navathe, Pearson, 7th Edition, 2017.
2. Database management systems by Ramakrishnan, and Gehrke, McGraw Hill, 3rd Edition, 2014.

Reference Books:

1. Database System Concepts, by Silberschatz, Korth and Sudharshan, Mc-GrawHill, 6th Edition, 2013
2. Database Principles Fundamentals of Design, Implementation and Management by Coronel, Morris, and Rob, Cengage Learning, 2012.

E-Books / Web References:

1. An introduction to Database systems by Bipin Desai
2. https://www.digitaldoughnut.com/articles/2020/june-2020/fundamentals-of-master-data-management-in-nutshell

MOOCs:

1. https://www.coursera.org/learn/database-management
2. https://onlinecourses.nptel.ac.in/noc19_cs46/preview

<table>
<tr><th>Prog. No.</th><th>Lab Programs</th><th>No. of Hours/ RBT levels</th></tr>
<tr><td>1</td><td>Creation of Tables:
1.Create a table called Employee with the following structure.
<table><tr><th>Name</th><th>Type</th></tr><tr><td>Empno</td><td>Number</td></tr><tr><td>Ename</td><td>Varchar2(20)</td></tr><tr><td>Job</td><td>Varchar2(20)</td></tr><tr><td>Mgr</td><td>Number</td></tr><tr><td>Sal</td><td>Number</td></tr></table>a. Add a column commission with domain to the Employee table.
b. Insert any five records into the table.
c. Update the column details of job
d. Rename the column of Employ table using alter command.
e. Delete the employee whose empno is19.
2. Create a table called reserves table
<table><tr><th>Name</th><th>Type</th></tr><tr><td>Boat id</td><td>Integer</td></tr><tr><td>Sid</td><td>Integer</td></tr><tr><td>Day</td><td>Integer</td></tr></table>a. Insert values into the reserves table.
b. Add column time to the reserves table.
c. Alter the column day data type to date.
d. Drop the column time in the table.
e. Delete the row of the table with some condition</td><td>02
L3</td></tr>
<tr><td>2</td><td>Queries using DDL and DML.
1.
a. Create a user and grant all permissions to the user.
b. Insert the any three records in the employee table and use rollback. Check the result.
c. Add primary key constraint and not null constraint to the employee table.
d. Insert null values to the employee table and verify the result.

2.
a. Create a user and grant all permissions to the user.
b. Update the table reserves and use save point and rollback.
c. Add constraint primary key, foreign key and not null to the reserves table Delete constraint not null to the table column.</td><td>02
L3</td></tr>
</table>

<table>
<tr><td>3</td><td>Queries using aggregate functions.
1.
a. By using the group by clause, display the enames who belongs to deptno 10 along with average salary.
b. Display lowest paid employee details under each department.
c. Display number of employees working in each department and their department number.
d. Using built in functions, display number of employees working in each department and their department name from dept table. Insert deptname to dept table and insert deptname for each row, do the required thing specified above.
e. List all employees which start with either B or C.
f. Display only these ename of employees where the maximum salary is greater than or equal to 5000.

2.
a. List the Vendors who have delivered products within 6 months from order date.
b. Display the Vendor details who have supplied both Assembled and Subparts.
c. Display the Sub parts by grouping the Vendor type (Local or Non-Local).
d. Display the Vendor details in ascending order.
e. Display the Sub part which costs more than any of the Assembled parts.
f. Display the second maximum cost Assembled part.</td><td>02
L3</td></tr>
<tr><td>4</td><td>Programs on Pl/Sql
1. a. Write a PL/SQL program to swap two numbers.
b. Write a PL/SQL program to find the largest of three numbers.

2. a. Write a PL/SQL program to find the total and average of 6 subjects and display the grade.
b. Write a PL/SQL program to find the sum of digits in a given number.</td><td>02
L3</td></tr>
<tr><td>5</td><td>Functions
1. Write a function to accept employee number as parameter and return Basic +HRA together as single column.
2. Accept year as parameter and write a Function to return the total net salary spent for a given year.</td><td>02
L3</td></tr>
<tr><td>6</td><td>Triggers
1. Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old values and new values:

CUSTOMERS table:
<table><tr><td>ID</td><td>NAME</td><td>AGE</td><td>ADDRESS</td><td>SALARY</td></tr><tr><td>1</td><td>Alive</td><td>24</td><td>Khammam</td><td>2000</td></tr><tr><td>2</td><td>Bob</td><td>27</td><td>Kadapa</td><td>3000</td></tr><tr><td>3</td><td>Cantri</td><td>25</td><td>Guntur</td><td>4000</td></tr><tr><td>4</td><td>Dena</td><td>28</td><td>Bangalore</td><td>5000</td></tr><tr><td>5</td><td>Eeshwar</td><td>27</td><td>Mysore</td><td>6000</td></tr><tr><td>6</td><td>Farooq</td><td>28</td><td>Belagavi</td><td>7000</td></tr></table></td><td>02
L3</td></tr>
<tr><td>7</td><td>Procedures
1. Write the PL/SQL programs to create the procedure for factorial of given number.
2. Write the PL/SQL programs to create the procedure to find sum of N natural number.</td><td>02
L3</td></tr>
<tr><td>8</td><td>Cursors
1. Write a PL/SQL block that will display the employee details along with salary using cursors.
2. To write a Cursor to display the list of employees who are working as a managers or Analyst.</td><td>02
L3</td></tr>
</table>

9	**Case Study: Book Publishing Company** A publishing company produces scientific books on various subjects. The books are written by authors who specialize in one particular subject. The company employs editors who, not necessarily being specialists in a particular area, each take sole responsibility for editing one or more publications. A publication covers essentially one of the specialist subjects and is normally written by a single author. When writing a particular book, each author works with on editor, but may submit another work for publication to be supervised by other editors. To improve their competitiveness, the company tries to employ a variety of authors, more than one author being a specialist in a particular subject for the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes. Create the logical data model using E-R diagrams.	**02** **L3**
10	**Case Study: General Hospital** A General Hospital consists of a number of specialized wards (such as Maternity, Pediatric, Oncology, etc). Each ward hosts a number of patients, who were admitted on the recommendation of their own GP and confirmed by a consultant employed by the Hospital. On admission, the personal details of every patient are recorded. A separate register is to be held to store the information of the tests undertaken and the results of a prescribed treatment. A number of tests may be conducted for each patient. Each patient is assigned to one leading consultant but may be examined by another doctor, if required. Doctors are specialists in some branch of medicine and may be leading consultants for a number of patients, not necessarily from the same ward. For the above case study, do the following. 1. Analyze the data required. 2. Normalize the attributes. Create the logical data model using E-R diagrams.	**02** **L3**
11	**Case Study: Car Rental Company** A database is to be designed for a car rental company. The information required includes a description of cars, subcontractors (i.e. garages), company expenditures, company revenues and customers. Cars are to be described by such data as: make, model, year of production, engine size, fuel type, number of passengers, registration number, purchase price, purchase date, rent price and insurance details. It is the company policy not to keep any car for a period exceeding one year. All major repairs and maintenance are done by subcontractors (i.e. franchised garages), with whom CRC has long-term agreements. Therefore, the data about garages to be kept in the database includes garage names, addresses, range of services and the like. Some garages require payments immediately after a repair has been made; with others CRC has made arrangements for credit facilities. Company expenditures are to be registered for all outgoings connected with purchases, repairs, maintenance, insurance etc. claims must be kept of file. CRC maintains a reasonably stable client base. For this privileged category of customers special credit card facilities are provided. These customers may also book in advance a particular car. These reservations can be made for any period of time up to one month. Casual customers must pay a deposit for an estimated time of rental, unless they wish to pay by credit card. All major credit cards are accepted. Personal details such as name, address, telephone number, driving license, number about each customer are kept in the database. For the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes. Create the logical data model using E-R diagrams.	**02** **L3**

12	**Case Study: Student Progress Monitoring System** A database is to be designed for a college to monitor students' progress throughout their course of study. The students are reading for a degree (such as BA, BA (Hons) M.Sc., etc) within the framework of the modular system. The college provides a number of modules, each being characterized by its code, title, credit value, module leader, teaching staff and the department they come from. A module is coordinated by a module leader who shares teaching duties with one or more lecturers. A lecturer may teach (and be a module leader for) more than one module. Students are free to choose any module they wish but the following rules must be observed: Some modules require pre- requisites modules and some degree programmes have compulsory modules. The database is also to contain some information about students including their numbers, names, addresses, degrees they read for, and their past performance i.e. modules taken and examination results. For the above case study, do the following: 1. Analyze the data required. 2. Normalize the attributes. 3. Create the logical data model i.e., ER diagrams. 4. Comprehend the data given in the case study by creating respective tables with primary keys and foreign keys wherever required. 5. Insert values into the tables created (Be vigilant about Master- Slave tables). 6. Display the Students who have taken M.Sc course. 7. Display the Module code and Number of Modules taught by each Lecturer. 8. Retrieve the Lecturer names who are not Module Leaders. 9. Display the Department name which offers ―English module.‖ 10. Retrieve the Prerequisite Courses offered by every Department (with Department names).	**02** **L3**

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – III

FOUNDATIONS OF DATA SCIENCE

Semester:	**03**	**CIE Marks:**	**50**
Course Code:	**22ADS34**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**2:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits;**	**03**

Prerequisites (if any): Basics of Probability

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand the problems solvable with data science
2	Ability to solve problems from a statistical perspective.
3	To build the skills to create data analytical pipelines
4	To bring the familiarity with the data science ecosystem and the various tools needed to continue developing as a data scientist.

Module 1	No. of Hours	RBT Level
Introduction to Data Science: Evolution of Data Science, Data Science Roles,Lifecycle of Data Science, Representation of Data Science as a Venn Diagram, Technologies revolving around Data Science. **Types of Data:** Structured and Unstructured Data, Quantitative and Qualitative Data, Four Levels of data (Nominal, Ordinal, Interval, Ratio Level). **Data Pre-processing:** Asking interesting question, Obtaining of data, Exploration of data, Modeling of data, Communication and visualization.	**08**	**L2**
Module 2		
Data Mining: What is Data Mining? Types of Data Mining, Challenges of implementation in Data Mining, Advantages and Disadvantages, Applications of DataMining. **Overview of Basic Data Mining Tasks:** Classification, Regression, Time Series Analysis, Prediction, Clustering, Sequence Discovery.	**08**	**L3**
Module 3		
Basics of Statistics: Introduction to Statistics, Terminologies in Statistics, Measures of center, variance and relative standing, Normalization of data using the z-score, Empirical rule, Categories in Statistics (Descriptive and Inferential Statistics). **Descriptive Statistics:** Data Objects and Attribute, Basic Statistical Description of Data (Measuring the Central Tendency of Data, Measuring the Dispersion of Data, Graphical Displays), Data Visualization Techniques, Measuring Data Similarity and Dissimilarity.	**08**	**L3**
Module 4		
Inferential Statistics: Overview of Probability Distributions (Bernoulli, Binomial, Poisson, Chi-square, t-tail), Joint distribution of the Sample Mean and Sample Variance, Confidence Intervals, Bayesian Analysis of samples from Normal Distribution, Fisher Estimator, Central Limit Theorem.	**08**	**L3**

Module 5		
Hypothesis Testing: Testing simple hypotheses, Uniform tests, Two-sided alternatives, t-Test, F-Distribution, Bayes Test Procedures, Case studies based onHypothesis Testing.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the basics of data science, data mining techniques.
CO2	Apply the advanced mining concepts.
CO3	Interpret the basic statistical description of data.
CO4	Implement Data sampling Techniques.
CO5	Apply the data mining concepts on the real data.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3		2			2		2		2	3	
CO2	3	3	3		2			2		2		2	3	
CO3	3	3	3		2			2		2		2	3	
CO4	3	3	3		2			2		2		2	3	
CO5	3	3	3		2			2		2		2	3	
Average	3	3	3		2			2		2		2	3	

High-3: Medium-2: Low-1

Text Books:

1. Principles of Data Science by Sinan Ozdemir, Sunil Kakade, Packt Publishing Limited,2nd Edition, 2018
2. Probability and Statistics, by Morris H Degroot, Mark J Schervish, Pearson, 4th Edition, 2012.

Reference Books:

1. Data Mining Concepts and Techniques by Jiawei Han and Micheine Kamber, Morgan Kaufmann, 3rd Edition, 2011.
2. Machine Learning:A probabilistic perspective, by Murphy, KevinP, MIT Press, 2012.

E-Books / Web References:

1. **Learn Data Science : Open content for self-directed learning in Data Science :** http://learnds.com/
2. **Foundations of Data Science:** https://www.cs.cornell.edu/jeh/book.pdf

MOOCs:

1. **Introduction to Mathematical Thinking:** https://www.coursera.org/learn/mathematical-thinking
2. **IBM Data Science Professional Certificate:** https://www.coursera.org/professional-certificates/ibm-data-science

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Quiz 1 / AAT	05	
Quiz 2 / AAT	05	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –III

PYTHON FOR DATA SCIENCE

Semester:	**03**	**CIE Marks:**	**50**
Course Code:	**22ADS35**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**ETC**	**Credits:**	**03**

Prerequisites (if any): Programming with Python.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To build a strong foundation to understand advanced python packages for data science.
2	To understand daily tasks that data scientists tackle.
3	To gain skills needed to implement machine learning, AI, and predictive analytics algorithms.
4	To understand the access to a wide variety of data analysis and data science libraries.
5	To meet industry demand for experts with Python skills.

Module 1	No. of Hours	RBT Level
NumPy Basics: Arrays and Vectorized Computation **Basics of Numpy Arrays:** NumPy Array Attributes **The NumPy nd array:** A Multidimensional Array Object, Creating nd arrays, Data Types for nd arrays, Arithmetic with NumPy Arrays, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes, Reshaping of Arrays, Aggregations, Universal Functions: Fast Element-Wise Array Functions, Array-Oriented Programming with Arrays, Expressing Conditional Logic as Array Operations, Mathematical and Statistical Methods, Methods for Boolean Arrays, Sorting, Unique and Other Set Logic, File Input and Output with Arrays, Linear Algebra, Pseudorandom Number Generation, Example: Random Walks.	**08**	**L2**
Module 2		
Pandas: Installing and using Pandas, Introducing Pandas Objects, Operating on data in pandas. **Introduction to pandas Data Structures:** Series, DataFrame, Index Objects **Essential Functionality:** Reindexing, Dropping Entries from an Axis, Indexing, Selection, and Filtering, Integer Indexes, Arithmetic and Data Alignment, Function Application and Mapping, Sorting and Ranking, Axis Indexes with Duplicate Labels. **Combining Datasets:** Concat, Append, Merge and Join. Working with Time Series.	**08**	**L2**
Module 3		
Plotting and Visualization: A Brief matplotlib API Primer: Figures and Subplots, Charts using plot(), pie chart, violin plot, scatter plot, histogram, bar chart, area plot, Quiver plot, Mesh grid, contour plot, Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File, matplotlib Configuration. **Plotting with pandas and seaborn:** Three-Dimensional Plotting in Matplotlib, Python Visualization Tools for categorical Variables and Continuous Variables.	**08**	**L2**

Module 4		
Data Cleaning and Preparation: Handling Missing Data, Filtering Out Missing Data, Filling in Missing Data, Data Transformation, Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Renaming Axis Indexes, Discretization and Binning, Detecting and Filtering Outliers, Computing Indicator/Dummy Variables. **Data Wrangling:** Join, Combine, and Reshape: Combining and Merging Datasets, Database-Style Data Frame Joins, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap, Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Pivoting "Long" to "Wide"Format, Pivoting "Wide"to "Long"Format	**08**	**L2**
Module 5		
Use cases: USA.gov Data from Bitly, Counting Time Zones in Pure Python, Counting Time Zones with pandas, MovieLens 1M Dataset, Measuring Rating Disagreement, US Baby Names 1880–2010, Analyzing Naming Trends, USDA Food Database, 2012 Federal Election Commission Database, Donation Statistics by Occupation and Employer, Bucketing Donation Amounts, Donation Statistics by State, some examples of latest datasets.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the fundamental of NumPy and Ndarrays.
CO2	Understand the fundamental of Pandas.
CO3	Illustrate graphically data and results of statistical calculations.
CO4	Identify proficiency in the Data preparation and wrangling.
CO5	Apply the concepts of Data Science packages on the real world data.

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3		2	2			2			2	3	
CO2	3	3	3		2	3					2	2	3	
CO3	3	2	3		2					3		2	2	
CO4	2	3	3		3	2			3	3		2	3	
CO5	3	3	3		2				2		3	3	2	
Average	3	3	3		2	2			3	3	2	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Python Data Science handbook, by Jake Vander Plas, O'Reilly.
2. Python for Data Analysis, by Wes McKinney, 2nd Edition, O'Reilly.
3. Bharti Motwani, Data Analytics using Python, Wiley.

Reference Books:

1. Gowrishankar S, Veena A, ―Introduction to Python Programming, 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372.
2. AurelienGeron, ―Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems‖, 2nd Edition, O'Reilly Media, 2019. ISBN – 13: 978-9352139057.

E-Books / Web References:

1. Automate The Boring Stuff with Python
   https://automatetheboringstuff.com/
2. Python 3 Tutorial
   https://www.tutorialspoint.com/python3/python_tutorial.pdf
3. Python 3 for Absolute Beginners
   http://index-of.es/Python/Python%203%20for%20Absolute%20Beginners.pdf

MOOCs:

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.edx.org/course/python-basics-for-data-science
3. https://cognitiveclass.ai/courses/python-for-data-science

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –III

OPERATING SYSTEM

Semester:	**03**	**CIE Marks:**	**50**
Course Code:	**22ADS36**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**AEC**	**Credits:**	**03**

Prerequisites (if any): NA

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand the OS services, types of OS and different computing environments.
2	To understand the concept of processes, IPC and multithreading models.
3	To understand scheduling algorithms to compute various scheduling criteria
4	To understand methods for handling deadlock and solve memory management problems using page replacement algorithms.

Module 1	No. of Hours	RBT Level
Introduction to OS: What Operating Systems Do, Computer-System Organization, Computer-System Architecture, Operating-System Operations, Resource Management. **Operating-System Services:** User and Operating-System Interface, System Calls, Operating-System Design andImplementation, Operating-System Structure.	**06**	**L1**
Module 2		
Process Management and Threads: Processes, Process Concept, Process Scheduling, Operations on Processes, InterprocessCommunication, IPC in Shared-Memory Systems, IPC in Message-Passing Systems. **Threads**: Overview, Multithreading Models.	**06**	**L1**
Module 3		
CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms (First Come First Serve, ShortestJob First, Shortest Remaining Time First, Priority Scheduling, Round Robin)	**06**	**L2**
Module 4		
Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance (Safe State, Banker's Algorithm), Deadlock Detection, Recovery from Deadlock	**06**	**L2**
Module 5		
Memory Management: Main Memory management- Contiguous Memory Allocation, Segmentation, Paging, Virtual Memory Hardware -TLB, Page Replacement Algorithms (FIFO, LRU, Optimal Page Replacement) .	**06**	**L2**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the Operating system functionality with system calls and computing environment.
CO2	Discuss the different process scheduling mechanisms and multithreading models.
CO3	Interpret the optimization of resource utilization using different scheduling algorithms.
CO4	Identify root causes of deadlock and provide the solution for deadlock elimination
CO5	Solve the memory allocation issues using page replacement algorithms.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3											2		
CO2	3											2		
CO3	3	2	2									2	3	
CO4	3	2	2									2	3	
CO5	3	2	2									2	3	
Average	3	2	2									2	3	

High-3: Medium-2: Low-1

Text Books:

1. Operating System Concepts‖, by Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Wiley, 9th Edition.
2. Operating Systems‖, by William Stallings, Pearson Education, 5th Edition.

Reference Books:

1. Operating Systems‖, by Ramez Elmasri, A Carrick, David Levine, A Spiral Approach, McGrawHill, 2009.
2. Modern Operating System‖, by Andrew S. Tanenbaum, PHI.

E-Books / Web References:

1. Operating system overview https://www.tutorialspoint.com/operating_system/os_overview.html
2. Lecture notes on Operating System https://www.bput.ac.in › lecture-notes-download
3. Operating System https://en.wikipedia.org/wiki/Operating_system
4. https://www.youtube.com/watch?v=vBURTt97 EkA&list=PLBlnK6fEyqRiVhbXDGLXDk_ OQAeuVcp2O
5. https://www.youtube.com/watch?v=a2B69vCtj OU&list=PL3-wYxbt4yCjpcfUDz-TgD_ainZ2K3MUZ&index=2

MOOCs:

1. https://www.coursera.org/learn/os-power-user
2. https://www.udacity.com/course/introduction-to-operating-systems--ud923

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouragedto use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

	Components	**Marks**	**Total**
CIE	CIE TEST 1	40	50
	CIE TEST 2	40	
	CIE TEST 3	40	
	Quiz 1 / AAT	05	
	Quiz 2 / AAT	05	
SEE	SEE	50	50
Grand Total			100

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – IV

PROBABILITY AND LINEAR ALGEBRA

(Common for CSE/ISE/AI&DS/AIML/CS(AIML))

Course Code:	**22MAT41A**	**CIE Marks:**	**50**
Hours/Week (L: T: P):	**2:2:0**	**SEE Marks:**	**50**
No. of Credits:	**3**	**Examination Hours:**	**03**

Course Objectives: To enable students to apply the knowledge of Mathematics in fields of computer science and allied branches by making them to learn:

CLO1	Probability and Random Variables
CLO2	System of linear equations
CLO3	Vector spaces, linear transformations
CLO4	Eigenvalues, Eigenvectors, diagonalization and Singular value decomposition

Content	**No. of Hours/ RBT levels**
Module 1 Random Variable, Binomial, Poisson, Exponential and Normal distributions. Joint distributions (both discrete and continuous), Expectation and Covariance. Central limit theorem and law of large numbers.	**08 Hours** **L2, L3**
Module 2 System of linear equations, row reduction and echelon form, vector equations, The matrix equation AX = b. Linear independence and introduction to linear transformations. Matrix of linear transformation, invertible matrix, inverse of a matrix by Gauss Jordan method.	**08 Hours** **L2, L3**
Module 3 Vector space, subspaces, linearly independent sets, Bases. Coordinate systems, the dimensions of a vector space, Rank, Change of basis. Eigen vectors and Eigen values, diagonalization, Eigen vectors and linear transformations.	**08 Hours** **L2, L3**
Module 4 Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization.	**08 Hours** **L2, L3**
Module 5 Least square solutions and fittings, diagonalization of symmetric matrices, quadratic forms, constrained optimization; Singular value decomposition.	**08 Hours** **L2, L3**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO41.1	Solve problems associated with random variables using probability distributions
CO41.2	Solve systems of linear equations.
CO41.3	Work within vector spaces.
CO41.4	Use computational techniques for the study of Eigenvalues, Eigenvectors, and diagonalization

Textbooks:

1. T Veerarajan, Probability, Statistics and Random Processes for Engineers, Tata McGraw Hill, 3rd Edition, 2008
2. David C Lay, Linear Algebra and its applications, Pearson, 4th Edition, 2012.

Reference books:

1. Richard H Williams, Probability, Statistics and Random Processes for Engineers, Cengage Learning, 1st Edition, 2003
2. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning, 4th Edition, 2006
3. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall, 2nd Edition, 2004.

Scheme of Examination:

Semester End Examination (SEE):
SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):
Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. CIE is executed by way of quizzes / Alternate Assessment Tools (AATs), and three tests. **Some possible AATs:** seminar/assignments/ mini-projects/ concept videos/ partial reproduction of research work/ group activity/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO41.1	3	2	1									3				
CO41.2	3	2	1									3				
CO41.3	3	2	1									3				
CO41.4	3	2	1									3				
Average	3	2	1									3				

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – IV

DESIGN AND ANALYSIS OF ALGORITHMS

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**22ADS42**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 1: 2**	**Duration of SEE(Hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): C Programming & Data Structures using C

Course Learning Objectives:

Sl. No.	Course Learning Objectives (CLO)
1	To apply mathematical concepts and notations to define a problem.
2	To understand and apply algorithms design techniques.
3	Ability to solve real life problems using algorithms techniques.
4	To understand the limitations of Algorithmic power.

Module 1	No. of Hours	RBT Level
Introduction: What is an Algorithm? Algorithm Specification, Analysis Framework **Performance Analysis:** Space complexity, Time complexity. **Asymptotic Notations:** Big-Oh notation (O), Omega notation (Ω), Theta notation (Q), and Little-oh notation (o), Mathematical analysis of Non- Recursive and recursive Algorithms with Examples. **Important Problem Types:** Sorting, Searching, String processing, Graph Problems, Combinatorial Problems.	**10**	**L3**
Module 2		
Algorithm Design Techniques – II: **Brute Force:** Introduction, Selection Sort, Sequential Search and Brute force string matching algorithms –NAIVE string-matching algorithms, **Exhaustive Search –** Travelling Salesman problem, Knapsack problem, Assignment problem. **Divide & Conquer:** General method, Recurrence equation for divide and conquer, Binary search, Merge sort, Quick sort, Strassen‘s matrix multiplication, Advantages and Disadvantages of divide and conquer.	**10**	**L3**
Module 3		
Algorithm Design Techniques – II: **Greedy Methods:** Introduction, General method, Knapsack Problem, Job sequencing with deadline. **Minimum cost spanning trees:** Prim‘s Algorithm, Kruskal‘s Algorithm. Single source shortest paths: Dijkstra's Algorithm. **Optimal Tree problem:** Huffman Trees and Codes. **Transform and Conquer Approach:** Heaps and Heap Sort.	**10**	**L3**

Module 4		
Algorithm Design Techniques – III: **Dynamic Programming:** Introduction, Computing Binomial Coefficients, Transitive closure - Warshall's and Floyd's algorithm, Bellman Ford algorithm, Knapsack problem & memory functions. **Decrease & Conquer: Introduction –** Decrease by constant, decrease by constant factor, variable size decrease, Breadth First search traversal, Depth First search traversal, Topological sorting using DFS and source removal method.	**10**	**L3**
Module 5		
Algorithm Design Techniques – IV: **Backtracking:** Introduction, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. **Branch & Bound:** Introduction, Travelling Salesman problem, Knapsack problem, Assignment problem. **Limitations Of Algorithm Power:** Decision Trees for sorting and searching, **Approximation Algorithms for NP-Hard Problems** – Traveling Salesperson Problem, Knapsack Problem.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Choose the basic techniques of analyzing the algorithms using time & space complexity and asymptotic notations
CO2	Design algorithms using brute force and Divide and Conquer techniques for a given problem.
CO3	Demonstrate Graph Algorithms using greedy method, Transform and Conquer approach to model Engineering Problems.
CO4	Employ Dynamic Programming and Decrease & Conquer strategies to solve a given problem.
CO5	Apply Back Tracking, Branch and Bound design techniques for solving Computa - tionally hard problems.

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3		2							2	3	
CO2	3	3	3		2							2	3	
CO3	3	3	3		2							2	3	
CO4	3	3	3		2							2	3	
CO5	3	3	3		2							2	3	
Average	3	3	3		2							2	3	

High-3: Medium-2: Low-1

Text Books:

1. Introduction to the Design and Analysis of Algorithms‖, by AnanyLevitin:, 2nd Edition, 2009 Pearson.
2. Computer Algorithms/C++‖, by Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.

Reference Books:

1. Introduction to Algorithms‖, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, CliffordStein, 3rd Edition, PHI.

E-Books / Web References:

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/index.htm
2. https://www.javatpoint.com/daa-tutorial

MOOCs:

1. https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2015/
3. https://www.coursera.org/specializations/algorithms
4. https://www.udemy.com/course/design-and-analysis-of-algorithms/

Prog. No.	Lab Programs	No. of Hours/ RBT levels
1	Sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 10000 and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be generated using the random number generator. Demonstrate how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.	**03 L3**
2	Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 10000, and record thetime taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate how the divide-and-conquer method works along with its time complexity analysis.	**03 L3**
3	Find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm.	**03 L3**
4	Find Minimum Cost Spanning Tree of a given connected undirected graphusing Prim's algorithm.	**03 L3**
5	Write the program for the given weighted connected graph to find shortest paths to all other vertices from the given source vertex Using Dijkstra's algorithm.	**03 L3**
6	Write programs to: a. Implement All-Pairs Shortest Paths problem using Floyd's algorithm b. Implement the 0/1 Knapsack problem using Dynamic Programming.	**03 L3**
7	Implement Travelling Sales Person problem using Dyna mic programming.	**03 L3**
8	Write programs to: a. Print all the nodes reachable from a given starting node in a digraph usingBFS method. b. Check whether a given graph is connected or not using DFS method.	**03 L3**
9	Implement N-Queen's problem using Back Tracking.	**03 L3**
10	Design and implement c program to find a subset of a given set S = {Sl, S2,.....,Sn} of n positive integers Whose SUM is equal to a given positive integer d. For example, if S = {1, 2, 5, 6, 8} and d= 9, there are two Solutions {1, 2, 6} and {1, 8}. Display a suitable message, if the given problem instance doesn't have a solution.	**03 L3**

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER –IV
MACHINE LEARNING - I

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**22ADS43**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 1: 2**	**Duration of SEE(Hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): Python for Data Science.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Examine the data for various features, properties, characteristics and assessment of the problemthey represent.
2	Learn methods to transform raw data into a form that is ready for application of algorithms.
3	Become conversant with types of Machine Learning Algorithms, their applicability and InductiveBias.
4	Familiarize with techniques for Dimensionality Reduction and Computational Efficiency.
5	Apply and practice the knowledge by solving real time problems.

Module 1	No. of Hours	RBT Level
Introduction to Machine Learning: Basic steps of ML, Perspectives and Issues, Designing learning systems, Concepts of hypotheses. **Datasets and Partitions, Data Pre-processing and Scaling:** Different Preprocessing techniques, Data Integration, Outlier removal, artifact removal, Applying Data Transformations, Scaling Training and Test Data the Same Way, Data Normalization, Data Transformation techniques.	**10**	**L2**
Module 2		
Dealing With Missing Values: Assumptions and Missing Data Mechanisms, Simple approaches to missing Data, Dealing With Noisy Data: Identifying Noise, Types of Noise Data, Noise filtering at data level. **Data Reduction:** Curse of Dimensionality, PCA, LDA, Data sampling, Binning.	**10**	**L2**
Module 3		
Feature Engineering: Feature Extraction, Feature Ranking, Best Features, Feature Selection	**10**	**L2**
Module 4		
Introduction to Supervised learning - Regression Algorithms: Linear Regression, Polynomial Regression, Lasso, Ridge and Elastic nets Regression, Regularization methods, Categorical Variables in Regression, Loss functions, Risk functions. **Use Case:** Relationship between Buying Intention and Awareness of Electric Vehicles, Application of Technology Acceptance Model in Cloud Computing, Impact of Social Networking Websites on Quality of Recruitment, Transportation optimization, Applications in Smart phones.	**10**	**L2**

Module 5		
Supervised Learning: Classification Algorithms: Supervised Machine Learning Algorithms: Sample Datasets, logistic regression, k-Nearest Neighbors (Regression and Classification) **Linear Models -** Naive Bayes, Decision Trees. **Use Case:** Prediction of Customer buying Intension due to Digital Marketing, Measuring Acceptability of a New Product, Predicting phishing websites, loan categorization, Diagnosis and Treatment of Diseases, Security applications	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the data pre-processing techniques used in the data science.
CO2	Understand how to handle missing and noisy data.
CO3	Demonstrate Supervised Learning techniques on real data using regression algorithms
CO4	Demonstrate Supervised Learning techniques on real data using classification algorithms
CO5	Implement machine learning models to classify data on exemplary applications related to real world.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	3	2					3	2	3	
CO2	2	2	2	3	3	2					3	2	3	
CO3	3	2	3	3	3	2			3		3	2	2	
CO4	3	2	3	3	3	2			3		3	2	3	
CO5	3	3	3	3	3	3			3		3	2	2	
Average	3	2	3	3	3	2			3		3	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Data preprocessing in Data Mining‖, by Salvador García, JuliánLuengo Francisco Herrera, Springer.
2. Introduction to Machine Learning with Python ,by Sarah Guido, Andreas C. Müller, O‘ Reilly, 2017.
3. Bharti Motwani, _Data Analytics using Python‘, Wiley.

Reference Books:

1. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms‖, by John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, Worked Examples, and Case Studies, The MIT Press, 2015.
2. Introduction to Machine Learning‖, by Ethem Alpaydin, PHI Learning, 2nd Edition, 2019.

E-Books / Web References:

1. Building Machine Learning Systems with Python
   http://totoharyanto.staff.ipb.ac.id/files/2012/10/Building-Machine-Learning-Systems-with-Python-Richert-Coelho.pdf
2. Foundations of Machine Learning
   https://cs.nyu.edu/~mohri/mlbook/
3. Understanding Machine Learning: From Theory to Algorithms
   https://www.cs.huji.ac.il/w~shais/UnderstandingMachineLearning/understanding-machine-learning-theory-algorithms.pdf

MOOCs:

1. https://www.coursera.org/learn/machine-learning
2. https://www.tensorflow.org/resources/learnml?gclid=Cj0KCQjw29CRBhCUARIsAOboZbJrDLSTHJKj8iIDKyhQzv9srD_TMSSGpXRigtJAIysLYcGH_x2GC4UaAj7NEALw_wcB
3. https://www.udemy.com/course/machine-learning-one-hour/?ranMID=39197&ranEAID=JVFxdTr9V80&ranSiteID=JVFxdTr9V80-CGdwe6MbhMFzQeBY4coFxw&LSNPUBID=JVFxdTr9V80&utm_source=aff-campaign&utm_medium=udemyads
4. https://www.udemy.com/course/what-is-machine-learning/?ranMID=39197&ranEAID=JVFxdTr9V80&ranSiteID=JVFxdTr9V80-cIV9JiZ_AJo5kC9cS9TbrQ&LSNPUBID=JVFxdTr9V80&utm_source=aff-campaign&utm_medium=udemyads

Prog. No.	Lab Programs	No. of Hours/ RBT levels
1	Write a program to implement different data imputations in Machine Learning using Python.	**03 L3**
2	Write a program to implement to implement different feature scaling techniques using python	**03 L3**
3	Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	**03 L3**
4	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.	**02 L3**
5	For the iris dataset, Implement Logistic Regression and Linear Regression. Plot the following graphs: Accuracy and Loss values per iteration.	**02 L3**
6	Implement ID3 decision tree algorithm using Python.	**02 L3**
7	For the diabetics dataset implement RandomForest classifier.	**02 L3**
8	Extract features and perform text classification from unstructured text using Python	**02 L3**
9	Write a program to implement Word2Vec and produce the word embedding using Python.	**03 L3**
10	For the given dataset, develop the recommendation system using PCA.	**03 L3**

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –IV

SOFT COMPUTING TECHNIQUES

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**22ADS44**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**2: 2: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): Discrete Mathematics.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Provide an understanding of the basic mathematical elements of the theory of fuzzy sets.
2	Provide an emphasis on the differences and similarities between fuzzy sets and classical sets theories.
3	Explain the concepts of fuzzy logic, and decision systems.
4	Enable students to Solve problems that are appropriately solved by fuzzy logic

Module 1	No. of Hours	RBT Level
Classical Sets and Fuzzy Sets: Classical Sets, Operations on Classical Sets, Properties of Classical (Crisp) Sets, Mapping of Classical Sets to Functions, Fuzzy Sets, Fuzzy Set Operations, Properties of Fuzzy Sets, Alternative Fuzzy Set Operations, Fuzzy Arithmetic. **Classical Relations and Fuzzy Relations:** Cartesian Product, Crisp Relations, Cardinality of Crisp Relations, Operations on Crisp Relations, Properties of Crisp Relations, Composition, Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Tolerance and Equivalence Relations, Crisp Equivalence Relation, Crisp Tolerance Relation, Fuzzy Tolerance and Equivalence Relations, Value Assignments, Cosine Amplitude, Max–Min Method.	**10**	**L2**
Module 2		
Properties of Membership Functions, Fuzzification, and Defuzzification: Features of the Membership Function, Various Forms, Fuzzification, Defuzzification to Crisp Sets, λ-Cuts for Fuzzy Relations, Defuzzification to Scalars. **Development of Membership Functions:** Membership Value Assignments, Intuition, Inference, Inductive Reasoning.	**10**	**L3**
Module 3		
Fuzzy Classification: Classification by Equivalence Relations, Cluster Analysis, Cluster Validity, c-Means Clustering, Hard c-Means (HCM), Fuzzyc-Means (FCM), Classification Metric, Hardening the Fuzzy c-Partition, Similarity Relations from Clustering.	**10**	**L3**
Module 4		
Decision Making with Fuzzy Information: Fuzzy Synthetic Evaluation, Fuzzy Ordering, Nontransitive Ranking Preference and Consensus, Multiobjective Decision Making, Fuzzy BayesianDecision Method, Decision Making Under Fuzzy States and Fuzzy Actions.	**10**	**L3**
Module 5		
Applications of Fuzzy Systems: Fuzzy TOPSIS, Fuzzy AHP (Geometric and Mean method), Mamdani and Sugeno Fuzzy Systems and building the decision model on the real data (Medical applications).	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand basic knowledge of fuzzy sets and fuzzy logic.
CO2	Apply basic fuzzy inference and approximate reasoning.
CO3	Apply fuzzy classification algorithms on the real data
CO4	Apply basic fuzzy system modeling methods.
CO5	Apply principles of Fuzzy decision techniques to solve real world problems.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	3	2					3	2	3	
CO2	2	2	2	3	3	2					3	2	3	
CO3	3	2	3	3	3	2			3		3	2	2	
CO4	3	2	3	3	3	2			3		3	2	3	
CO5	3	3	3	3	3	3			3		3	2	2	
Average	3	2	3	3	3	2			3		3	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Fuzzy Sets And Fuzzy Logic With Engineering Applications, by Timothy J. Ross, Fourth Edition, Wiley.
2. Principles of Soft Computing, by S. N Sivanandam, S.N Deepa, 3rd Edition, Wiley.

Reference Books:

1. Neuro-Fuzzy and Soft Computing, by J.S. R. Jang, C.-T. Sun, and E. Mizutani, Prentice Hall.
2. Fuzzy sets Fuzzy logic, by Klir, G. J and Yuan B.B, Prentice Hall of India Pvt. Ltd., New Delhi.

E-Books / Web References:

1. Fuzzy Sets by Lotfi A. Zadeh.
2. Fuzzy Logic by Lotfi A. Zadeh.

MOOCs:

1. https://www.udemy.com/course/fuzzy-logic/
2. https://www.udemy.com/course/intro-to-fuzzy-logic-and-artificial-intelligence/
3. https://onlinecourses.nptel.ac.in/noc20_ge09/preview
4. https://www.coursera.org/lecture/children-literacy/fuzzy-logical-model-of-perception-ZT8ZJ

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouragedto use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Quiz 1 / AAT	05	
Quiz 2 / AAT	05	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.

The students will have to answer five full questions, selecting one full

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –IV

IMAGE PROCESSING

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**22ADS45**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**2:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**ETC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	To develop insight into the fundamental concepts of Digital image processing.
2	To evaluate the techniques followed in image enhancements.
3	To illustrate the techniques involved in image compression algorithms.
4	To illustrate the techniques involved in image segmentation algorithms.

Module 1	No. of Hours	RBT Level
Introduction: Introduction, Fundamental steps in image processing, Components of an Image Processing System, Digital Image Fundamentals, Elements of visual perception, Image model, Sampling and quantization, Relationship between pixels	**08**	**L2**
Module 2		
Image Formation: Introduction, Geometric Model, Photometric Model. **Digitalization:** Introduction, Sampling, Quantization, Digital Image, Elements of Digital Geometry.	**08**	**L3**
Module 3		
Image Enhancement: Enhancement by point processing, Sample intensity transformation, Histogram processing, Image subtraction, Image averaging, Spatial filtering, Smoothing filters, Sharpening filters, Frequency domain: Low-Pass, High-Pass, Homomorphic filtering.	**08**	**L3**
Module 4		
Image Compression: Coding redundancy, Inter-pixel redundancy, Fidelity criteria, Image compression models, Error-free compression, Variable length coding, Bit-plane coding, Loss-less predicative coding, Lossy compression, Image compression standards, Fractal Compression, Real-Time image transmission, JPEG and MPEG.	**08**	**L3**
Module 5		
Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Use of motion in segmentation, Spatial techniques, Frequency domain techniques, Spatial Operations and Transformations Spatially dependent transform template and convolution, Window operations, 2- Dimensional geometric transformations.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Explain the fundamentals of Digital Image Processing.
CO2	Obtain an insight on the transformation algorithms underlying the formation of images
CO3	Explain the underlying concepts to contrast between Image enhancement and Image compression
CO4	Develop a good insight into Image segmentation technique
CO5	Contrast well between Enhancement, Compression and Segmentation algorithms

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		1	1	1	1		2		2	3	
CO2	3	3	2	2	3	2	2	1		2		2	3	
CO3	3	3	3	2	3	2	2	1	2	2		3	3	
CO4	3	3	3	2	3	2	2	1	2	2	2	3	3	
CO5	3	3	3	2	3	2	2	1	2	2	2	3	3	
Average	3	3	3	2	3	2	2	1	2	2	2	3	3	

High-3: Medium-2: Low-1

Text Books:

1. R. Gonzalez and R. E. Wood, Digital Image Processing, Prentice Hall of India, 4th Edition, 2018.
2. B. Chanda and D. DuttaMajumder, Digital Image Processing and Analysis, Prentice Hall of India, 2nd Edition, 2011.

Reference Books:

1. Andrian Low, Introductory Computer Vision and Image Procession, McGraw Hill Co., 1991.
2. Robert Schalkoff, Pattern Recognition-Statistical, Structural and neural approach, John Willey & Sons, 4th Edition, 2007.
3. W.K. Pratt, Digital Image Processing, McGraw Hill, 1992.
4. A. K. Jain, Fundamentals of Image Processing, PHI, 2nd Edition.

E-Books / Web References:

1. Principles of Digital Image Processing, Wilhelm Burger http://omercetin.com.tr/DERS/IP/Kitap/2.Principles%20of%20digital%20image%20processing.p df
2. Image Processing, Analysis and Machine Vision, Milan Sonka https://kgut.ac.ir/useruploads/1550563201478ety.pdf
3. Introductory Digital Image Processing, John R Jensen https://media.oiipdf.com/pdf/f11c7ea9-28a4-42c8-8854-21a2f96a6338.pdf

MOOCs:

1. https://www.coursera.org/specializations/image-processing
2. https://www.coursera.org/learn/digital
3. https://www.udemy.com/course/digital-image-processing-from-ground-up-in-python/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIEis executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes areto be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ conceptvideos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a- thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table.

Table: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –IV

PROGRAMMING IN JAVA

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**22ADS46**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**2:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**AEC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Introduces Object Oriented Programming concepts.
2	To understand in detail about the control statements, classes, and inheritance.
3	Importance of exception handling and how to handle exceptions.
4	Introduces the concept of J2EE and how to establish the connection with the database.
5	To enable students to understand Java servlets and JSP.

Module 1	No. of Hours	RBT Level
Object-Oriented Thinking: Different paradigms for problem solving, need for OOP paradigm, differences between OOP and Procedure oriented programming, Overview of OOP concepts: Abstraction, Encapsulation, Inheritance and Polymorphism, Summary of Object-Oriented concepts. Java buzzwords, An Overview of Java, Data types, Variables and Arrays, operators, expressions	**08**	**L2**
Module 2		
Classes: Control statements, Introducing classes, Methods and Classes, Inheritance.	**08**	**L3**
Module 3		
Exception handling: Fundamentals of exception handling, Exception types, Termination or resumptive models, Uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built- in exceptions, creating own exception sub classes. Multithreading- Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication.	**08**	**L2**
Module 4		
The Concept of JDBC: JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; Result Set; Transaction Processing; Metadata, Data types; Exceptions.	**08**	**L2**
Module 5		
Servlets: Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple Servlet; The Servlet API; The Javax.servlet Package; Reading Servlet Parameter; The Javax.servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking. **JSP:** Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects.	**08**	**L2**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Interpret the need for advanced Java concepts like enumerations and collections in developing modular and efficient programs
CO2	Demonstrate the concepts of flow control
CO3	Describe exception handling and multithreading
CO4	Illustrate database access and details for managing information using the JDBC API
CO5	Describe how servlets and JSP fit into Java-based web application architecture

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		2			1		2		2	3	
CO2	2	3	1		2			1		2		2	3	
CO3	1	2	3		2			1		2		2	3	
CO4	1	2	3		2			1		2		2	3	
CO5	3	3	3		2			1		2		2	3	
Average	2	2	2		2			1		2		2	3	

High-3: Medium-2: Low-1

Text Books:

1. Herbert Schildt: JAVA the Complete Reference, 7th/9th Edition, Tata McGraw Hill, 2007.
2. Jim Keogh: J2EE-TheCompleteReference, McGraw Hill, 2007.

Reference Books:

1. Y. Daniel Liang: Introduction to JAVA Programming, 7thEdition, Pearson Education, 2007.
2. Stephanie Bodoff et al: The J2EE Tutorial, 2nd Edition, Pearson Education,2004.
3. Uttam K Roy, Advanced JAVA programming, Oxford University press, 2015.

E-Books / Web References:

1. https://www.javatpoint.com/java-tutorial
2. https://www.simplilearn.com/learn-java-basics-skillup

MOOCs:

1. udemy.com/topic/java
2. https://www.coursera.org/courses?query=java

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying20 marks each. Students are required to answer any **five full questions** choosing at least **one full questionfrom each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIEis executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes areto be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a- thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table.

Table: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

B.E. in Artificial Intelligence and Data Science
Scheme of UG Autonomous Program – 2022 batch

V SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22ADS51	Economics and Management in Data Science	PC	Respective Department	3	0	0	50	50	100	3
2	22ADS52	Big Data Analytics Tools & Techniques	IPC		3	1	2	50	50	100	4
3	22ADS53	Machine Learning – II	IPC		3	2	2	50	50	100	4
4	22MAT54	Linear Algebra for Machine Learning	PC		3	0	0	50	50	100	3
5	22ADS55X	Program Elective 1	PEC		3	0	0	50	50	100	3
6	22ADS56	Web Technologies	AEC		2	0	2	50	50	100	2
7	22CIV57	Environmental Science	CV	Civil	1	0	0	50	50	100	1
	OR										
	22UHV57	Universal Human Values	BS	Respective Department							
TOTAL								**350**	**350**	**700**	**20**

Program Elective 1*	
22ADS551	**Introduction to NoSQL**
22ADS552	**Computer Networks**

***NPTEL for Credit transfer**: Students can take 12 weeks NPTEL course as an equivalent to Program elective. The NPTEL courses of duration less than 12 weeks will not be considered for credit transfer. The courses (only technical) taken are as per the recommendation of BOS of respective department. The similarity of the contents as offered by NPTEL should not exceed a maximum of 40% of the courses being registered by the student. The NPTEL course need to be completed before the registration of the elective. Any certificate obtained after the registration of elective would not be considered. The validity of NPTEL certificate is for two years and it cannot be used more than once to avail the benefit. The student is eligible to transfer a maximum of nine credits in the entire duration of the program. The grades will be awarded as equivalent to the grades obtained in the NPTEL course.

B.E. in Artificial Intelligence and Data Science
Scheme of UG Autonomous Program – 2022 batch

VI SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22ADS61	Full Stack Web Development	PC	Respective Department	2	2	0	50	50	100	3
2	22ADS62	Neural Networks & Deep Learning	IPC		3	1	2	50	50	100	4
3	22ADS63	Data Visualization using Tableau	IPC		3	1	2	50	50	100	4
4	22ADS64X	Program Elective 2	PEC		3	0	0	50	50	100	3
5	22ADS65X	Open Elective 1	OEC	Offering Department	3	0	0	50	50	100	3
6	22CIV66	Environmental Science	HSM	Civil	1	0	0	50	50	100	1
	OR										
	22UHV66	Universal Human Values	HSM	Respective Department							
7	22ADSMP67	Mini Project	MP	Respective Department	Two Contact hours per week			50	50	100	2
							TOTAL	**350**	**350**	**700**	**20**

Program Elective 2*	
22ADS641	**Introduction to Quantum Computing**
22ADS642	**Cryptography**
Open Elective 1 (Offered to other branch students)	
22ADS651	**Big data analytics**
22ADS652	**Foundations of Data Science**

***NPTEL for Credit transfer**: Students can take 12 weeks NPTEL course as an equivalent to Program elective. The NPTEL courses of duration less than 12 weeks will not be considered for credit transfer. The courses (only technical) taken are as per the recommendation of BOS of respective department. The similarity of the contents as offered by NPTEL should not exceed a maximum of 40% of the courses being registered by the student. The NPTEL course need to be completed before the registration of the elective. Any certificate obtained after the registration of elective would not be considered. The validity of NPTEL certificate is for two years and it cannot be used more than once to avail the benefit. The student is eligible to transfer a maximum of nine credits in the entire duration of the program. The grades will be awarded as equivalent to the grades obtained in the NPTEL course.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

ECONOMICS AND MANAGEMENT IN DATA SCIENCE

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22ADS51**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Examination Hours:**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites: NIL

Course Objectives:

This Course will enable the students to:

1	Explain the principles of management, organization and entrepreneur.
2	Understand the importance of planning, organizing, staffing, directing and controlling and gain the leadership qualities required to run an enterprise.
3	Illustrate the ability to recognize a business opportunity either locally or globally.
4	Infer the importance of ERP, intellectual property rights and understand the significance of institutional support
5	Elucidate how to launch an entrepreneurial career.

Module 1	**No. of Hours**	**RBT Level**
Introduction: Meaning, Nature and characteristics of management, Scope and Functional areas of management, Goals of management, Levels of management. Planning- Nature, importance, types of plans, steps in planning, Organizing- nature and purpose, Types of Organization, Staffing- Meaning, Process of recruitment and selection. **Case Study**: The Bangalore International Airport	**08**	**L2**
Module 2		
Directing and controlling- Meaning and Nature of Directing, Leadership Styles, Motivation Theories (Maslows Need Hierarchy Theory, ERG Herberg's two factor theory), Communication- Meaning and importance, Coordination meaning and importance, Controlling- meaning, steps in controlling- meaning, steps in controlling, Methods of establishing control. **Case Study**: True Lies in Satyam	**08**	**L2**
Module 3		
Entrepreneur – Meaning of entrepreneur, Characteristics of entrepreneurs, classification and types of entrepreneurs, role of entrepreneurs in economic development, entrepreneurship in India, Market feasibility study, Technical feasibility study, Financial feasibility study and Social feasibility study. **Case Study:** Mokshagundam Visvesvaraya, Mohan Singh Oberoi: From Homeless to Hotelier	**08**	**L2**
Module 4		
Preparation of project and ERP - Meaning of project, Project Identification, Project Selection, Project Report, Need and Significance of Project Report, Contents, Formulation, Guidelines by planning commission for Project Report, Enterprise Resource Planning: Meaning and Importance- ERP and Functional areas of Management – Marketing / Sales- Supply Chain Management – Finance and Accounting – Human Resources – Types of reports and methods of report generation.	**08**	**L2**

Case Study: Naresh Goyal & Jet Airways		
Module 5		
Micro and Small Enterprises: Definition of micro and small enterprises, Classification of MSMED, characteristics and advantages of micro and small enterprises, steps in establishing micro and small enterprises, Government of India indusial policy 2007 on micro and small enterprises. **Case Study**: Shahnaz Husain- The Ayurveda Entrepreneur	**08**	**L2**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

CO1	Understand the functional areas of management and apply their principles in establishing an enterprise.
CO2	Outline the business opportunities and analyze the management skills for the economic growth of the society.
CO3	Illustrate the project proposals and reports for the effective management of an organization.
CO4	Understand the importance of Small scale industries in economic development.
CO5	Interpret how the entrepreneur applies the principles of management to meet the personal and societal needs.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					2		3	3	3	2	3	3	
CO2	3					2		3	3	3	2	3	3	
CO3	3					2		3	3	3	2	3	3	
CO4	3					2		3	3	3	2	3	3	
CO5	3					2		3	3	3	2	3	3	
Average	3					2		3	3	3		3	3	

Low-1: Medium-2: High-3

Text Books:

1. Principles of Management -P. C. Tripathi, P. N. Reddy; Tata McGraw Hill, 4th / 6th Edition, 2010.
2. Management and Enterpreneurship- Kanishka Bedi- Oxford University Press-2017.

Reference Books:

1. Management Fundamentals -Concepts, Application, Skill Development Robert Lusier– Thomson.
2. Entrepreneurship Development -S S Khanka -S Chand & Co.
3. Management -Stephen Robbins -Pearson Education /PHI -17th Edition, 2003.
4. Dynamics of Entrepreneurial Development & Management -Vasant Desai Himalaya Publishing House.
5. Entrepreneurship Development -Small Business Enterprises-Poornima M Charantimath Pearson Education – 2006.

MOOCs

1. http://nptel.ac.in
2. https://www.khanacademy.org/
3. https://www.class-central.com (MOOCS)
4. E-learning: www.vtu.ac.in

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper will be set for 50 marks. There will be 50 questions, 10 questions from each module, each question carrying 1 marks each. Students are required to answer all the questions.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –V

BIG DATA ANALYTICS TOOLS AND TECHNIQUES

Semester:	**5**	**CIE Marks:**	**50**
Course Code:	**22ADS52**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:1:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Understand fundamentals of Big Data analytics
2	Explore the Hadoop framework and Hadoop Distributed File system
3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data
4	Understand various mining streams
5	Understand various tools like Hive and Pig for Big Data Analytics.

Module 1	No. of Hours	RBT Level
Introduction to Big Data: Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data processing platforms: HADOOP, SPARK, FLINK, and MOA, Challenges of Conventional Systems, Big Data Analytics Applications and Case Studies.	**10**	**L2**
Module 2		
HADOOP: Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. Hadoop Distributed File System Basics: HDFS Design Features, Components, HDFS User Commands. Hadoop Map-Reduce Framework.	**10**	**L3**
Module 3		
Hive – What is Hive? Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), CREATE TABLE, DROP TABLE, ALTER TABLE, CREATE DATABASE, DROP DATABASE, DESCRIBE, INSERT, COUNT(*), SELECT, DISTINCT, HAVING, LIMIT, GROUP BY,ORDER BY, VARIOUS JOINS. **Pig**-What is Pig? Pig on Hadoop, Datatypes in Pig, Running Pig, Execution modes of Pig, HDFS Commands, Relational operators, Eval Function, Pig-Latin Language-DISTINCT, FILTER, FOREACH, GROUP, JOINS(Inner, Outer, Full), LIMIT, LOAD, ORDER BY, RANK, STORE, STREAM, UNION, DUMP. Complex Data Types, User Defined Functions, Word Count example using Pig.	**10**	**L3**

Module 4		
Essential Hadoop Tools: Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase. Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive - fundamentals of HBase and ZooKeeper, IBM Info Sphere Big Insights and Streams.	**10**	**L3**
Module 5		
NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL DataStore, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared- Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases. **Overview and History of NoSQL Databases:** NO-SQL database Techniques for Big Data, Comparison of Relational Databases with NO-SQL Databases. Advantages of NO-SQL over RDBMS,Scale out VS Scale up, Types of NO-SQL databases, Characteristics of NO-SQL Databases.NO-SQL solutions for Big Data Management,NO-SQL Data Models, Key-value stores, column based stores, graph based stores and document based stores.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Explain fundamentals of Big Data analytics.
CO2	Investigate Hadoop framework and Hadoop Distributed File system
CO3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
CO4	Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.
CO5	Demonstrate how to work with Hive and Pig.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		2			1		2		2	3	
CO2	2	3	1		2			1		2		2	3	
CO3	1	2	3		2			1		2		2	3	
CO4	1	2	3		2			1		2		2	3	
CO5	3	3	3		2			1		2		2	3	
Average	2	2	2		2			1		2		2	3	

High-3: Medium-2: Low-1

Textbooks:

1. Raj Kamal and Preeti Saxena, Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning,McGraw Hill Education, 2018.
2. Douglas Eadline, Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem, Pearson Education, 1st Edition, 2016
3. Seema Acharya, Subhashini Chellappan, Big data and Analytics, Wiley publications, 2nd Edition, 2019.

Reference Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Third Edition, 2012.

E-Books / Web References:

1. Big Data Now: http://cdn.oreillystatic.com/oreilly/radarreport/0636920028307/Big_Data_Now_2012_Edition.pdf
2. Bigdata Analytics with Hadoop: https://www.packtpub.com/free-ebook/big-data-analytics-with-hadoop-3/9781788628846

MOOCs:

1. Big Data Computing, IIT Patna, https://nptel.ac.in/courses/106104189
2. https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data/

Prog. No.	Lab Programs	No. of Hours/ RBT levels
1	Install Virtual Box. Install a virtual machine (that has Hadoop Installed) on the top of Virtual box. Learn HDFS and execute general and user commands.	**02 L3**
2	Write and execute Map-reduce word-count program in a single node as well as amultimode cluster.	**02 L3**
3	Write and execute a MAP-Reduce Python program to calculate the Total sales amount of various stores, at stores level and store/order date level.	**02 L3**
4	Write and execute a Map-reduce program to print year wise sales of a company from a given CSV file.	**02 L3**
5	Write and execute a Map-reduce program to read data from multiple files and perform mapper side join to print order amount	**02 L3**
6	Understand and practice various PIG-Latin Commands.	**02 L3**
7	Practice and write PIG-Latin scripts using the following commands.DISTINCT, FILTER, FOREACH, GROUP, JOINS(Inner, Outer, Full), LIMIT, LOAD, RDER BY, RANK, STORE, STREAM, UNION, DUMP.	**02 L3**
8	Understand and practice various HQL Query Commands.	**02 L3**
9	Practice and write HQL Queries using the following commands. CREATE TABLE, DROP TABLE, ALTER TABLE, CREATE DATABASE, DROP DATABASE, DESCRIBE, INSERT, COUNT(*), SELECT, DISTINCT, HAVING, LIMIT, GROUP BY,ORDER BY, VARIOUS JOINS.	**02 L3**
10	Create partition and buckets in a HIVE database. Query from a partitioned and bucketed database.	**02 L3**
11	Understand and practice various Mongo-DB Commands.	**02 L3**
12.	Practice with the following Mongo-DB commands. CREATECOLLECTION, FIND, UPDATEONE, UPDATEMANY, REPLACEONE, DELETEONE, DELETEMANY, INSERTONE, INSERTMANY, COUNT, PRETTY,SIZE,AGGREGATE COMMANDS, Etc.	**02 L3**

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –V

MACHINE LEARNING II

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22ADS53**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:2:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): Machine Learning I

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Understanding of the fundamental classification algorithms and challenges of supervised algorithms
2	Become conversant with types of multiclass classification algorithms, and their applicability
3	Familiarize with the unsupervised machine learning algorithms
4	To improve the performance of the algorithms using hyperparameter tuning techniques.
5	To understand and apply reinforcement learning concepts to the real data.

Module 1	No. of Hours	RBT Level
Supervised Learning (Classification): Support Vector Machine (SVC and SVR), Kernel Methods, Random Forest, Ensemble classification methods (Bagging and Boosting Techniques).	**10**	**L3**
Module 2		
Multiclass Classification: Multiclass classification problem, Generalization bounds, Uncombined multi-class algorithms, aggregated multi-class algorithms, Performance Metrics **Explainable AI:** Introduction to XAI, LIME, SHAP. **Introduction to Data Annotation:** Images and Text.	**10**	**L3**
Module 3		
Unsupervised Learning: Introduction to Unsupervised Learning, Clustering, k-means Clustering, Bisecting k- means, K-Means as special case of Expectation Maximization, Agglomerative Clustering and Divisive Clustering, DBSCAN, Comparing and Evaluating Clustering Algorithms, Semi-Supervised Learning models.	**10**	**L3**
Module 4		
Hyperparameter Tuning: Overview, Manual Search, Grid Search, Random Search, Random Search with Hyperopt, Bayesian Optimization, Multi-fidelity Optimization, Optuna.	**10**	**L3**
Module 5		
Reinforcement Learning(RL): Key elements of RL, the RL Algorithm, how RL differs from other ML paradigms, The Markov Decision Process, Action space, Episodic and Continuous tasks, Return and discount factor, The Value function, Q-function, model-based and model-free learning, types of environments, Applications.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, the students will be able to

CO1	Apply supervised learning techniques to real data using classification algorithms
CO2	Apply multiclass classification learning techniques to real data
CO3	Apply unsupervised learning algorithms for prediction.
CO4	Apply hyperparameter tuning techniques to improve the performance of the model
CO5	Apply reinforcement learning algorithms to solve real-world problems.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	3	2					3	2	3	
CO2	2	2	2	3	3	2					3	2	3	
CO3	3	2	3	3	3	2			3		3	2	2	
CO4	3	2	3	3	3	2			3		3	2	3	
CO5	3	3	3	3	3	3			3		3	2	2	
Average	3	2	3	3	3	2			3		3	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Introduction to Machine Learning with Python‖ Sarah Guido, Andreas C. Müller, O‘ Reilly, 2017.
2. Deep Reinforcement Learning with Python – Sudharsan Ravichandiran, by Packt Publishing – 2nd edition 2020.
3. Principles of Data Science by Sinan Ozdemir, Sunil Kakade, Packt Publishing Limited, 2nd Edition, 2018.

Reference Books:

1. Principles of Soft Computing by S N Sivanandam and S N Deepa, 3rd Edition, Wiley.
2. Introduction to Machine Learning‖, by Ethem Alpaydin, PHI Learning, 2nd Edition, 2019.

E-Books / Web References:

1. https://towardsdatascience.com/hyperparameter-tuning-for-machine-learning-models- 1b80d783b946.
2. https://smartlabai.medium.com/reinforcement-learning-algorithms-an-intuitive-overview- 904e2dff5bbc.

MOOCs:

1. **Udemy.**
2. **Coursera**
3. **NPTEL**

Prog. No.	Lab Programs	No. of Hours/ RBT levels
1	Write a program to demonstrate Support Vector Machine using different Kernelfunctions.	**02 L3**
2	Write a program to implement Bagging and Boosting classifiers.	**02 L3**
3	Write a program to demonstrate pipeline in Machine Learning.	**02 L3**
4	Write a program to classify the data using Multiclass classification algorithm 1.	**02 L3**
5	Write a program to classify the data using Multiclass classification algorithm 2.	**02 L3**
6	Write a program to cluster the data using K-Means clustering algorithm.	**02 L3**
7	Write a program to implement Label Propagation algorithm (Semi – Supervised Learning)	**02 L3**
8	Write a program to demonstrate Random Forest algorithm and improve the performanceusing different Hyper Parameter Tuning Techniques (Randomized and Grid search CV).	**02 L3**
9	Write a program to demonstrate on classification algorithm and improve the performanceusing different Hyper Parameter Tuning Techniques (Bayesian and Optuna).	**02 L3**
10	Write a program to implement Q-Learning.	**02 L3**

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub-questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a- thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table.

Table: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Lab	**20**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER V

LINEAR ALGEBRA FOR MACHINE LEARNING

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22MAT54**	**SEE Marks:**	**50**
Teaching hours/Week (L:T:P):	**3:0:0**	**Exam Hours:**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Course Objectives:

To enable students to apply the knowledge of Linear Algebra in Artificial Intelligence and Machine Learning by making them to learn:

1	System of linear equations.
2	Vector spaces, linear transformations.
3	Eigenvalues, Eigenvectors, diagonalization and Singular value decomposition

Module 1
System of linear equations, row reduction and echelon form, vector equations, The matrix equation AX = b. Linear independence and introduction to linear transformations.
Module 2
Matrix of linear transformation, matrix operations, invertible matrix, inverse of a matrix by Gauss Jordan method. Vector space, subspaces, linearly independent sets, Bases.
Module 3
Coordinate systems, The dimensions of a vector space, Rank, Change of basis. Eigen vectors and Eigen values, diagonalization, Eigen vectors and linear transformations.
Module 4
Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization.
Module 5
Least square solutions and fittings, diagonalization of symmetric matrices, quadratic forms, constrained optimization; Singular value decomposition.

Course Outcomes

Upon completion of this course, student will be able to:

CO54.1	Solve systems of linear equations.
CO54.2	Work within vector spaces.
CO54.3	Manipulate matrices and do matrix algebra
CO54.4	Use computational techniques for the study of Eigenvalues, Eigenvectors, and diagonalization

Text Books:

1. David C Lay, Linear Algebra and its applications, Pearson, 4th Edition, 2012.
2. Gilbert Strang, Linear Algebra and its Applications, Cengage Learning, 4th Edition, 2006

Reference Book:

1. K. Hoffman and R. Kunze, Linear Algebra, Prentice Hall, 2nd Edition, 2004.

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of three sub questions) from each module carrying 20 marks each. Students are required to answer any five full questions choosing at least one full question from each module.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average of Marks scored in all three tests is added to test component. Assignment marks for 10 is based on the execution of laboratory programs communicated by the course instructor.

Typical Evaluation pattern for regular courses is shown in Table 2.

Table 2: Distribution of weightage for CIE & SEE of Regular courses

Component		Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Assignments	**10**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

CO/PO Mapping																
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO	PSO	PSO	PSO
CO54.1	3	2	1									3				
CO54.2	3	2	1									3				
CO54.3	3	2	1									3				
CO 54.4	3	2	1									3				
Average	3	2	1									3				

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –V

INTRODUCTION TO NOSQL

Program Elective - 1

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22ADS551**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type o Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): Basic Knowledge about DBMS.

Course Learning Objectives:

Sl. No.	Course Learning Objectives (CLO)
1	Illustrate the Emergence of NoSQL.
2	Understand the challenges of NoSQL approach.
3	Outline the features of Key/value databases.
4	Define Column Oriented NoSQL databases.
5	Understand Databases using Riak.

Module 1	No. of Hours	RBT Level
Overview and History of NoSQL Databases: Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Key Points.	**08**	**L3**
Module 2		
Comparison of relational databases to new NoSQL stores: MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key- Value and Document Data Models, Column-Family Stores, Aggregate-Oriented Databases. **Distribution Models:** Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.	**08**	**L3**
Module 3		
Map-Reduce on databases: Basics, Partitioning and Combining, Composing Map-Reduce Calculations. **NoSQL Key/Value databases using MongoDB**: Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.	**08**	**L3**
Module 4		
Column- oriented NoSQL databases using Apache HBASE and Cassandra: Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage.	**08**	**L3**
Module 5		
NoSQL Key/Value databases using Riak: Key-Value Databases, Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases(storing session info, User profiles, shopping cart data), When not to use Key-Value stores. **Graph NoSQL databases using Neo4(Graph Databases):** Graph structure, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Explain and compare different types of NoSQL Databases
CO2	Compare and contrast RDBMS with different NoSQL databases.
CO3	Demonstrate the detailed architecture and performance tune of Document-oriented NoSQL databases.
CO4	Explain performance tune of Key-Value Pair NoSQL databases.
CO5	Explain NoSQL development tools on different types of NoSQL Databases.

CO / PO Mapping														
CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		2			1		2		2	3	
CO2	2	3	1		2			1		2		2	3	
CO3	1	2	3		2			1		2		2	3	
CO4	1	2	3		2			1		2		2	3	
CO5	3	3	3		2			1		2		2	3	
Average	2	2	2		2			1		2		2	3	

High-3: Medium-2: Low-1

Text Books:

1. Sadalage P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2012.

Reference Books:

1. Making Sense of NoSQL, Dan McCreary and Ann Kelly, Manning publications, 1st edition, 2013.

E-Books / Web References:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.javatpoint.com/nosql-databa
3. https://www.geeksforgeeks.org/introduction-to-nosql/

MOOCs:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.javatpoint.com/nosql-databa
3. https://www.geeksforgeeks.org/introduction-to-nosql/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying20 marks each. Students are required to answer any **five full questions** choosing at least **one full questionfrom each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes areto be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ conceptvideos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a- thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table.

Table: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –V

COMPUTER NETWORKS

Program Elective - 1

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22ADS552**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type o Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): None.

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Build an understanding of the fundamental concepts of computer networking
2	Familiarize students with the concepts of switching & framing
3	Introduce the concepts of Wireless LANs
4	Describe various layers of networks and the operating protocols
5	Understand the concepts of Adhoc networks & Sensor networks

Module 1	No. of Hours	RBT Level
Introduction: Data Communications, Networks, Network Types, Internet History, Standards and Administration, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer-1: Data and Signals, Digital Signals, Transmission Impairment, Data Rate limits, Performance.	**08**	**L2**
Module 2		
Switching: Introduction, Circuit Switched Networks and Packet switching. Error Detection and Correction: Introduction, Block coding, Cyclic codes, Checksum, Forward error correction.: Framing, Flow and Error Control	**08**	**L2**
Module 3		
Wired LANs Ethernet: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet and 10 Gigabit Ethernet, Wireless LANs: Introduction, IEEE 802.11 Project and Bluetooth. Data Traffic, Congestion and Congestion Control	**08**	**L2**
Module 4		
Protocols : Internet Protocol, ICMPv4,Mobile IP, Next generation IP: IPv6 addressing, The IPv6 Protocol, The ICMPv6 Protocol and Transition from IPv4 to IPv6.Domain Name System: Name Space, Domain name space, Distribution Name Space, DNS in the Internet, Resolution, DNS Messages, Types of Records	**08**	**L2**
Module 5		
Mobile AdHoc Networks and Wireless Sensor Neworks: Overview of Wireless Ad-Hoc networks, Routing in AdHOc Networks, Routing protocols for and Security of AdHoc networks, Sensor Networks and protocol structures, Communication Energy model, Clustering protocols, Routing protocols, ZigBee technology and 802.15.4.	**08**	**L2**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand basic computer networking concepts OSI,TCP/IP models.
CO2	Describe various networking architectures, flow & error control mechanisms .
CO3	Understand Wireless LAN concepts
CO4	Identify the protocols and services of different layers
CO5	Understand basics of Wireless Adhoc & Sensor networks.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2			2			2	2	2	2
CO2	2	2	3	2	2			2			2	2	2	2
CO3	2	2	3	2	3			2			2	2	2	2
CO4	2	2	3	3	3			2			3	3	2	2
CO5	2	2	3	3	3			2			3	3	2	2
Average	2	2	3	3	3			2			3	3	2	2

High-3: Medium-2: Low-1

Text Books:

1. Behrouz A Forouzan, Data and Communications and Networking, Sixth Edition, McGraw Hill, Indian Edition.
2. Nader F Mir, Computer and Communication Networks, 2nd Edition, Pearson, 2014(Chapter 19 & Chapter 20).

Reference Books:

1. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017
2. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER

E-Books / Web References:

1. NPTEL Lecture https://nptel.ac.in/courses/112/103/112103280/
2. https://archive.nptel.ac.in/courses/117/104/117104099/

MOOCs:

1. https://learn.saylor.org/course/CS402
2. https://www.coursera.org/specializations/computer-communications

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a- thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –V

WEB TECHNOLOGIES

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22ADS56**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**2:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**AEC**	**Credits:**	**02**

Prerequisites (if any): None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Illustrate the Semantic Structure of HTML
2	Illustrate CSS and Compose forms and tables using HTML and CSS
3	Understand different approaches to creating page layout
4	Design Client-Side programs using JavaScript
5	Design Server-Side programs using PHP

Module 1	No. of Hours	RBT Level
Website Basics: Clients, Servers and communication, The Internet, World wide web, HTTP Request message, HTTP response message, Web Clients, Web Servers **Introduction to HTML:** What is HTML and Where did it come from? HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements.	**08**	**L2**
Module 2		
Introduction to CSS: What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling. **HTML Tables and Forms:** Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility	**08**	**L2**
Module 3		
Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design	**08**	**L2**
Module 4		
JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms	**08**	**L3**
Module 5		
PHP: Quick Tour of PHP, Program Control, Functions, PHP Arrays, $_GET and $_POST, Reading/Writing Files, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Adapt HTML syntax and semantics to build web pages.
CO2	Construct and visually format tables and forms using HTML and CSS
CO3	Construct complex layouts to build web pages.
CO4	Develop Client-Side Scripts using JavaScript to display the contents dynamically
CO5	Develop Server-Side Scripts using PHP to generate and display the contents dynamically.

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2									3	3	
CO2	2	2	2									3	3	
CO3	2	2	2									3	3	
CO4	3	3	3									3	3	
CO5	3	3	3									3	3	
Average	2	2	2									3	3	

High-3: Medium-2: Low-1

Text Books:

1. Fundamentals of Web Development, Randy Connolly, Ricardo Hoar, Pearson Education India, (ISBN:978-9332575271), 1st Edition.

Reference Books:

1. Learning PHP, MySQL &JavaScript with jQuery, CSS and HTML5, Robin Nixon, O'ReillyPublications (ISBN:978-9352130153), 4th Edition, 2015.
2. PHP and MySQL Web Development, Luke Welling, Laura Thomson, Pearson Education(ISBN:978-9332582736), 5th Edition, 2016.
3. Professional JavaScript for Web Developers, Nicholas C Zakas, Wrox/Wiley India(ISBN:978-8126535088), 3rd Edition, 2012.

E-Books / Web References:

1. http://www.pearsonglobaleditions.com/connolly
2. https://www.w3schools.com/html/html5_intro.asp
3. https://www.w3schools.com/css/
4. https://www.w3schools.com/jS/default.asp
5. https://www.w3schools.com/pHP/default.asp
6. https://getbootstrap.com/
7. https://www.apachefriends.org/index.html
8. https://www.w3schools.com/xml/
9. https://www.w3schools.com/xml/ajax_intro.asp https://jquery.com

MOOCs:

1. NPTEL: https://nptel.ac.in/courses/106105084
2. Udemy: https://www.udemy.com/topic/web-app-development/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying20 marks each. Students are required to answer any **five full questions** choosing at least **one full questionfrom each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes areto be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ conceptvideos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a- thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table.

Table: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

ENVIRONMENTAL SCIENCE

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22CIV57**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**1:0:0**	**Examination Hours:**	**01**
Type of Course:	**HSM**	**Credits:**	**01**

Prerequisites: NIL

Course Objectives:

This Course will enable the students to:

1	The fundamentals of environmental science.
2	The types of natural resources
3	The various global environmental concerns.
4	The types of wastes generated and their handling at a basic level
5	The area of environmental law and policies with a few important acts in the field

Module 1	**No. of Hours**	**RBT Level**
Environment: • Definition, scope & importance • Components of Environment Ecosystem: Structure and function of various types of ecosystems • Human Activities – Food, Shelter, and Economic & Social Security. • Population - Growth, variation among nations – population explosion and impact on environment **Biodiversity:** Types, Value; Hot spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.	**04**	**L2**
Module 2		
Natural Resources: Forest, Water, Mineral, Food, Energy, Land Environmental Pollution - Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards.	**04**	**L2**
Module 3		
Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.	**04**	**L2**
Module 4		
Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Solid Waste Management Rules in India Sources and management of E – Waste, Biomedical Waste, Hazardous waste, and construction waste at individual and community level. Socio-economic aspect of waste management Environmental Toxicology.	**04**	**L2**
Module 5		
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship, NGOs.	**04**	**L2**

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1	Understand holistically the key concepts "Environment", and "Biodiversity".
CO2	Classify the types of natural resources available and the effects of anthropogenic interventions.
CO3	Express the gravity of various global environmental concerns.
CO4	Categorize the types of wastes generated and their handling at a basic level.
CO5	Understand the importance of environmental law and policies.

Textbooks:

1. Environmental studies, Benny Joseph, Tata Mcgraw-Hill 2nd edition 2012
2. Environmental studies, S M Prakash, pristine publishing house, Mangalore 3rd edition-2018
3. Gilbert M.Masters, Introduction to Environmental Engineering and Science, 2nd edition, Pearson Education, 2004

Reference books:

1. Benny Joseph, Environmental studies, Tata Mcgraw-Hill 2nd edition 2009
2. M.Ayi Reddy Textbook of Environmental Science and Technology, BS publications 2007
3. Dr. B.S Chauhan, Environmental Studies, University of science press 1st edition

Web References:

https://www.hzu.edu.in/bed/E%20V%20S.pdf

https://onlinecourses.nptel.ac.in/noc23_hs155/preview

https://onlinecourses.swayam2.ac.in/cec19_bt03/preview

Scheme of Examination:

Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.

Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	Marks	Total Marks
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

CO/PO Mapping															
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
22CIV57.1/66.1	2	-	-	-	-	-	3	-	-	-	-	-	1	-	-
22CIV57.2/66.2	2	1	-	-	-	-	3	-	-	-	-	1	1	-	1
22CIV57.3/66.3	2	-	2	-	-	2	3	1	-	-	-	1	1	-	1
22CIV57.4/66.4	2	2	-	-	-	2	3	-	-	-	-	-	-	-	1
22CIV57.5/66.5	2	-	-	-	-	2	3	-	-	-	-	-	-	1	1
Average	**2**	**1.5**	**2**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

UNIVERSAL HUMAN VALUES

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**22UHV57**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**1:0:0**	**Examination Hours:**	**01**
Type of Course:	**HSM**	**Credits:**	**01**

Prerequisites: NIL

Course Objectives:

This Course will enable the students to:

1	To create an awareness on Engineering Ethics and Human Values.
2	To understand social responsibility of an engineer.
3	To appreciate ethical dilemma while discharging duties in professional life.

Module 1	**No. of Hours**	**RBT Level**
Introduction to Value Education • Value Education, Definition, Concept and Need for Value Education. • The Content and Process of Value Education. • Basic Guidelines for Value Education, • Self-exploration as a means of Value Education. • Happiness and Prosperity as parts of Value Education.	**05**	**L2**
Module 2		
Harmony in the Human Being • Human Being is more than just the Body. • Harmony of the Self ('I') with the Body. • Understanding Myself as Co-existence of the Self and the Body. • Understanding Needs of the Self and the needs of the Body. • Understanding the activities in the Self and the activities in the Body.	**05**	**L2**
Module 3		
Harmony in the Family and Society and Harmony in the Nature • Family as a basic unit of Human Interaction and Values in Relationships. • The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love, • Comprehensive Human Goal: The Five Dimensions of Human Endeavour. • Harmony in Nature: The Four Orders in Nature. • The Holistic Perception of Harmony in Existence.	**05**	**L2**
Module 4		
Social Ethics • The Basics for Ethical Human Conduct, Defects in Ethical Human Conduct. • Holistic Alternative and Universal Order, • Universal Human Order and Ethical Conduct. • Human Rights violation and Social Disparities.	**05**	**L2**
Module 5		
Professional Ethics • Value based Life and Profession., Professional Ethics and Right Understanding. • Competence in Professional Ethics. • Issues in Professional Ethics – The Current Scenario. • Vision for Holistic Technologies • Production System and Management Models.	**05**	**L2**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3	Understand the role of a human being in ensuring harmony in society and nature.
CO4	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

Textbooks:

1.A.N Tripathy, New Age International Publishers, 2003. 2.Bajpai. B. L, New Royal Book Co, Lucknow, Reprinted, 2004 3.Bertrand Russell Human Society in Ethics & Politics

Reference books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Corliss Lamont, Philosophy of Humanism.
4. Gaur. R.R. , Sangal. R, Bagari G.P, A Foundation Course in Value Education,Excel Books, 2009.
5. Gaur. R.R. , Sangal R , Bagaria G.P, Teachers Manual, Excel Books, 2009.
6. I.C. Sharma, Ethical Philosophy of India, Nagin & co, Julundhar
7. William Lilly- Introduction to Ethics -Allied Publisher

Scheme of Examination:
Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.
Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

CO/PO Mapping																
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
22UHV57.1/66.1	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
22UHV57.2/66.2	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
22UHV57.3/66.3	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
22UHV57.4/66.4	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
Average	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VI

FULL STACK WEB DEVELOPMENT

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**22ADS61**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**2: 2 :0**	**Duration of SEE(Hours):**	**03**
Type of Course	**PC**	**Credits**	**03**

Prerequisites: HTML, CSS and JavaScript

Course Learning Objectives:

1	To independently set up a React project, create React components, and apply styling techniques
2	To effectively manage component state, pass and utilize props for data flow, and implement parent-child communication within React applications.
3	To design and implement dynamic forms, applying form validation techniques, and configuring routing for multi-page React applications
4	To independently set up a Node.js web server, manage packages with NPM, implement routing, and utilize middleware in Express.js.
5	To design MongoDB schemas and seamlessly connecting a Node.js application to a MongoDB database for efficient data management and retrieval

Module 1	**No. of Hours**	**RBT Level**
Introduction to React JS: Why React? What is React? Features of React, setting up a React Project, Hello React, React Component, React JSX, styling react components.	**8**	**L3**
Module 2		
State and Props: Why Props and State? How to work with state?, useState, how to use props, passing methods as Props, Accessing Child Nodes	**8**	**L3**
Module 3		
React Forms and Router: Why Forms? React Form Elements, React refs, Routing in React styling forms, Form Validation, Routing in React: Why Router? Router Configuration	**8**	**L3**
Module 4		
Node.js and Express.js: What is node.js? Getting started with Node.js, create web server in Node.js, Node package Manager (NPM), Express Development Environment, Routing, Middleware's.	**8**	**L3**
Module 5		
Connecting to MongoDB: Introduction, Schema, Validation and defaults, Models. CRUD Operations - Create, Read, Update and Delete	**8**	**L3**

COURSE OUTCOMES (CO): Upon completion of this course, student will be able to:

CO1	Design, and style React applications, incorporating components, JSX, and basic project structure for effective user interface development
CO2	Demonstrate proficiency in managing component state, passing and utilizing props, and implementing parent-child component communication within React applications.
CO3	Design and implement dynamic forms, handle form data and events, apply form validation techniques, and configure routing for multi-page React applications.
CO4	Demonstrate proficiency in applying Node.js to set up a web server, utilizing NPM for package management, implementing routing and middleware in Express.js
CO5	Design MongoDB schemas, performing CRUD operations, and effectively connecting and interacting with MongoDB databases in web applications.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3		2							2	3	
CO2	3	3	3		2							2	3	
CO3	3	3	3		2							2	3	
CO4	3	3	3		2							2	3	
CO5	3	3	3		2							2	3	
Average	3	3	3		2							2	3	

High-3: Medium-2: Low-1

Textbooks:

1. FullStack React: The Complete Book on ReactJS and Friends by Anthony Accomazzo, Nate Murray, Ari Lerner, Clay Allsopp, David Gutman, and Tyler McGinnis
2. Get Programming with Node.js by Jonathan Wexler

Reference Books:

1. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB by Azat Mardan
2. Full-Stack JavaScript Development by Eric Bush.
3. Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl , Kamil Przeorski, Maciej Czarnecki

MOOC and Online Material:

1. Learning Full Stack Development - https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094425539764224299_shared/overview
2. IBM Full Stack Software Developer Professional Certificate – https://www.coursera.org/professional-certificates/ibm-full-stack-cloud-developer
3. Beginner Full Stack Web Development: HTML, CSS, React & Node – https://www.udemy.com/course/ultimate-web/

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VI

NEURAL NETWORKS & DEEP LEARNING

Semester:	**6**	**CIE Marks:**	**50**
Course Code:	**22ADS62**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:1:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): Machine Learning I and Machine Learning II

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To impart hands-on knowledge on Advanced Machine Learning Topics.
2	Provide in-depth coverage of Data Augmentation and Convolutions.
3	Impart application of Deep Learning techniques like CNN and RNN.
4	Exposure to unsupervised feature engineering techniques

Module 1	No. of Hours	RBT Level
Introduction: Understanding the Biological Neurons, Exploring the Artificial Neurons (Perceptron), Perceptron learning rule, Examples on single layer perceptron, Process of designing a Neural Networks (Architecture), Types of Activation Functions, derivative of activation functions. Multilayer perceptron (Mathematics Behind Back propagation, Deep L layer Neural Network, Understanding the notion of forward and backward propagation), Optimization algorithms in NN, Loss functions, Dropout, Implementation of ANN.	**10**	**L2**
Module 2		
Convolutional Neural Networks: Mathematics behind CNN, Layers, Architectures of CNN, ILSVRC winner architectures, Implementation of CNN, Building the model from the scratch	**10**	**L3**
Module 3		
Introduction: Gradient based approaches, Visualizing gradients, Saliency map, Class Model, SmoothGRAD, DeConvolution, Guided Back Propagation Grad-CAM, Occlusion sensitivity	**10**	**L3**
Module 4		
Recurrent Neural Networks: Types of RNN, Challenges in training RNN: Exploding and Vanishing Gradients, Networks with Memory **Long Short-Term Memory (LSTM):** Gated Recurrent Unit (GRU), Sequence Learning Architectures, Sequence Learning with one RNN Layer, Sequence Learning with multiple RNN Layers Implementation example using Keras in Python: sentiment analysis	**10**	**L3**

Module 5		
Other Deep Learning Architectures: Encoder-Decoder Architecture, AttentionMechanism, Transformer Architecture, Generative Adversarial Networks, Unet.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the fundamental concepts in the neural networks.
CO2	Apply deep neural models to various learning problems.
CO3	Develop insight behind the theory of deep learning methods (CNN, RNN, etc.).
CO4	Design Deep Learning Methods for working with sequential data.
CO5	Develop GAN to generate more images to solve the problems on less data.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	3	2					3	2	3	
CO2	2	2	2	3	3	2					3	2	3	
CO3	3	2	3	3	3	2			3		3	2	2	
CO4	3	2	3	3	3	2			3		3	2	3	
CO5	3	3	3	3	3	3			3		3	2	2	
Average	3	2	3	3	3	2			3		3	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Deep learning – Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Amlan, 1st Edition, Pearson.
2. Deep learning- Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, MIT Press,2015

Reference Books:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, Springer.
2. Pattern Recognition and Machine Learning, Bishop C, Springer, 2006

E-Books / Web References:

1) https://cs231n.github.io/convolutional-networks/
2) https://github.com/terryum/awesome-deep-learning-papers
3) https://project.inria.fr/deeplearning/files/2016/05/deepLearning.pdf

MOOCs:

1. Deep Learning specialization in Coursera.
2. https://nptel.ac.in/courses/106106184
3. https://www.udemy.com/topic/deep-learning/

Prog. No.	Lab Programs	No. of Hours/ RBT levels
1	For the set of images perform the following a. Read the images from the folder. b. For one image – Apply text, borders, noise removal, brightness increase, filtering, enhancement, and augmentation.	**03 L3**
2	Write a python program to implement YOLO V8 and apply NMS.	**03 L3**
3	Write a python program to implement Faster R-CNN and apply NMS.	**03 L3**
4	Write a python program to demonstrate the Image captioning.	**03 L3**
5	Write a python program to demonstrate the VAE	**03 L3**
6	Write a python program to implement the variant of GAN.	**03 L3**
7	Write a python program to demonstrate the diffusion model from the scratch.	**03 L3**
8	Write a python program to demonstrate the diffusion model on the text.	**03 L3**
9	Write a Python program to build a model for face recognition.	**03 L3**
10	Write a Python program to build a model for face recognition using FaceNet and VGGFace2.	**03 L3**

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have beenencouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Assignment	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VI

DATA VISUALIZATION USING TABLEAU

Semester:	**06**	**CIE Marks**	**50**
Course Code	**22ADS63**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:1:2**	**Duration of SEE (hours):**	**03**
Type of Course	**IPC**	**Credits**	**04**

Prerequisites (if any): None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Provide an overview of the good practice of data visualization.
2	Introduce students to the key design principles and techniques for visualizing data.
3	Learn how to navigate Tableau and connect to data sources, leverage drag-and-drop interface to create impactful visualizations.
4	Provide an overview and develop an introductory level of competency on the use of Power BI that can be used for data visualization.
5	Facilitate project-based opportunities to identify, understand, analyze, prepare, and present effective visualizations on a variety of data.

Module 1	No. of Hours	RBT Level
Data Visualization: Introduction to the Art and Science of Data Visualization, What is Data Visualization and why does it matter? Why Use Data Visualization? Brief History of Data Visualization, Data Visualization Tools, Pros and cons of Data Visualization. **Design Fundamentals:** Design Principles, Colors, and "Chart Junk", The Shaffer 4C's of Data Visualization, Best practices (examples).	**10**	**L3**
Module 2		
Storytelling with Data: Creating a good data set for analysis, Selecting data for your KPIs, Approaches to storytelling with data, Dashboards vs. Storyboards vs. Infographics, The Duell Rules for Actionable Visualizations. **Tableau:** What is Tableau? History of Tableau, Advantages and disadvantages of Tableau, Tableau architecture, Tableau Public and Tableau Desktop, Workspace, Connecting to data source, Files and folders, Tableau navigation, Terminologies, Data types, Data roles, Data aggregation, File types.	**10**	**L3**
Module 3		
Data connection: Extracting data, Joining, Blending, Splits, Sorting, Fields operations. **Tableau calculations:** Operators, Functions, Numeric, string, date, table calculations, Level of Details expressions.	**10**	**L3**

Module 4		
Sort and filter: Basic filters, Filter operations, Extract filters, Quick filters, Context filters, Condition filters, Data source filters, Top filters, Build groups, hierarchy, sets. **Charts:** Bar, Line, Pie, Crosstab, Bubble, Bullet, Area, Pareto, Bump chart, Gantt chart, Histogram, Motion charts, Waterfall charts. Plots: Scatter, Boxplot. Maps: Heat map, Tree map.	**10**	**L3**
Module 5		
Advanced Tableau: Dashboard, Formatting, Forecasting, Trend Lines. **Power BI:** Introduction, Architecture, Tableau vs Power BI, Data modelling, Dashboard, Visualization options, Data Analysis Expressions.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Develop insight on the fundamentals and various design techniques for effective Data Visualization.
CO2	Learn ways to create dashboards as well as story points to develop a strong, powerful data story.
CO3	Learn ways and methods to analyze and apply design principles to Tableau visualization.
CO4	Acquaint themselves with various functions available in Advanced Tableau, Power BI tools.
CO5	Familiarize themselves well with current trends in Data Visualization through relevant case studies.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3		2	2			2		2	2	3	3
CO2	2	1	2		2	2			2		3	2	3	2
CO3	1	2	3		3	2			2		2	2	3	2
CO4	2	1	3		3	2			2		3	2	3	3
CO5	2	1	3		3	2			2		3	2	3	3
Average	2	1	3		3	2			2		3	2	3	3

High-3: Medium-2: Low-1

Text Books:

1) Tableau 10 Business Intelligence Cookbook Book – Donabel Santos, Packt Publishing, 2016
2) The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts, and Figures, Dona M. Wong, W. W. Norton & Company,

Reference Books:

1. Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, Stephen Few, O'Reilly Media, 2013
2. Show Me the Numbers: Designing Tables and Graphs to Enlighten, Stephen Few, Analytics Press, 2004
3. Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics, Nathan Yau, Wiley, 2011
4. Now You See It, Stephen Few, Analytics Press, 2009
5. The Visual Display of Quantitative Information, Edward Tufte, Graphics Press, 2nd Edition, 2001

Books / Web References:

1. Data Visualization and Exploration with R A Practical Guide to Using R RStudio and Tidyverse for Data Visualization Exploration and Data Science Applications: https://www.pdfdrive.com/data-visualization-and-exploration-with-r-a-practical- guide-to-using-r-rstudio-and-tidyverse-for-data-visualization-exploration-and- data-science-applications-d176184240.html
2. Beginning Data Science in R: Data Analysis, Visualization, and Modelling for the Data Scientist: https://www.pdfdrive.com/beginning-data-science-in-r-data- analysis-visualization-and-modelling-for-the-data-scientist-d181093942.html

MOOCs:

1. https://www.coursera.org/learn/datavisualization
2. https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11
3. https://www.edx.org/course/data-visualization-for-all
4. https://www.udemy.com/course/the-complete-data-visualization-course/

Sl. No.	Programs	No. of Hours/ RBT levels
1	Implement Data Blending on the given dataset using Tableau.	03 L3
2	Demonstrate Calculated Fields on the given dataset using Tableau.	03 L3
3	Demonstrate Tableau measure names and measure values on the given dataset.	03 L3
4	Implement Tableau Parameters on the given dataset.	03 L3
5	Illustrate clustering on the given dataset using Tableau.	03 L3

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	**Marks**	**Total Marks**
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

INTRODUCTION OF QUANTUM COMPUTING
Program Elective 2

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**22ADS641**	**SEE Marks:**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): None

Module 1	**No. of Hours**	**RBT Level**
Introduction to Quantum Computing: Introduction to QC and brief about the quantum mechanics, Why QC, Classic architecture vs quantum architecture, History of QC, What is QC, Qubit notations,Features of QC (Superposition, entanglement, decoherence), Usecases of QC, Linear vector spaces, Postulates of quantum mechanics.	**08**	**L2**
Module 2		
Quantum bits (qubits) & Quantum logic gates: Quantum State Transformation, Introduction to Logic Gates, Quantum gates & Circuits - Single Qubit Gates and Operations, Multiple Qubit Gates and Operations, Introduction to Quantum Simulator. **Textbook:** Learn Quantum Computing with Python and IBM Quantum Experience by Robert Loredo.	**08**	**L2**
Module 3		
Practical Implementation: Introduction to Qiskit and QSim simulator toolkit, Python libraries needed for the implementation of Quantum computing, Implementation of Pauli gates in Qiskit and QSim, Implementation of Hadamard gate, Implementation of 2 qubit quantum gates, Implementation of three qubit quantum gates.	**08**	**L3**
Module 4		
Quantum Algorithms I: No cloning theorem, Quantum Teleportation, Deutsch's-Jozsa Algorithm, Bernstien Vazirani, practical implementation of the algorithms using Qiskit. **Textbook:** Fundamentals of Quantum Computing Theory and Practice, Venkateswaran Kasirajan, Springer, 1 st Edn., 2021.	**08**	**L3**
Module 5		
Quantum Algorithms II: Quantum Fourier transformation, Simon, Shor's, Grover's algorithm & generalization, practical implementation of the algorithms using Qiskit, Introduction to Quantum Machine Learning **Textbook:** QISKIT textbook: https://qiskit.org/textbook/content/ch-ex/ https://medium.com/@SPX701/quantum-machine-learning-a-beginners-guide-7c7f1d349693	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand Quantum Machine Learning - What Quantum Computing Means To Data Mining.
CO2	Understand the basics of quantum machine learning
CO3	Apply by implementing quantum classification algorithms on the real dataset
CO4	Apply by implementing regression on the real dataset
CO5	Apply by implementing pattern recognition on real dataset

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		2	2	2	1		2		2	3	
CO2	3	3	2	2	3	2	2	1		2		2	3	
CO3	3	3	3	2	3	2	2	1	2	2		3	3	
CO4	3	3	3	2	3	2	2	1	2	2	2	3	3	
CO5	3	3	3	2	3	2	2	2	2	2	2	3	3	
Average	3	3	3	2	3	2	2	1	2	2	2	3	3	

High-3: Medium-2: Low-1

Text Books:

1. Learn Quantum Computing with Python and IBM Quantum Experience by Robert Loredo.
2. Fundamentals of Quantum Computing Theory and Practice, Venkateswaran Kasirajan, Springer, 1 st Edn., 2021.
3. Quantum Machine Learning - What Quantum Computing Means To Data Mining, Peter Wittek, Elsevier, 2014.

Reference Books:

1. Quantum Machine Learning With Python: Using Cirq from Google Research and IBM Qiskit by Santanu Pattanayak.

E-Books / Web References:

MOOCs:

1. https://www.educative.io/courses/hands-on-quantum-machine-learning-python
2. https://www.udemy.com/course/quantum-computing-and-quantum-machine-learning-part-1/
3. https://www.udemy.com/course/quantum-computing-and-quantum-machine-learning-part-2/

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Class test	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CRYPTOGRAPHY
Program Elective 2

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**22ADS642**	**SEE Marks:**	**50**
Hours/Week (L: T: P)	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Enable students to understand the basics of symmetric key and public key cryptography
2	Equip students with some basic mathematical concepts and pseudorandom number generators required for cryptography.
3	Enable students to authenticate and protect the encrypted data.

Module 1	No. of Hours	RBT Level
Basic Concepts of Number Theory and Finite Fields: Divisibility and the divisibility algorithm, Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Polynomial arithmetic, Finite fields of the form GF(2n)(Text 1: Chapter 3) L1, L2	**08**	**L2**
Module 2		
Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Steganography (Text 1: Chapter 1) SYMMETRIC CIPHERS: Traditional Block Cipher structure, Data Encryption Standard (DES) (Text 1: Chapter 2: Section1, 2)	**08**	**L2**
Module 3		
SYMMETRIC CIPHERS: The AES Cipher. (Text 1: Chapter 4: Section 2, 3, 4) Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs (Text 2: Chapter 16: Section 1, 2, 3, 4)	**08**	**L2**
Module 4		
More number theory: Prime Numbers, Fermat‘s and Euler‘s theorem, Primality testing, Chinese Remainder theorem, discrete logarithm. (Text 1: Chapter 7) Principles of Public-Key Cryptosystems: The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography	**08**	**L2**
Module 5		
One-Way Hash Functions: Background, Snefru, N-Hash, MD4, MD5, Secure Hash Algorithm [SHA],One way hash functions using symmetric block algorithms, Using public key algorithms, Choosing a one-way hash functions, Message Authentication Codes. Digital Signature Algorithm, Discrete Logarithm Signature Scheme (Text 2: Chapter 18: Section 18.1 to 18.5, 18.7, 18.11 to 18.14 and Chapter 20: Section 20.1, 20.4)	**08**	**L2**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Use basic cryptographic algorithms to encrypt the data.
CO2	Generate some pseudorandom numbers required for cryptographic applications.
CO3	Provide authentication and protection for encrypted data.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2			2			2	2	2	2
CO2	2	2	3	2	2			2			2	2	2	2
CO3	2	2	3	2	3			2			2	2	2	2
Average	2	2	3	3	3			2			3	3	2	2

High-3: Medium-2: Low-1

Text Books:

1. William Stallings , ―Cryptography and Network Security Principles and Practice‖, Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3 2.
2. Bruce Schneier, ―Applied Cryptography Protocols, Algorithms, and Source code in C‖, Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X

Reference Books:

1. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017 .
2. Larry L Peterson and Brusce S Davie, Computer Networks, fifth edition, ELSEVIER

E-Books / Web References:

1. NPTEL Lecture https://nptel.ac.in/courses/112/103/112103280/
2. https://archive.nptel.ac.in/courses/117/104/117104099/

MOOCs:

1. https://learn.saylor.org/course/CS402
2. https://www.coursera.org/specializations/computer-communications

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Class test	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respectiveBoard of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VI

BIG DATA ANALYTICS

Open Elective 1

Semester:	**6**	**CIE Marks:**	**50**
Course Code:	**22ADS651**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**OEC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Understand fundamentals of Big Data analytics
2	Explore the Hadoop framework and Hadoop Distributed File system
3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data
4	Understand various mining streams
5	Understand various tools like Hive and Pig for Big Data Analytics.

Module 1	No. of Hours	RBT Level
Introduction to Big Data: Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data processing platforms: HADOOP, SPARK, FLINK, and MOA, Challenges of Conventional Systems, Big Data Analytics Applications and Case Studies.	**08**	**L2**
Module 2		
HADOOP: Introduction to Hadoop: Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. Hadoop Distributed File System Basics: HDFS Design Features, Components, HDFS User Commands. Hadoop Map-Reduce Framework.	**08**	**L3**
Module 3		
Hive – What is Hive? Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), CREATE TABLE, DROP TABLE, ALTER TABLE, CREATE DATABASE, DROP DATABASE, DESCRIBE, INSERT, COUNT(*), SELECT, DISTINCT, HAVING, LIMIT, GROUP BY,ORDER BY, VARIOUS JOINS. **Pig**-What is Pig? Pig on Hadoop, Datatypes in Pig, Running Pig, Execution modes of Pig, HDFS Commands, Relational operators, Eval Function, Pig-Latin Language-DISTINCT, FILTER, FOREACH, GROUP, JOINS(Inner, Outer, Full), LIMIT, LOAD, ORDER BY, RANK, STORE, STREAM, UNION, DUMP. Complex Data Types, User Defined Functions, Word Count example using Pig.	**08**	**L3**

Module 4		
Essential Hadoop Tools: Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase. Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, Querying Data in Hive - fundamentals of HBase and ZooKeeper, IBM Info Sphere Big Insights and Streams.	**08**	**L3**
Module 5		
NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL DataStore, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases. **Overview and History of NoSQL Databases:** NO-SQL database Techniques for Big Data, Comparison of Relational Databases with NO-SQL Databases. Advantages of NO-SQL over RDBMS,Scale out VS Scale up, Types of NO-SQL databases, Characteristics of NO-SQL Databases.NO-SQL solutions for Big Data Management,NO-SQL Data Models, Key-value stores, column based stores, graph based stores and document based stores.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Explain fundamentals of Big Data analytics.
CO2	Investigate Hadoop framework and Hadoop Distributed File system
CO3	Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
CO4	Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.
CO5	Demonstrate how to work with Hive and Pig.

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		2			1		2		2	3	
CO2	2	3	1		2			1		2		2	3	
CO3	1	2	3		2			1		2		2	3	
CO4	1	2	3		2			1		2		2	3	
CO5	3	3	3		2			1		2		2	3	
Average	2	2	2		2			1		2		2	3	

High-3: Medium-2: Low-1

Textbooks:

1. Raj Kamal and Preeti Saxena, Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning,McGraw Hill Education, 2018.
2. Douglas Eadline, Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem, Pearson Education, 1st Edition, 2016
3. Seema Acharya, Subhashini Chellappan, Big data and Analytics, Wiley publications, 2nd Edition, 2019.

Reference Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Third Edition, 2012.

E-Books / Web References:

1. Big Data Now: http://cdn.oreillystatic.com/oreilly/radarreport/0636920028307/Big_Data_Now_2012_Edition.pdf
2. Bigdata Analytics with Hadoop: https://www.packtpub.com/free-ebook/big-data-analytics-with-hadoop-3/9781788628846

MOOCs:

1. Big Data Computing, IIT Patna, https://nptel.ac.in/courses/106104189
2. https://www.udemy.com/course/the-ultimate-hands-on-hadoop-tame-your-big-data/

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes are to be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively.

Some possible AATs: seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic toolbox for problem solving/ report based on participation in create-a-thon/ make-a- thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical Evaluation pattern for regular courses is shown in Table.

Table: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

FOUNDATIONS OF DATA SCIENCE

Open Elective 1

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**22ADS652**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**OEC**	**Credits:**	**03**

Prerequisites (if any): Basics of Probability

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand the problems solvable with data science
2	Ability to solve problems from a statistical perspective.
3	To build the skills to create data analytical pipelines
4	To bring the familiarity with the data science ecosystem and the various tools needed to continue developing as a data scientist.

Module 1	No. of Hours	RBT Level
Introduction to Data Science: Evolution of Data Science, Data Science Roles,Lifecycle of Data Science, Representation of Data Science as a Venn Diagram, Technologies revolving around Data Science. **Types of Data:** Structured and Unstructured Data, Quantitative and Qualitative Data,Four Levels of data (Nominal, Ordinal, Interval, Ratio Level). **Data Pre-processing:** Asking interesting question, Obtaining of data, Exploration of data, Modeling of data, Communication and visualization.	**08**	**L2**
Module 2		
Data Mining: What is Data Mining? Types of Data Mining, Challenges of implementation in Data Mining, Advantages and Disadvantages, Applications of DataMining. **Overview of Basic Data Mining Tasks:** Classification, Regression, Time Series Analysis, Prediction, Clustering, Sequence Discovery.	**08**	**L3**
Module 3		
Basics of Statistics: Introduction to Statistics, Terminologies in Statistics, Measures ofcenter, variance and relative standing, Normalization of data using the z-score, Empirical rule, Categories in Statistics (Descriptive and Inferential Statistics). **Descriptive Statistics:** Data Objects and Attribute, Basic Statistical Description of Data (Measuring the Central Tendency of Data, Measuring the Dispersion of Data, Graphical Displays), Data Visualization Techniques, Measuring Data Similarity and Dissimilarity.	**08**	**L3**
Module 4		
Inferential Statistics: Overview of Probability Distributions (Bernoulli, Binomial, Poisson, Chi-square, t-tail), Joint distribution of the Sample Mean and Sample Variance, Confidence Intervals, Bayesian Analysis of samples from Normal Distribution, Fisher Estimator, Central Limit Theorem.	**08**	**L3**

Module 5		
Hypothesis Testing: Testing simple hypotheses, Uniform tests, Two-sided alternatives, t-Test, F-Distribution, Bayes Test Procedures, Case studies based onHypothesis Testing.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the basics of data science, data mining techniques.
CO2	Apply the advanced mining concepts.
CO3	Interpret the basic statistical description of data.
CO4	Implement Data sampling Techniques.
CO5	Apply the data mining concepts on the real data.

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3		2			2		2		2	3	
CO2	3	3	3		2			2		2		2	3	
CO3	3	3	3		2			2		2		2	3	
CO4	3	3	3		2			2		2		2	3	
CO5	3	3	3		2			2		2		2	3	
Average	3	3	3		2			2		2		2	3	

High-3: Medium-2: Low-1

Text Books:

1. Principles of Data Science by Sinan Ozdemir, Sunil Kakade, Packt Publishing Limited,2nd Edition, 2018
2. Probability and Statistics, by Morris H Degroot, Mark J Schervish, Pearson, 4th Edition, 2012.

Reference Books:

1. Data Mining Concepts and Techniques by Jiawei Han and Micheine Kamber, Morgan Kaufmann, 3rd Edition, 2011.
2. Machine Learning:A probabilistic perspective, by Murphy, KevinP, MIT Press, 2012.

E-Books / Web References:

1. **Learn Data Science : Open content for self-directed learning in Data Science :** http://learnds.com/
2. **Foundations of Data Science:** https://www.cs.cornell.edu/jeh/book.pdf

MOOCs:

1. **Introduction to Mathematical Thinking:** https://www.coursera.org/learn/mathematical-thinking
2. **IBM Data Science Professional Certificate:** https://www.coursera.org/professional-certificates/ibm-data-science

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouragedto use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Quiz 1 / AAT	05	
Quiz 2 / AAT	05	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board ofStudies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

ENVIRONMENTAL SCIENCE

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**22CIV66**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**1:0:0**	**Examination Hours:**	**01**
Type of Course:	**HSM**	**Credits:**	**01**

Prerequisites: NIL Course

Objectives:

This Course will enable the students to:

1	The fundamentals of environmental science.
2	The types of natural resources
3	The various global environmental concerns.
4	The types of wastes generated and their handling at a basic level
5	The area of environmental law and policies with a few important acts in the field

Module 1	**No. of Hours**	**RBT Level**
Environment: • Definition, scope & importance • Components of Environment Ecosystem: Structure and function of various types of ecosystems • Human Activities – Food, Shelter, and Economic & Social Security. • Population - Growth, variation among nations – population explosion and impact on environment **Biodiversity:** Types, Value; Hot spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.	**04**	**L2**
Module 2		
Natural Resources: Forest, Water, Mineral, Food, Energy, Land Environmental Pollution - Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards.	**04**	**L2**
Module 3		
Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.	**04**	**L2**
Module 4		
Sources: Sources of Solid waste, Types of solid waste, Physical and Chemical composition of municipal solid waste. Solid Waste Management Rules in India Sources and management of E – Waste, Biomedical Waste, Hazardous waste, and construction waste at individual and community level. Socio-economic aspect of waste management Environmental Toxicology.	**04**	**L2**
Module 5		
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship, NGOs.	**04**	**L2**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

CO1	Understand holistically the key concepts "Environment", and "Biodiversity".
CO2	Classify the types of natural resources available and the effects of anthropogenic interventions.
CO3	Express the gravity of various global environmental concerns.
CO4	Categorize the types of wastes generated and their handling at a basic level.
CO5	Understand the importance of environmental law and policies.

Textbooks:

1. Environmental studies, Benny Joseph, Tata Mcgraw-Hill 2nd edition 2012
2. Environmental studies, S M Prakash, pristine publishing house, Mangalore 3rd edition-2018
3. Gilbert M.Masters, Introduction to Environmental Engineering and Science, 2nd edition, Pearson Education, 2004

Reference books:

1. Benny Joseph, Environmental studies, Tata Mcgraw-Hill 2nd edition 2009
2. M.Ayi Reddy Textbook of Environmental Science and Technology, BS publications 2007
3. Dr. B.S Chauhan, Environmental Studies, University of science press 1st edition

Web References:

https://www.hzu.edu.in/bed/E%20V%20S.pdf
https://onlinecourses.nptel.ac.in/noc23_hs155/preview
https://onlinecourses.swayam2.ac.in/cec19_bt03/preview

Scheme of Examination:
Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.
Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	Marks	Total Marks
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

CO/PO Mapping															
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
22CIV57.1/66.1	2	-	-	-	-	-	3	-	-	-	-	-	1	-	-
22CIV57.2/66.2	2	1	-	-	-	-	3	-	-	-	-	1	1	-	1
22CIV57.3/66.3	2	-	2	-	-	2	3	1	-	-	-	1	1	-	1
22CIV57.4/66.4	2	2	-	-	-	2	3	-	-	-	-	-	-	-	1
22CIV57.5/66.5	2	-	-	-	-	2	3	-	-	-	-	-	-	1	1
Average	**2**	**1.5**	**2**	**-**	**-**	**2**	**3**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**1**

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

UNIVERSAL HUMAN VALUES

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**22UHV66**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**1:0:0**	**Examination Hours:**	**01**
Type of Course:	**HSM**	**Credits:**	**01**

Prerequisites: NIL Course

Objectives:

This Course will enable the students to:

1	To create an awareness on Engineering Ethics and Human Values.
2	To understand social responsibility of an engineer.
3	To appreciate ethical dilemma while discharging duties in professional life.

Module 1	**No. of Hours**	**RBT Level**
Introduction to Value Education • Value Education, Definition, Concept and Need for Value Education. • The Content and Process of Value Education. • Basic Guidelines for Value Education, • Self-exploration as a means of Value Education. • Happiness and Prosperity as parts of Value Education.	**05**	**L2**
Module 2		
Harmony in the Human Being • Human Being is more than just the Body. • Harmony of the Self ('I') with the Body. • Understanding Myself as Co-existence of the Self and the Body. • Understanding Needs of the Self and the needs of the Body. • Understanding the activities in the Self and the activities in the Body.	**05**	**L2**
Module 3		
Harmony in the Family and Society and Harmony in the Nature • Family as a basic unit of Human Interaction and Values in Relationships. • The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love, • Comprehensive Human Goal: The Five Dimensions of Human Endeavour. • Harmony in Nature: The Four Orders in Nature. • The Holistic Perception of Harmony in Existence.	**05**	**L2**
Module 4		
Social Ethics • The Basics for Ethical Human Conduct, Defects in Ethical Human Conduct. • Holistic Alternative and Universal Order, • Universal Human Order and Ethical Conduct. • Human Rights violation and Social Disparities.	**05**	**L2**
Module 5		
Professional Ethics • Value based Life and Profession., Professional Ethics and Right Understanding. • Competence in Professional Ethics. • Issues in Professional Ethics – The Current Scenario. • Vision for Holistic Technologies • Production System and Management Models.	**05**	**L2**

COURSE OUTCOMES:
Upon completion of this course, student will be able to:

CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3	Understand the role of a human being in ensuring harmony in society and nature.
CO4	Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

Textbooks:

1.A.N Tripathy, New Age International Publishers, 2003. 2.Bajpai. B. L, New Royal Book Co, Lucknow, Reprinted, 2004 3.Bertrand Russell Human Society in Ethics & Politics

Reference books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Corliss Lamont, Philosophy of Humanism.
4. Gaur. R.R. , Sangal. R, Bagari G.P, A Foundation Course in Value Education,Excel Books, 2009.
5. Gaur. R.R. , Sangal R , Bagaria G.P, Teachers Manual, Excel Books, 2009.
6. I.C. Sharma, Ethical Philosophy of India, Nagin & co, Julundhar
7. William Lilly- Introduction to Ethics -Allied Publisher

Scheme of Examination:
Semester End Examination (SEE): SEE Question paper is to be set for 50 marks with multiple choice questions of 1 mark each covering all aspects of the syllabus.

Continuous Internal Evaluation (CIE): Three Tests are to be conducted for 50 marks each. The average of the three tests are taken for computation of CIE. Question paper for each of the CIE is to be of the multiple-choice type with 50 question each.
Typical Evaluation pattern for regular courses is shown in Table.

Table 1: Distribution of weightage for CIE & SEE for 1 credit course

	Component	Marks	Total Marks
CIE	CIE Test-1	**50**	**50**
	CIE Test-2	**50**	
	CIE Test-2	**50**	
SEE	Semester End Examination	**50**	**50**
		Grand Total	**100**

CO/PO Mapping																
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
22UHV57.1/66.1	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
22UHV57.2/66.2	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
22UHV57.3/66.3	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
22UHV57.4/66.4	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-
Average	-	-	-	-	-	-	-	**2**	-	-	-	**1**	-	-	-	-

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

MINI PROJECT

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**22ADSMP67**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**0:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**MP**	**Credits:**	**02**

Mini-project work: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-Project:

a. Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

b. Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college. The CIE marks awarded for the Mini- Project shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-Project:

a. Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

b. Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**50**	**50**
	Review-2		
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

B.E. in Artificial Intelligence and Data Science
Scheme of UG Autonomous Program – 2022 batch

VII SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22ADS71	Deep Learning for Computer Vision	PC	Respective Department	2	2	0	50	50	100	3
2	22ADS72	Advanced Data Visualization	IPC		3	0	2	50	50	100	4
3	22ADS73	Natural Language Processing	IPC		3	0	2	50	50	100	4
4	22ADS74X	Program Elective 3	PEC		3	0	0	50	50	100	3
5	22ADS75X	Open Elective 2	OEC	Offering Department	3	0	0	50	50	100	3
6	22ADSP76	Project Phase 1	MP	Two Contact hours per week				100	-	100	2
				TOTAL				**350**	**250**	**600**	**19**

Program Elective 3*	
22ADS741	**Cloud Computing**
22ADS742	**Cyber Security**
Open Elective 2 (Offered to other branch students)	
22ADS751	**Neural Networks & Deep Learning**
22ADS752	**Data Visualization Tools**

***NPTEL for Credit transfer**: Students can take 12 weeks NPTEL course as an equivalent to Program elective. The NPTEL courses of duration less than 12 weeks will not be considered for credit transfer. The courses (only technical) taken are as per the recommendation of BOS of respective department. The similarity of the contents as offered by NPTEL should not exceed a maximum of 40% of the courses being registered by the student. The NPTEL course need to be completed before the registration of the elective. Any certificate obtained after the registration of elective would not be considered. The validity of NPTEL certificate is for two years and it cannot be used more than once to avail the benefit. The student is eligible to transfer a maximum of nine credits in the entire duration of the program. The grades will be awarded as equivalent to the grades obtained in the NPTEL course.

B.E. in Artificial Intelligence and Data Science
Scheme of UG Autonomous Program – 2022 batch

VIII SEMESTER

Sl. No.	Course Code	Course Title	Course Type	Teaching Dept.	Teaching Hours/Week			Examination			CREDITS
					L	T	P	CIE	SEE	Total	
1	22ADS81	Large Language Models	PC	Respective Department	4	0	0	50	50	100	4
2	22ADS82X	Program Elective 4	PEC		3	0	0	50	50	100	3
3	22ADS83X	Program Elective 5	PEC		3	0	0	50	50	100	3
4	22ADSP84	Project work phase – II	MP	Two Contact hours per week				100	100	200	8
5	22ADSS85	Technical Seminar	MP	One Contact hour per week				100	--	100	1
6	22INT86	Internship	INT	Completed during the intervening period of VI and VII Semester				100	--	100	2
				TOTAL				**450**	**250**	**700**	**21**

Program Elective 4*	
22ADS821	**Predictive and Time Series Analysis**
22ADS822	**Explainable Artificial Intelligence**
Program Elective 5*	
22ADS831	**Mobile App Development**
22ADS832	**Data Science for Security**

***NPTEL for Credit transfer**: Students can take 12 weeks NPTEL course as an equivalent to a Program elective. The NPTEL courses of duration less than 12 weeks will not be considered for credit transfer. The courses (only technical) taken are as per the recommendation of BOS of respective department. The similarity of the contents as offered by NPTEL should not exceed a maximum of 40% of the courses being registered by the student. The NPTEL course needs to be completed before the registration of the elective. Any certificate obtained after the registration of elective would not be considered. The validity of NPTEL certificate is for two years and it cannot be used more than once to avail the benefit. The student is eligible to transfer a maximum of nine credits in the entire duration of the program. The grades will be awarded as equivalent to the grades obtained in the NPTEL course.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER-VII

DEEP LEARNING FOR COMPUTER VISION

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**22ADS71**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**2:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): Image Processing & Deep Learning

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To impart the fundamentals of image formation, the major ideas, methods, andtechniques of computer vision and pattern recognition
2	To understand the workings of Generative AI and the diffusion models.
3	To develop an appreciation for various techniques of Computer Vision for Object detection and Face Recognition systems
4	To provide the student with programming experience from implementing computervision and object recognition applications.

Module 1	No. of Hours	RBT Level
Introduction to Computer Vision Basic concepts: pixel representation of an image, Image in frequency domain, different color models, and their transformation, Filtering and Convolution, Image preprocessing using PIL/Pillow, OpenCV, and Keras: reading multiple images from a directory, plotting, enhancement,filtering, re-scaling, morphological operations and image data augmentation.	**8**	**L2**
Module 2		
Object Detection Basic concepts: bounding box representation, sliding window methods, anchorboxes, grid cells, and non-maximum suppression (NMS). State-of-the-artarchitectures: R-CNN and YOLO. Evaluation metrics: Intersection over Union (IoU) and Mean Average Precision (mAP), Practical use case.	**10**	**L3**
Module 3		
Generative AI Models Introduction to Gen AI, Types, Variational Autoencoders and GANs (Variations of GANs – cGAN, wGAN, cyclic GAN, style tranfers using GAN), difference between VAEs & GANs, Image Captioning – LSTMs based, Transformers based.	**12**	**L3**
Module 4		
Normalizing Flows and Diffusion Models Diffusion process, Forward Diffusion, Reverse Diffusion, Training a diffusion model, Architecture, Guided Diffusion, Stable diffusion, Sampling Procedure, Practical Implementation.	**12**	**L3**
Module 5		
Face Recognition Deep learning for face recognition: face detection in photographs, face identification & verification using VGGFace2, and face classification using FaceNet. Practical use case. Challenges: privacy and ethical considerations, variability in pose, expression, lightning, and occlusion.	**8**	**L3**

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1	Understand the basic concepts, terminology, theories, models, and methods in the field of computer vision.
CO2	Apply Generative AI for text and image applications.
CO3	Apply diffusion models to understand the working of removal of noise.
CO4	Apply state-of-the-art architectures such as R-CNN and YOLO for object detection.
CO5	Demonstrate the face recognition concepts in detecting the photography, face identification, face classification.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	3	2					3	2	3	
CO2	2	2	2	3	3	2					3	2	3	
CO3	3	2	3	3	3	2			3		3	2	2	
CO4	3	2	3	3	3	2			3		3	2	3	
CO5	3	3	3	3	3	3			3		3	2	2	
Average	3	2	3	3	3	2			3		3	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Deep learning for Computer Vision by Jason Brownlee.

Reference Books:

1. Internet source.

E-Books / Web References:

1) https://analyticsindiamag.com/optimisation-machine-learning-methods-gradient-descent/
2) https://serokell.io/blog/ml-optimization
3) https://machinelearningmastery.com/why-optimization-is-important-in-machine-learning/

MOOCs:

1. Deep Learning specialization in Coursera.
2. https://nptel.ac.in/courses/106106184
3. https://www.udemy.com/topic/deep-learning/

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances individual faculty's autonomy (freedom and flexibility) and enablesthem to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problemsolving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Quiz 1 / AAT	05	
Quiz 2 / AAT	05	

Note: The CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VII

ADVANCED DATA VISUALIZATION

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**22ADS72**	**SEE Marks;**	**50**
Hours/Week (L: T: P):	**3:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To introduce students to the fundamental problems, concepts and approaches in the design and analysis of data visualization using the most widely used visualization tools such as Tableau and PowerBI.
2	To familiarize students with the understanding of the features and rich capabilities provided by visualization tools and build the required skillset that are required in the current and future industry.
3	To familiarize students with the stages of data modelling, visualization pipeline and evaluating the effectiveness of visualizations for specific data, task.
4	Provide an overview and develop an advanced level of competency in the use of Power BI and Tableau that can be used for data visualization.
5	Facilitate project-based opportunities to identify, understand, analyze, prepare, and present effective visualizations on a variety of data.

Module 1	No. of Hours	RBT Level
Data Modelling in Tableau: Performing Data Analysis on a relational model, Building Relationships in Tableau, working on creating calculated fields, Building Visualizations using related data, Performing a case study on a set of related data. Filtering at a large scale using calculated fields and nested CASE statements. Table summary statistics – show percentage of values down and across the table. Dynamic population of Rows and columns with Parameterization. Students will Perform analysis on various datasets to understand the above concepts.	**10**	**L3**
Module 2		
Level of Details Expression (LOD) fundamentals: FIXED, INCLUDE and EXCLUDE LODs and their application to solve complex problems, multiple examples of how to use these LODs in different scenarios. Complex data Analysis using LODs and nested LODs. Ranking at multiple levels, Bringing Data on a dual Axis, Creating moving averages chart.	**12**	**L3**

Reference bands and distribution bands with parameterization. Students will Perform analysis on various datasets to understand the above concepts.		
Module 3		
Machine Learning using Tableau/Python: Installation of TabPy server. Connecting between Tableau and Python using TapPy. Passing Data from Tableau to Python, Simple and Multiple Linear regression in Tableau using TabPy server. Passing Data from Tableau to Python for Classification examples, executing Naïve Bayes, Random Forest, Decision Tree using, SVM etc. from Tableau through TabPy Server. Clustering. Dashboard creation and Fundamentals. Tableau Prep Builder Basics. Students will Perform analysis on various datasets to understand the above concepts.	**10**	**L3**
Module 4		
Importing Data into PowerBI: Creation of Various charts – Stacked Bar chart, stacked column chart, clustered column chart, Area chart, stacked area chart, Line and stacked column chart etc. Build Visual, Format Page. Sort and Filters, Slicing, Simple and multi-level Ranking. Data Modelling in PowerBI, Performing Data Analysis on a relational Model, Create Model Relationships, Building Visualizations using related data from the data Model. Students will Perform analysis on various datasets to understand the above concepts.	**10**	**L3**
Module 5		
The language of Power BI - Data Analysis Expressions (DAX) Engine Basics: Aggregate functions – AVERAGE, AVERAGEX, AVERAGEA, COUNT, COUNTA, COUNTX, MAX, MAXA, MAXX, MIN, MINA, MINX, SUM, SUMA, SUMX. Date Functions – DATE, DAY, MONTH, YEAR, DATEDIFF Filter Functions – ALL, ALLEXCEPT, ALLSELECTED, CALCULATE, CALCULATETABLE, KEEPFILTERS, SELECTEDVALUE Table Manipulation functions – ADDCOLUMNS, CROSSJOIN, CURRENTGROUP, DATATABLE, GENERATE, GENERATEALL, GROUPBY, NATURALJOIN, NATURALOUTERJOIN, SELECTCOLUMNS, SUMMARIZE, SUMARIZECOLUMNS, TOPN, VALUES DAX statements – DEFINE, EVALUATE, ORDER BY, VAR Creating Measures, Calculated Columns and Tables. Problem solving Techniques using Measures and Calculated columns and Tables using above functions. Dashboard creation. Students will Perform analysis on various datasets to understand the above concepts.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Develop insight on the fundamentals and various design techniques for effective Data Visualization.
CO2	Learn ways to create dashboards as well as story points to develop a strong, powerful data story.
CO3	Learn ways and methods to analyze and apply design principles to Tableau visualization.
CO4	Acquaint themselves with various functions available in Advanced Tableau, Power BI tools.
CO5	Familiarize themselves well with current trends in Data Visualization through relevant case studies.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3		2	2			2		2	2	3	3
CO2	2	1	2		2	2			2		3	2	3	2
CO3	1	2	3		3	2			2		2	2	3	2
CO4	2	1	3		3	2			2		3	2	3	3
CO5	2	1	3		3	2			2		3	2	3	3
Average	2	1	3		3	2			2		3	2	3	3

High-3: Medium-2: Low-1

Text Books:

1) Tableau 10 Business Intelligence Cookbook Book – Donabel Santos, Packt Publishing, 2016
2) The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts, and Figures, Dona M. Wong, W. W. Norton & Company.
3) Power BI – Jack Hyman (Free online pdf available)

Reference Books:

1. Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, Stephen Few, O'Reilly Media, 2013
2. Show Me the Numbers: Designing Tables and Graphs to Enlighten, Stephen Few, Analytics Press, 2004
3. Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics, Nathan Yau, Wiley, 2011
4. Now You See It, Stephen Few, Analytics Press, 2009
5. The Visual Display of Quantitative Information, Edward Tufte, Graphics Press, 2nd Edition, 2001
6. Data Analysis with Microsoft Power BI 1st edition – Brian Larson

Books / Web References:

1. Data Visualization and Exploration with R A Practical Guide to Using R RStudio and Tidyverse for Data Visualization Exploration and Data Science Applications: https://www.pdfdrive.com/data-visualization-and-exploration-with-r-a-practical-guide-to-using-r-rstudio-and-tidyverse-for-data-visualization-exploration-and-data-science-applications-d176184240.html
2. Beginning Data Science in R: Data Analysis, Visualization, and Modelling for the Data Scientist: https://www.pdfdrive.com/beginning-data-science-in-r-data-analysis-visualization-and-modelling-for-the-data-scientist-d181093942.html
3. Micrsoft Power BI Cookbook – Brett Powell, Packt Publishing, 2017 (Free online PDF download available)
4. Microsoft PowerBI web reference – learn.microsoft.com/en-us/dax (Best reference manual)

MOOCs:

1. https://www.coursera.org/learn/datavisualization
2. https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11
3. https://www.edx.org/course/data-visualization-for-all
4. https://www.udemy.com/course/the-complete-data-visualization-course/

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VII

NATURAL LANGUAGE PROCESSING

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**22ADS73**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**IPC**	**Credits:**	**04**

Prerequisites (if any): Machine Learning and Deep Learning

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To learn the fundamentals of natural language processing.
2	To understand the working of Language based models and apply word embedding algorithms.
3	To understand the role of semantics of sentences and pragmatics and apply them in NER.
4	To perform sentiment analysis and text classification.
5	Facilitate project-based opportunities under machine translation, dialog systems and ethical considerations in NLP.

Module 1	No. of Hours	RBT Level
Introduction to NLP and Text Processing: Definition and scope of NLP, Historical overview and milestones in NLP, Components of NLP, NLP applications, Phases of NLP, Tokenization, Stemming, Lemmatization, Stop word removal, Zipf's law, Punctuation handling, Text normalization, Case conversion	**10**	**L2**
Module 2		
Language Modeling: Bag of Words, Bag of N-grams, TF-IDF, Hashing with HashingVectorizer, Split words, Encoding with one_hot, Hash encoding, N-gram models and language probability **Word embeddings:** Word2Vec, Training word embeddings, Applications of word embeddings, Word embedding algorithms, CBOW, Skip-Gram, GloVe, reuse an embedding, Gensim Python Library, Plot word vectors using PCA	**10**	**L3**
Module 3		
Syntax, Parsing: Part-of-speech tagging, Dependency parsing and constituency parsing, Parsing algorithms and techniques **Named Entity Recognition:** Introduction to NER, NER techniques and tools, Applications of NER in information extraction	**10**	**L3**
Module 4		
Applied NLP: Classical NLP pipeline, Sentiment analysis applications in social media and reviews, Text classification methods, Interpreting Text Classification models, Text summarization.	**10**	**L3**

Module 5		
Machine Translation and Dialog Systems: Introduction to machine translation, Statistical and neural machine translation, Types of dialog systems, Introduction to chatbots and virtual assistants **NLP Ethics and Bias:** Ethical considerations, Fairness, Accountability, Multilingual NLP	**10**	**L3**

Prog. No.	Lab Programs	No. of Hours / RBT levels
1	Write a Python program to demonstrate Lemmatization and Stemming.	**02/L3**
2	Write a program to implement TF-IDF technique and demonstrate Word2vec embedding.	**02/L3**
3	Write a program for implementing POS tagging and Named Entity Recognition using NLTK.	**02/L3**
4	Write a program for spam detection using NLTK.	**02/L3**
5	Write a program to demonstrate Neural machine translation with attention.	**02/L3**
6	Write a program to build an NLP classifier which can use input text parameters to determine the label/s of the blog.	**02/L3**
7	Write a program to design and test a sequential model that analyses the customer's sentiments based on their reviews in the IMDB database.	**02/L3**
8	Write a program to implement transfer learning, paraphrasing from iNLTK.	**02/L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO 1	Understand NLP foundations, text processing techniques, and practical applications.
CO 2	Apply diverse language models, embeddings; adapt in practical applications.
CO 3	Implement tagging, parsing, Named Entity Recognition techniques.
CO 4	Perform classical NLP, sentiment analysis, text classification, and summarization.
CO 5	Obtain competence in machine translation, dialog systems, and ethical NLP practices.

CO / PO Mapping														
CO /PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	1	2	3	3					3	2	
CO2	3	2	2	2	2	3	3					3	3	
CO3	3	2	3	1	2	3	2					3	3	
CO4	3	2	2	2	2	3	3					3	2	
CO5	3	2	2	2	2	3	2					3	3	
Average	3	2	2	2	2	3	3					3	3	

High-3: Medium-2: Low-1

Text Books:

1. Deep Learning for Natural Language Processing - Jason Brownlee, 2018.
2. Practical Natural Language Processing - Sowmya Vajjala, Bodhisattwa Majumder, O'Reilly, 2020.
3. Foundations of Statistical Natural Language Processing - Christopher D. Manning, The MIT Press, 2000.

Reference Books:

1. Natural Language Processing with Python - Steven Bird, Ewan Klein, and Edward Loper, O'Reilly, 2009.
2. Speech and Language Processing - Daniel Jurafsky, James H. Martin, 2023.

E-Books / Web References:

1. Natural Language Processing in Action - Hobson Lane, Cole Howard, and Hannes Max. file:///C:/Users/Admin/Downloads/Natural%20Language%20Processing%20in%20Action_%20Understanding,%20analyzing,%20and%20generating%20text%20with%20Python%20(%20PDFDrive%20).pdf

MOOCs:

1. https://www.udemy.com/course/data-science-natural-language-processing-in-python/
2. https://www.coursera.org/specializations/natural-language-processing

Scheme of Evaluation: (Integrated courses)

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reduced to 50. There will be two full questions (with a maximum of four sub questions) from each module carrying 20 marks each. Students are required to answer any **five full questions** choosing at least **one full question from each module.**

The laboratory assessment would be restricted to only the CIE evaluation.

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. The average of the three tests are taken for computation of CIE on a scale of 30, the CIE would also include laboratory evaluation for 20 marks. The laboratory marks of 20 would comprise of 10 marks for regular laboratory assessment to include lab record and observation. 10 marks would be exclusive for laboratory internal assessment test to be conducted at the end of the semester.

Typical Evaluation pattern for integrated courses is shown in the Table below

Table: Distribution of weightage for CIE & SEE of Integrated courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**30**	**50**
	CIE Test-2	**30**	
	CIE Test-3	**30**	
	Laboratory	**20**	
SEE	Semester End Examination	**100**	**50**
		Grand Total	**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VII

CLOUD COMPUTING

Program Elective 3

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**22ADS741**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	To understand the fundamental ideas behind cloud computing, evolution of the paradigm,its applicability, benefits and challenges.
2	Discuss virtualization and outline their role in enabling the cloud computing system model and different platforms in regard to industry relevance.
3	Illustrate the security aspects for building cloud based applications and outline theapplications of cloud in various industries.

Module 1	No. of Hours	RBT Level
Introduction: Introduction to cloud computing, History of cloud computing, Characteristics and Benefits, Challenges Ahead, Types of clouds: (Public cloud, private cloud and hybrid cloud), Economics of cloud, Building Cloud Computing platforms and technologies.	**08**	**L2**
Module 2		
Virtualization: Introduction to Virtualization, Characteristics of Virtualization, Taxonomy of Virtualization techniques, Types of Virtualization Techniques, Pros and Cons of Virtualization, Technology examples Xen: Paravirtualization, VMware: Full Virtualization.	**08**	**L2**
Module 3		
Cloud Computing Architecture: Introduction, cloud reference model, cloud computing services: Infrastructure as a service (IAAS), Platform as a service (PAAS) and Software as a service (SAAS), Aneka framework overview, Anatomy of the Aneka Container, Building Aneka clouds, Cloud Programming and Management, Open source platforms for private clouds.	**08**	**L3**
Module 4		
Cloud Security: Operating System (OS) Security, Virtual Machine (VM) Security, Security risks posed by shared images, ethical issues. **Cloud Platforms**: Amazon Web Services (AWS) - Compute services, Storage services, Communication services, Microsoft Azure- Azure concepts, SQL Azure.	**08**	**L3**
Module 5		
Cloud Applications: Scientific Applications: Healthcare: ECG analysis in the cloud, Biology: Gene expressions data analysis for cancer diagnosis. **Business and Consumer Applications:** Social Networking, media applications and multiplayer online gaming.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the core concepts of cloud computing paradigm and Describe the various cloud computing platforms.
CO2	Outline the various virtualization technologies and Illustrate a virtual instance usingvirtualization.
CO3	Explain the architecture, infrastructure and deployment models of cloud computing.
CO4	Understand the security aspects of cloud and Identify the platforms for development ofcloud applications.
CO5	Obtain an insight on applications of cloud and Develop a project for the applications

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3						1					3		
CO2	3	2	3									3	2	
CO3	3	2	2		1		1					3	3	
CO4	3	3	3		2	1						3	3	
CO5	3	3	3		2	1	1					3	3	
Average	3	2	3		2	1	1					3	3	

High-3: Medium-2: Low-1

Text Books:

1. Rajkumar Buyya, Christian Vecchiola and Thamrai Selvi Mastering Cloud Computing McGraw Hill Education.
2. Dan C Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elseveir 2013.

Reference Books:

1. Logic Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.
2. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the cloud, O'Reilly Publication.
3. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

E-Books / Web References:

1. Mastering Cloud Computing : https://dokumen.pub/download/mastering- cloud computing9781259029950.html
2. Cloud Computing Theory and Practice https://eclass.uoa.gr/modules/document/file.php/D416/CloudComputingTh eoryAndPractice.pdf

MOOCs:

1. https://www.udemy.com/course/cloudintro/
2. https://www.coursera.org/learn/cloud-computing-foundations-duke

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouragedto use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	20	50
CIE TEST 2	20	
Quiz 1 / AAT	05	
Quiz 2 / AAT	05	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VII

CYBER SECURITY

Program Elective 3

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**22ADS742**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): None

Prerequisites (if any): Basics of Computer Networks.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand various types of cyber-attacks and cyber-crimes
2	To learn threats and risks within context of the cyber security
3	To have an overview of the cyber laws & concepts of cyber forensics
4	To study the defensive techniques against these attacks

Module 1	No. of Hours	RBT Level
Understanding Cyber Crime: Cyber Security–the need of the hour, impact of internet, CIA triad, Reasons for cybercrime, Cyber Terrorism, Classification of cybercrimes, Cyber Criminals, Types of Cybercrimes,	**8**	**L2**
Module 2		
Cyber Crime in Devices: Introduction, Proliferation of mobile and wireless devices, Credit card fraud in the mobility era, Challenges posed by mobile devices, Registry settings, Attacks on mobile/cell phones, Security implications and Measures for organizations in handling mobile devices, Organizational security policies and measures in mobile computing era, Laptops	**8**	**L2**
Module 3		
Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics	**8**	**L2**
Module 4		
Tools and method used in Cybercrime: Introduction, proxy servers and Anonymizers, Phishing, Password cracking, Keyloggers and spywares, virus and worms, Trojan Horses and back doors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer overflow	**8**	**L2**

Module 5		
Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc. **Cybercrime: Examples and Mini-Cases:** The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.	**8**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Describe cybercrime, its classifications and various types of Cyber attacks
CO2	Describe the organizational methods and policies for cyber-crime handling in mobile and wireless devices
CO3	Understand Cyber Security Regulations and Roles of International Law and Learn, analyze and validate Forensics Data
CO4	Distinguish the different tools and methods used in cybercrime and discuss the impact of Phishing
CO5	Apply policies and procedures to manage Privacy issues

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	1	1				1		1		1		1
CO2	2	2	1	1				1		1		1		1
CO3	2	2	1	1				1		1		1		1
CO4	2	2	1	1				1		1		1		1
CO5	2	2	1	1				1		1		1		1
Average	2	2	1	1				1		1		1		1

High-3: Medium-2: Low-1

Text Books:

1. Sunith Belapure and Nina Godbole, "Cyber Security: Understanding Cyber crime, computer forensics and legal perspectives", Wiley India, 2013.
2. Anand Shinde, "Introduction to Cyber Security: Guide to the world of cyber security", Notion Press, 2021.

Reference Books:

1. Marjie T Britz, "Computer Forensics and Cyber Crime - An Introduction", Pearson Education, 2nd Edition, 2012.
2. Harish Cahnder, "Cyber Laws and IT Protection", PHI, 2012.
3. Thomas JMoubray, "Cyber Security: Managing Systems, Conducting Testing and Investigating Inrusions", John Wiley, 2014.
4. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi,

MOOCs:

1. https://www.cyberdegrees.org/
2. https://www.udemy.com/course/the-complete-internet-security-privacy-course-volume-1/E-Books /

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Assignment	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respectiveBoard of Studies and can be given here.

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

NEURAL NETWORKS & DEEP LEARNING

Open Elective 2

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**22ADS751**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**OEC**	**Credits:**	**03**

Prerequisites (if any): Machine Learning I and Machine Learning II

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To impart hands-on knowledge on Advanced Machine Learning Topics.
2	Provide in-depth coverage of Data Augmentation and Convolutions.
3	Impart application of Deep Learning techniques like CNN and RNN.
4	Exposure to unsupervised feature engineering techniques

Module 1	No. of Hours	RBT Level
Introduction: Understanding the Biological Neurons, Exploring the Artificial Neurons (Perceptron), Perceptron learning rule, Examples on single layer perceptron, Process of designing a Neural Networks (Architecture), Types of Activation Functions, derivative of activation functions. Multilayer perceptron (Mathematics Behind Back propagation, Deep L layer Neural Network, Understanding the notion of forward and backward propagation), Optimization algorithms in NN, Loss functions, Dropout, Implementation of ANN.	**10**	**L2**
Module 2		
Convolutional Neural Networks: Mathematics behind CNN, Layers, Architectures of CNN, ILSVRC winner architectures, Implementation of CNN, Building the model from the scratch	**10**	**L3**
Module 3		
Introduction: Gradient based approaches, Visualizing gradients, Saliency map,Class Model, SmoothGRAD, DeConvolution, Guided Back Propagation Grad-CAM, Occlusion sensitivity	**10**	**L3**
Module 4		
Recurrent Neural Networks Types of RNN, Challenges in training RNN: Exploding and Vanishing Gradients, Networks with Memory **Long Short-Term Memory (LSTM)** Gated Recurrent Unit (GRU), Sequence Learning Architectures, Sequence Learning with one RNN Layer, Sequence Learning with multiple RNN Layers Implementation example using Keras in Python: sentiment analysis	**10**	**L3**
Module 5		
Other Deep Learning Architectures: Encoder-Decoder Architecture, Attention Mechanism, Transformer Architecture, Generative Adversarial Networks, Unet.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand the fundamental concepts in the neural networks.
CO2	Apply deep neural models to various learning problems.
CO3	Develop insight behind the theory of deep learning methods (CNN, RNN, etc.).
CO4	Design Deep Learning Methods for working with sequential data.
CO5	Develop GAN to generate more images to solve the problems on less data.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	3	2					3	2	3	
CO2	2	2	2	3	3	2					3	2	3	
CO3	3	2	3	3	3	2			3		3	2	2	
CO4	3	2	3	3	3	2			3		3	2	3	
CO5	3	3	3	3	3	3			3		3	2	2	
Average	3	2	3	3	3	2			3		3	2	3	

High-3: Medium-2: Low-1

Text Books:

1. Deep learning – Amit Kumar Das, Saptarsi Goswami, Pabitra Mitra, Amlan, 1st Edition, Pearson.
2. Deep learning- Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville, MIT Press,2015

Reference Books:

1. Neural Networks: A Systematic Introduction, Raúl Rojas, Springer.
2. Pattern Recognition and Machine Learning, Bishop C, Springer, 2006

E-Books / Web References:

1) https://cs231n.github.io/convolutional-networks/
2) https://github.com/terryum/awesome-deep-learning-papershttps://project.inria.fr/deeplearning/files/2016/05/deepLearning.pdf

MOOCs:

1. Deep Learning specialization in Coursera.
2. https://nptel.ac.in/courses/106106184
3. https://www.udemy.com/topic/deep-learning/

Scheme of Examination (CIE):

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Table 1: CIE Evaluation		
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CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Assignment	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respectiveBoard of Studies and can be given here.

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

DATA VISUALIZATION TOOLS

Open Elective 2

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**22ADS752**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**OEC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives:

Sl.No	Course Learning Objectives (CLO)
1	Provide an overview of the good practice of data visualization.
2	Introduce students to the key design principles and techniques for visualizing data.
3	Learn how to navigate Tableau and connect to data sources, leverage drag-and-drop interface to create impactful visualizations.
4	Provide an overview and develop an introductory level of competency on the use of Power BI that can be used for data visualization.
5	Facilitate project-based opportunities to identify, understand, analyze, prepare, and present effective visualizations on a variety of data.

Module 1	No. of Hours	RBT Level
Data Visualization: Introduction to the Art and Science of Data Visualization, Whatis Data Visualization and why does it matter? Why Use Data Visualization? Brief History of Data Visualization, Data Visualization Tools, Pros and cons of Data Visualization. **Design Fundamentals:** Design Principles, Colors, and "Chart Junk", The Shaffer 4C's of Data Visualization, Best practices (examples).	**10**	**L3**
Module 2		
Storytelling with Data: Creating a good data set for analysis, Selecting data for yourKPIs, Approaches to storytelling with data, Dashboards vs. Storyboards vs. Infographics, The Duell Rules for Actionable Visualizations. **Tableau:** What is Tableau? History of Tableau, Advantages and disadvantages of Tableau, Tableau architecture, Tableau Public and Tableau Desktop, Workspace, Connecting to data source, Files and folders, Tableau navigation, Terminologies, Data types, Data roles, Data aggregation, File types.	**10**	**L3**
Module 3		
Data connection: Extracting data, Joining, Blending, Splits, Sorting, Fieldsoperations. **Tableau calculations:** Operators, Functions, Numeric, string, date, table calculations, Level of Details expressions.	**10**	**L3**

Module 4		
Sort and filter: Basic filters, Filter operations, Extract filters, Quick filters, Contextfilters, Condition filters, Data source filters, Top filters, Build groups, hierarchy, sets. **Charts:** Bar, Line, Pie, Crosstab, Bubble, Bullet, Area, Pareto, Bump chart, Gantt chart, Histogram, Motion charts, Waterfall charts. Plots: Scatter, Boxplot. Maps: Heat map, Tree map.	**10**	**L3**
Module 5		
Advanced Tableau: Dashboard, Formatting, Forecasting, Trend Lines. **Power BI:** Introduction, Architecture, Tableau vs Power BI, Data modelling,Dashboard, Visualization options, Data Analysis Expressions.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Develop insight on the fundamentals and various design techniques for effective Data Visualization.
CO2	Learn ways to create dashboards as well as story points to develop a strong, powerful data story.
CO3	Learn ways and methods to analyze and apply design principles to Tableau visualization.
CO4	Acquaint themselves with various functions available in Advanced Tableau, Power BI tools.
CO5	Familiarize themselves well with current trends in Data Visualization through relevant case studies.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3		2	2			2		2	2	3	3
CO2	2	1	2		2	2			2		3	2	3	2
CO3	1	2	3		3	2			2		2	2	3	2
CO4	2	1	3		3	2			2		3	2	3	3
CO5	2	1	3		3	2			2		3	2	3	3
Average	2	1	3		3	2			2		3	2	3	3

High-3: Medium-2: Low-1

Text Books:

1) Tableau 10 Business Intelligence Cookbook Book – Donabel Santos, Packt Publishing, 2016
2) The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of PresentingData, Facts, and Figures, Dona M. Wong, W. W. Norton & Company,

Reference Books:

1. Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, Stephen Few,O'Reilly Media, 2013
2. Show Me the Numbers: Designing Tables and Graphs to Enlighten, Stephen Few, AnalyticsPress, 2004
3. Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics, Nathan Yau,Wiley, 2011
4. Now You See It, Stephen Few, Analytics Press, 2009
5. The Visual Display of Quantitative Information, Edward Tufte, Graphics Press, 2nd Edition,2001

Books / Web References:

1. Data Visualization and Exploration with R A Practical Guide to Using R RStudioand Tidyverse for Data Visualization Exploration and Data Science Applications:https://www.pdfdrive.com/data-visualization-and-exploration-with-r-a-practical-guide-to-using-r-rstudio-and-tidyverse-for-data-visualization-exploration-and- data-science-applications-d176184240.html
2. Beginning Data Science in R: Data Analysis, Visualization, and Modelling for the Data Scientist: https://www.pdfdrive.com/beginning-data-science-in-r-data- analysis-visualization-and-modelling-for-the-data-scientist-d181093942.html

MOOCs:

2. https://www.coursera.org/learn/datavisualization
3. https://freevideolectures.com/course/4041/nptel-introduction-to-learning-analytics/11
4. https://www.edx.org/course/data-visualization-for-all
5. https://www.udemy.com/course/the-complete-data-visualization-course/

Scheme of Examination (CIE):

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- Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE 1	40	50
CIE 2	40	
CIE 3	40	
Assignment	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respectiveBoard of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.
- The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VII

PROJECT PHASE 1

Semester:	**07**	**CIE Marks:**	**100**
Course Code:	**22ADSP76**	**SEE Marks:**	**-**
Hours/Week (L: T: P):	**2Hous/Week**	**Duration of SEE (hours):**	**-**
Type of Course:	**MP**	**Credits:**	**02**

Content
Project work phase - 1: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6. **CIE procedure for Project Work Phase - 1:** **a. Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology) using Rubrics, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the Project report shall be the same for all the batch mates. **b. Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates as per Rubrics covering all Program Outcomes.

Table 1: Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
	Review-2		
SEE	Semester End Examination	--	--
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VIII

LARGE LANGUAGE MODELS

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**22ADS81**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**4:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

Prerequisites (if any): Natural Language Processing

Course Learning Objectives: The students will be abler to:

Sl. No	Course Learning Objectives (CLO)
1	To learn the fundamentals of LLMs.
2	To understand the scutting-edge research topics centering around pre-trained language models
3	To understand the technical foundations (BERT, GPT, T5 models, mixture-of-expert models, retrieval-based models), emerging capabilities (knowledge, reasoning, few-shot learning, in-context learning), fine-tuning and adaptation, system design, as well as security and ethics.

Module 1	No. of Hours	RBT Level
Introduction to LLMs-What are LLMs? BERT: Deep contextualized word representations (ELMo), Improving Language Understanding by Generative Pre-Training (OpenAI GPT), **T5(Encoer-decoder models)** Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer **GPT-3 (decoder-only models):** Language Models are Unsupervised Multitask Learners (GPT-2), PaLM: Scaling Language Modeling with Pathways	**10**	**L2**
Module 2		
How to use and adapt LLMs? **Prompting for few-shot learning:** Exploiting Cloze Questions for Few Shot Text Classification and Natural Language Inference, True Few-Shot Learning with Language Models. **Prompting as parameter-efficient fine-tuning :** Prefix-Tuning: Optimizing Continuous Prompts for Generation, Factual Probing Is [MASK]: Learning vs. Learning to Recall, P-Tuning v2: Prompt Tuning Can Be Comparable to Fine-tuning Universally Across Scales and Tasks , LoRA: Low-Rank Adaptation of Large Language Models, Towards a Unified View of Parameter-Efficient Transfer Learning	**10**	**L2**
Module 3		
How to use and adapt LLMs? Continued In-context learning: What Makes Good In-Context Examples for GPT-3? Fantastically Ordered Prompts and Where to Find Them: Overcoming Few-Shot Prompt Order Sensitivity, Data Distributional Properties Drive Emergent In-Context Learning in Transformers Calibration of prompting LLMs: Noisy Channel Language Model Prompting for Few-Shot Text Classification, How Can We Know When Language Models Know? On the Calibration of Language Models for Question Answering **Reasoning:** Chain of Thought Prompting Elicits Reasoning in Large Language Models **Knowledge:** Language Models as Knowledge Bases?	**10**	**L2**

Module 4		
Dissecting LLMs: **Data: The Pile:** An 800GB Dataset of Diverse Text for Language Modeling, Deduplicating Training Data Makes Language Models Better **Model Scaling:** Scaling Laws for Neural Language Models, Scale Efficiently: Insights from Pre-training and Fine-tuning Transformers **Risks :** Quantifying Memorization Across Neural Language Models, Deduplicating Training Data Mitigates Privacy Risks in Language Models, RealToxicityPrompts: Evaluating Neural Toxic Degeneration in Language Models, Self-Diagnosis and Self-Debiasing: A Proposal for Reducing Corpus-Based Bias in NLP.	**10**	**L2**
Module 5		
Beyond Current LLMs: Models and Applications : Sparse models, Retrieval-based LMs, Training LMs with human feedback, Code LMs, Multimodal LMs.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Understand fundamentals of LLMs.
CO2	Apply LLM and adapt LLMs in practical applications.
CO3	Perform Dissection of LLMs in terms of Data, Model Scaling and Risks.
CO4	Understand the different Models and Applications of LLMs

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO-10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	1	2	2	3					3	2	
CO2	3	2	2	1	2	2	3					3	3	
CO3	3	2	2	1	2	2	3					3	3	
CO4	3	2	2	1	2	2	3					3	3	
Average	3	2	2	1	2	2	3					3	3	1

High-3: Medium-2: Low-1

Text Books:

1) J & M, slp3 is an NLP textbook
2) On the Opportunities and Risks of Foundation Models - (published by Stanford researchers in July 2021) surveys a range of topics on foundational models (large langauge models are a large part of them).
3) A Primer in BERTology: What we know about how BERT works provides an excellent overview of what we understand about BERT (last update: Nov 2020).

E-Books / Web References:

- https://www.cs.princeton.edu/courses/archive/fall22/cos597G/

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation

Components	Marks	Total
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 2	40	
Quiz 1 / AAT	05	
Quiz 2 / AAT	05	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VIII

PREDICTIVE AND TIME SERIES ANALYSIS

Program Elective 4

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**22ADS821**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): Foundations of Data Science

]Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand the estimation and handling of time series data
2	To study the concept of forecasting on time series data.
3	To get exposure to predictive modelling.

Module 1	No. of Hours	RBT Level
Introduction to Time Series and Trend: **Time Series:** Introduction to times series data, Application of time series from various fields, Components of a time series, Decomposition of time series. **Trend:** Estimation of trend by free hand curve method, Method of semi averages, Fitting a various mathematical curve, and growth curves.	**8**	**L2**
Module 2		
Estimation of Trend and Seasonal Component: **Estimation of Trend:** Method of moving averages, Detrending, Effect of elimination of trend on other components of the time series. **Seasonal Component:** Estimation of seasonal component by Method of simple averages, Ratio to Trend, Ratio to moving average and Link relatives.	**8**	**L2**
Module 3		
Forecasting: **Stationary Time series:** Variate component method, Weak stationary, auto correlation function and correlogram of moving average. **Forecasting:** Exponential smoothing methods, Short-term forecasting methods: Brown's discounted regression, Box-Jenkins Method	**8**	**L2**
Module 4		
Overview of Predictive Analytics: Core ideas in data mining, Supervised and unsupervised learning, Classification vs Prediction, Steps in data mining, SEMMA Approach, Sampling, Pre-processing, Data cleaning, Data Partitioning, Building a model, Statistical models for predictive analytics.	**8**	**L2**
Module 5		
Implementation of Predictive Analytics: Data splitting, Balancing, Overfitting, Oversampling, Multiple Regression, Artificial neural networks (MLP), Variable importance, Profit/loss/prior probabilities, Model specification, Model selection, Multivariate Analysis.	**8**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Obtain an overview of trend surrounding time series data.
CO2	Illustrate the estimation of trend and seasonal component
CO3	Understand and apply forecasting on time series data
CO4	Obtain a good fundamental knowledge of Predictive Analysis
CO5	Implement Predictive Analysis by understanding the underlying principles.

CO / PO Mapping														
CO / PO	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**
CO1	3	2	2	1	-	-	-	2	1	-	1	2	1	1
CO2	3	2	2	1	-	-	-	2	2	-	2	2	2	1
CO3	3	2	2	1	-	-	-	2	1	-	3	2	1	1
CO4	3	2	2	1	-	-	-	2	2	-	2	2	1	1
CO5	3	2	2	1	-	-	-	2	2	-	3	2	2	1
Average	3	2	2	1				2	2		2	2	2	1

High-3: Medium-2: Low-1

Text Books:

4) Hamilton, James D. *Time series analysis*. Princeton university press, 2020.
5) Montgomery, Douglas C., Cheryl L. Jennings, and Murat Kulahci. *Introduction to time series analysis and forecasting*. John Wiley & Sons, 2015.
6) Larose, Daniel T. *Data mining and predictive analytics*. John Wiley & Sons, 2015.

Reference Books:

1) Siegel, Eric. *Predictive analytics: The power to predict who will click, buy, lie, or die*. John Wiley & Sons, 2013.
2) Carlberg, Conrad. *Predictive Analytics: Microsoft® Excel 2016*. Que Publishing, 2017.
3) Howard, Jeremy, Margit Zwemer, and Mike Loukides. *Designing great data products*. " O'Reilly Media, Inc.", 2012.
4) Bisgaard, Søren, and Murat Kulahci. *Time series analysis and forecasting by example*. John Wiley & Sons, 2011.

E-Books / Web References:

1) NPTEL Lecture: Applied Time Series Analysis: https://onlinecourses.nptel.ac.in/noc21_ch28/preview

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation

Components	Marks	Total
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 2	40	
Quiz 1 / AAT	05	
Quiz 2 / AAT	05	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - VIII

EXPLAINABLE ARTIFICIAL INTELLIGENCE

Program Elective 4

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**22ADS822**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 0: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites: Machine/Deep Learning

Course Learning Objectives: The course will enable students to:

1	Understand the importance of explainability in AI systems.
2	Know the difference between ML, Interpretable ML, and Explainable AI.
3	Learn methods to achieve explainability.
4	Become conversant with the types of explanations for different kinds of datasets.
5	Apply and practice the knowledge by solving real-time problems.

CONTENTS	No. of Hours	RBT Levels
Module 1		
Introduction: What is model explainability, why explainability and why not? Principles of XAI, Features of XAI, Types of explainability, Stages of explainabality, Evaluation Methods and Metrics for XAI, Properties of Explanations, Difference between Interpretability and Explainability, Demonstration of by Design Interpretable Models: Glass Box.	**08**	**L2**
Module 2		
Model-agnostic methods: Partial Dependance Plot, Individual Condition Expectation, Accumulated Local Effects Plots, Feature Interaction, Feature Importance, Global Surrogate, LIME, Shapley Values .	**08**	**L3**
Module 3		
Counterfactual Explanations: Working principle of counterfactual explanations, Mathematical modeling of counterfactual explanations, Global counterfactuals, Demonstration of counterfactual explanations on stroke dataset **Layer-wise Relevance Propagation (LRP):** Working principle of LRP, Mathematical modelling of LRP, Demonstration of LRP.	**08**	**L3**
Module 4		
Explainability for Image Data: Backpropagation-Based Approaches – DeepLIFT, Saliency, Guided Backpropagation, Occlusion, SHAP, SmoothGrad.	**08**	**L3**
Module 5		
Advanced Techniques for Image Data: Integrated Gradients (IG), Accumulating Gradients, Improvements on Integrated Gradients, Guided Integrated Gradients (Guided IG), XRAI: Working and the implementation of XRAI, XRAI with heatmaps, Grad-CAM	**08**	**L3**

Course Outcomes: Upon successful completion of this course, student will be able to

CO1	Understand the methods, metrics to evaluate XAI.
CO2	Demonstrate LIME and SHAP explanations.
CO3	Demonstrate counterfactual explanations and LRP.
CO4	Understand and implement Gradient approach of explainability.
CO5	Implement XAI models to classify data on exemplary applications related to real world.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	3	3	2					3	2	3	
CO2	2	2	2	3	3	2					3	2	3	
CO3	3	2	3	3	3	2			3		3	2	2	
CO4	3	2	3	3	3	2			3		3	2	3	
CO5	3	3	3	3	3	3			3		3	2	2	
Average	3	2	3	3	3	2			3		3	2	3	

High-3: Medium-2: Low-1

Text Books:

1) Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning: An Introduction to Xai, Uday Kamath, December 2021.
2) Interpretable Machine Learning, Christoph Molnar, 2019.
3) https://www.oreilly.com/library/view/explainable-ai-for/9781098119126/ch04.html

Reference Books:

1) Practicable Explainable AI using Python, Pradeepta Mishra, 2022.
2) Hands-On Explainable AI (XAI) with Python, Dennis Rothman, July 2020.
3) Explainable AI with Python, Leonida Gianfagna, 2021.

E-Books / Web References:

1) https://link.springer.com/book/10.1007/978-3-030-68640-6
2) https://towardsdatascience.com/using-shap-values-to-explain-how-your-machine-learning-model-works-732b3f40e137
3) https://analyttica.com/demystifying-lime-xai-through-leaps/

MOOCs:

1) https://www.udemy.com/course/xai-with-python/

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have been encouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

A typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation

Components	Marks	Total
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Assignment	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respective Board of Studies and can be given here.

Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying 20 marks each.
- There will be two full questions (with a maximum of four sub questions) from each module.

The students will have to answer five full questions, selecting one full question from

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VIII
MOBILE APP DEVELOPMENT
Program Elective 5

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**22ADS831**	**SEE Marks;**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To facilitate students to understand android SDK
2	To help students to gain a basic understanding of Android application development
3	To inculcate working knowledge of Android Studio development tool

Module 1	No. of Hours	RBT Level
Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.	**08**	**L3**
Module 2		
Android Application Design Essentials: Anatomy of an Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.	**08**	**L3**
Module 3		
Android User Interface Design Essentials: User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation.	**08**	**L3**
Module 4		
Testing and Publishing Android applications: Testing Android applications, Publishing Android application, Using Android preferences, Managing Application resources in a hierarchy, working with different types of resources.	**08**	**L3**
Module 5		
Using Common Android APIs: Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.	**08**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Identify various concepts of mobile programming that make it unique from programming for other platforms.
CO2	Critique mobile applications on their design pros and cons.
CO3	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces.
CO4	Program mobile applications for the Android operating system that use basic and advanced phone features.
CO5	Deploy applications to the Android marketplace for distribution.

CO / PO Mapping													
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	3		2	2			2		2	2	2	
CO2	2	1	2		2	2			2		3	2	2	
CO3	1	2	3		3	2			2		2	2	2	
CO4	2	1	3		3	2			2		3	2	2	
CO5	2	1	3		3	2			2		3	2	2	
Average	2	1	3		3	2			2		3	2	2	

High-3: Medium-2: Low-1

Text Books:

1. T1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)

Reference Books:

1. R1. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd 2. R2. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd 3. R3. Android Application Development All in one for Dummies by Barry Burd, Edition: I

Books / Web References:

1. https://archive.nptel.ac.in/courses/106/106/106106156/

MOOCs:

1. https://www.coursera.org/courses?query=mobile%20app%20development

Scheme of Examination (CIE):

In order to encourage innovative methods while delivering a course, the faculty members have beenencouraged to use the **Alternative Assessment Tool (AAT).** The AAT enhances the autonomy (freedom and flexibility) of individual faculty and enables them to create innovative pedagogical practices.

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/ concept videos/ partial reproduction of research work/ oral presentation of research work/ group activity/ developing a generic tool-box for problem solving/ report based on participation in create-a-thon/ make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ any other.

Typical evaluation pattern for regular courses is shown in Table 1:

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE TEST 1	40	50
CIE TEST 2	40	
CIE TEST 3	40	
Assignment	10	

Note: CIE pattern for courses like Drawing and Laboratories can be decided by the respectiveBoard of Studies and can be given here.

Scheme of Examination (SEE):

• The SEE question paper will be set for 100 marks and the marks scored will be proportionatelyreduced to 50.
• The question paper will have ten full questions carrying 20 marks each.
• There will be two full questions (with a maximum of four sub questions) from each module.
• The students will have to answer five full questions, selecting one full question from each module.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER - VIII

DATA SCIENCE FOR SECURITY

Program Elective 5

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	22ADS832	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PEC**	**Credits:**	**03**

Prerequisites (if any):None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Learn the security challenges that exist in the interconnected network of Internet.
2	Understand various data science approaches to solve security related challenges and problems.
3	Learn how to convert a security problem to a ML problem.
4	Understand the available technology that exist today to solve the security problems.
5	Understand the emerging threats of Adversarial Machine Learning.

Module 1	No. of Hours	RBT Level
Introduction to Data Science for Security, Thread landscape, Different types of threats, Basics of Malware, Typical Malware behaviors, Understanding Malware, Defining Malware classification, Static analysis and Dynamic analysis of Malware, Building Static and Dynamic malware detectors using Machine learning approaches.	**10**	**L3**
Module 2		
Advanced Malware detection, Detecting Obfuscated Java Script, Featurizing PDF files, Extracting N-grams using the hash-gram algorithm, Building the dynamic Malware classifier using the N-GRAMS approach on the sequence of API calls, Building the classifiers for the packers.	**10**	**L3**
Module 3		
Introduction to Penetration testing, Methodology, Foot printing, Scanning, Enumeration, Gaining access, escalating Privileges, Covering Tracks, Creating Back Doors, Machine Learning techniques for Pen Testing, Captcha Breaker, Deep Exploit, Malicious URL detector.	**10**	**L3**
Module 4		
Intrusion Detection, Denial of Service, DOS attack types, Distributed Denial Service (DDOS) attacks, DDOS detection, Machine learning approaches for DOS and DDOS, Phishing URL detection, Spam filtering, Credit card fraud detection, Anomaly detection using Isolation Forest.	**10**	**L3**
Module 5		
Introduction to Adversarial machine learning, Categories of attacks on Machine Learning, classification of attacks along dimensions namely timing, information and goals, evasion attack, attack on training data, white and black box attacks, decision time attacks on machine learning, attacks on anomaly detection and attack on PDF malware classifiers.	**10**	**L3**

Course Outcomes:

Upon successful completion of this course, student will be able to

CO1	Apply the knowledge gained in the class to illustrate the security challenges that exist today.
CO2	Apply the knowledge gained in the class to perform analysis on real-world case studies and datasets.
CO3	Build both fundamental and practical expertise.
CO4	Demonstrate the fundamental concepts on selecting the appropriate models in cyber security settings.
CO5	Explain the concept of Adversarial Machine Learning threats.

CO / PO Mapping														
CO / PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		2			1		2		2	3	
CO2	2	3	1		2			1		2		2	3	
CO3	1	2	3		2			1		2		2	3	
CO4	1	2	3		2			1		2		2	3	
CO5	3	3	3		2			1		2		2	3	
Average	2	2	2		2			1		2		2	3	

High-3: Medium-2: Low-1

Textbooks:

1. Machine Learning for Cyber Security – Cook Book, Emmanuel Tsukerman,Packt publications.
2. Machine Learning and Security, Clarence Chio & David Freeman

Reference Books:

1. Malware Data Science, Attack Detection and Attribution, Joshua Saxe, Hillary Sanders
2. Mastering Machine Learning for Penetration Testing, Chiheb Chebbi, Packt publications

Scheme of Examination:

Semester End Examination (SEE):

SEE Question paper is to be set for 100 marks and the marks scored will be proportionately reducedto 50. There will be two full questions (with a maximum of four sub questions) from each module carrying20 marks each. Students are required to answer any **five full questions** choosing at least **one full questionfrom each module.**

Continuous Internal Evaluation (CIE):

Three Tests are to be conducted for 40 marks each. Average marks scored is added to test component. CIEis executed by way of two quizzes / Alternate Assessment Tools (AATs), and Three tests. Two quizzes areto be conducted and each quiz is evaluated for 5 marks adding up to 10 marks.

Typical Evaluation pattern for regular courses is shown in Table.

Table: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**50**
	CIE Test-2	**40**	
	CIE Test-3	**40**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VIII

PROJECT WORK PHASE – II

Semester:	**08**	**CIE Marks:**	**100**
Course Code:	**22ADSP84**	**SEE Marks:**	**100**
Hours/Week (L: T: P):	**0:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**MP**	**Credits:**	**08**

Content
CIE procedure for Project Work Phase - II: **a. Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates using Rubrics. **b. Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates as per Rubrics covering all Program Outcomes. **SEE for Project Work Phase - II:** **a. Single discipline**: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department. **b. Interdisciplinary:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong.

Table 1: Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
	Review-2		
SEE	Semester End Examination	**100**	**100**
Grand Total			**200**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VIII

TECHNICAL SEMINAR

Semester:	**08**	**CIE Marks:**	**100**
Course Code:	**22ADSS85**	**SEE Marks:**	**-**
Hours/Week (L: T: P):	**1 Hour/Week**	**Duration of SEE (hours):**	**-**
Type of Course:	**MP**	**Credits:**	**01**

Technical Seminar:

All the students admitted to IV year of BE/B. Tech shall have to do power point presentation on any topic related to Artificial Intelligence and Data Science Engineering during VIII Semester and make a report of the presented topic referring to journals in that area. The prescribed credit shall be included in VIII Semester and shall be considered for the award of bachelor's degree. Those who do not present the Technical Seminar shall be declared fail and shall have to complete during subsequent University examination after satisfying the Technical Seminar requirements.

CIE procedure for Seminar:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Seminar shall be based on the evaluation of Seminar report, presentation skill and question and answer session in the ratio 50:25:25.

Typical Evaluation pattern for regular courses is shown in Table 1:

Table 1: Distribution of weightage for CIE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
	Review-2		
SEE	Semester End Examination	--	--
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VIII

INTERNSHIP

Semester:	**08**	**CIE Marks:**	**100**
Course Code:	**22INT86**	**SEE Marks:**	**-**
Type of Course:	**INT**	**Credits:**	**02**

All the students admitted to III year of BE/B. Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters.

Internship examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

CIE procedure for Internship:

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Internship shall be based on the evaluation of Internship report, presentation skill and question and answer session in the ratio 50:25:25.

SEE for Internship:

Contribution to the Internship and the performance of each Student shall be assessed individually in the semester end examination (SEE) conducted at the department.

Typical Evaluation pattern for regular courses is shown in Table 1.

Table 1: Distribution of weightage for CIE & SEE of Regular courses

	Component	Marks	Total Marks
CIE	Review-1	**100**	**100**
	Review-2		
SEE	Semester End Examination	-	-
Grand Total			**100**

Head of the Department
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