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

2020 BATCH

3RD TO 8TH SEMESTER SCHEME & SYLLABUS

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

GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous Institution Affiliated to VTU)

B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2020-21

III SEMESTER –UG

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	20MAT31A	Discrete Mathematics and Transform Calculus	Mathematics	3	2	--	03	50	50	100	4
2	PC	20ADS32	Principles of Artificial Intelligence	Respective Department	3	2	--	03	50	50	100	4
3	PC	20ADS33	Data Structures using C		3	2	--	03	50	50	100	4
4	PC	20ADS34	Database Management Systems		3	2	--	03	50	50	100	4
5	PC	20ADS35	Operating system		3	-	--	03	50	50	100	3
6	PC	20ADS36/ 20MADIP31	Python for Data Science/Dip. Mathematics		3	-	--	03	50	50	100	3
7	PC	20ADSL37	Data Structures Laboratory		--	-	2	03	50	50	100	1
8	PC	20ADSL38	Database Management System Laboratory		--	-	2	03	50	50	100	1
9	NCMC	NCMC3	Non Credit Mandatory Course 3	**Personality Development & Communication Skills (PD &C)**								
10	HSM	20KVK39/49	Vyavaharika Kannada (Kannada for communication)/	Any Department	--	2	--	--	100	--	100	0
		20KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR			OR							
		20CPH39/49	Constitution of India, Professional Ethicsand Cyber Law		-	2	--	-	100	-	100	0
				TOTAL	**18**	**10**	**04**	**24**	**500**	**400**	**900**	**24**

Note: BSC: Basic Science, PC: Professional Core, PE- Professional Elective, HSM: Humanity and Social Sciences, NCMC: Non-credit mandatory course.
20KVK39: Vyavaharika Kannada (Kannada for communication) is for non-kannada speaking, reading and writing students and 20KAK39 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write kannada.
Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs
(a) Diploma Mathematics 20MAT36 is prescribed for lateral entry Diploma holders admitted to III semester BE. The students shall attend the classes during this semester to complete all the formalities of the course and appear for the examination. In case, any student fails to register for the said course/ fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students must fulfil the requirements during subsequent semester/s to appear for SEE. This course shall be considered for vertical progression. **(b)** The regular students shall study the core subject 20XXX36.
Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs
Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses **Computer Aided Engineering Drawing and Engineering Mechanics of the First Year Engineering Program**. These courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.
NCMC3: Student can participate in any **Personality Development & Communication Skills Program** (minimum 5 days duration) conducted by Training and Placement cell of GAT/any other training organization. Students should be exposed to soft skills. Student should submit participation and successful completion certificate of PD&C for clearing this mandatory course. **This should be completed by the student before he/she enters 5th Sem.**
* **Title and Syllabus of Mathematics can be tailor made to suit the requirements of different engineering streams.**

GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous Institution Affiliated to VTU)

B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2020-21

IV SEMESTER –UG

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	20MAT41A	Graph Theory Probability and Sampling Techniques	Mathematics	3	2	--	03	50	50	100	4
2	PC	20ADS42	Design and Analysis of Algorithms	Respective Department	3	2	--	03	50	50	100	4
3	PC	20ADS43	Machine Learning – I		3	2	--	03	50	50	100	4
4	PC	20ADS44	Fuzzy Systems and Applications		3	2	--	03	50	50	100	4
5	PC	20ADS45	Foundations of Data Science		3	-	--	03	50	50	100	3
6	PC	20ADS46	Data Communication and Computer Networks		3	-	--	03	50	50	100	3
7	PC	20ADSL47	Design and Analysis of Algorithms Laboratory		-	-	2	03	50	50	100	1
8	PC	20ADSL48	Machine Learning Laboratory		-	-	2	03	50	50	100	1
9	NCMC	20NCMC4	Non Credit Mandatory Course 4	**Cultural Activities**								
10	HSM	20KVK39/49	Vyavaharika Kannada (Kannada for communication)/	Any Department	--	2	--	--	100	--	100	-
		20KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		20CPH39/49	Constitution of India, Professional Ethicsand Cyber Law		-	2	--	-	100	-		
				TOTAL	**18**	**10**	**04**	**24**	**500**	**400**	**900**	**24**

Note: BSC: Basic Science, PC: Professional Core, PE- Professional Elective, HSM: Humanity and Social Science, NCMC: Non-credit mandatory course.
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NCMC4: Student can participate in any of the C**ultural Activities** such as Music (Vocal/Instrumental), dance, debate, drama, drawing, painting, photography, short films, etc., conducted by college or any other organization. Student should produce participation certificate for clearing this mandatory course. The mentor appoint nitor the performance of the student in cultural activities. A committee consisting of senior faculties appointed by the Head of the Department shall evaluat ce in the cultural activities. **This should be completed by the student before he/she enters 5th Sem.** Note: If student is unable to participate in outside cultural activities, then department Head should take care of conducting any small cultural event (like Essay, Debate etc.) in the college. Physically challenged students can produce participation certificate of any technical/cultural events conducted by college/department.
***Title and Syllabus of Mathematics can be tailor made to suit the requirements of different engineering streams.**

Note: After training on soft skills in III sem., the students are expected to participate in Cultural activities. Training on soft skills will have a good impact on the quality of participation in Cultural Activities.

SEMESTER – III

Course: Discrete Mathematics and Transform Calculus

Course Code	**20MAT31A**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**3:2:0**	**SEE Marks**	**50**
No. of Credits	**4**	**Examination Hours**	**03**

Course Objectives:

To enable students to apply the knowledge of Mathematics in various fields of engineering by making them to learn:

CLO1	Logic and Set theory
CLO2	Permutations and Combinations
CLO3	Functions and Relations
CLO4	Fourier series of periodic functions
CLO5	Laplace Transforms

Content	No. of Hours/ RBT levels
Module 1 Basic Connectives and Truth Tables, Logic Equivalence: The Laws of Logic, Logical Implication: Rules of Inference. Quantifiers and the Proofs of Theorems. Sets and Subsets, Set Operations and the Laws of Set Theory, Counting and Venn Diagrams.	**10 Hours** **L3**
Module 2 The Rules of Sum and Product, Permutations, Combinations, The Binomial Theorem, Combinations with Repetition. The Well Ordering Principle- Mathematical Induction, Recursive Definitions.	**10 Hours** **L3**
Module 3 Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions. Properties of Relations, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions.	**10 Hours** **L3**
Module 4 Laplace transforms of elementary functions, Laplace transforms of Periodic functions, unit-step function and Dirac delta function. Inverse Laplace Transform,	**10 Hours** **L3**

Convolution theorem (without Proof), Solution of second order linear differential equations using Laplace transform.	
Module 5 Fourier series of periodic functions, Complex form of Fourier series. Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms.	**10 Hours** **L3**

COURSE OUTCOMES:

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

CO31.1	Use computational techniques essential for the study of mathematical logic, set operations, counting principles, relations and functions.
CO31.2	Determine Laplace and inverse Laplace transforms of given functions leading to the solution of linear differential equations.
CO31.3	Apply Fourier series to transform periodic signals into fundamental frequencies
CO31.4	Apply Fourier Transforms to transform continuous time signals from time domain to frequency domain and vice versa

Textbooks:

1. **Ralph P. Grimaldi**: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2020.
2. **B. S. Grewal**, Higher Engineering Mathematics, Khanna Publishers 44th Edition, 2017

Reference books:

1. **Kenneth H. Rosen:** Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007
2. **E. Kreyszig John Wiley & Sons**, Advanced Engineering Mathematics 10th Edition, 2016
3. **N.P.Bali and Manish Goyal** , A Textbook of Engineering Mathematics Laxmi Publications 6 th Edition, 2014

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 questionfrom each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component.
CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two 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	**20**	**50**
	CIE Test-2	**20**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
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
CO31.1	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO31.2	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO31.3	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO31.4	3	2	1	-	-	-	-	-	-	-	-	3	-	-
Average	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –III

PRINCIPLES OF ARTIFICIAL INTELLIGENCE

Semester:	**3**	**CIE Marks:**	**50**
Course Code:	**20ADS32**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	To search and discover intelligent characteristics of existing AI projects.
2	Identify the problems where AI is required and the different methods available.
3	Compare and contrast different AI techniques available.
4	Evaluate different Knowledge Representation schemes for typical AI problems, design and Implement a typical AI problem to be solved Using Machine Learning Techniques.
5	Design and implement a futuristic AI application of expert system.

Module 1	No. of Hours	RBT Level
Introduction to AI: What is AI, Foundation and History of AI, State of the art, level of model, criteria for success, Turing test. **Intelligent agents:** Agents and Environments, Good Behaviour, the concepts of Rationality, Nature of Environments, Structure of Agents, Reactive, deliberative,goal-driven, utility-driven, and learning agents.	**10**	**L3**
Module 2		
Problem-solving: Problem-solving agents, Example problems, Searching for Solutions. **Uninformed Search Algorithms:** Breadth-First Search, Depth-First Search, Depth-Limited Search, Iterative Deepening Search, and Bidirectional search, Uniform-Cost Search, Sensor less problems, Contingency problems. **Informed Search Algorithms:** Informed/Heuristic Search, Heuristic Search, A* Search, Memory bounded heuristic search, heuristic functions, local search and optimization, hill climbing, simulated annealing, local beam search, online search, online depth first search.	**10**	**L3**
Module 3		
Adversarial Search : Games, Optional Decisions in Games, Alpha-Beta Pruning, Imperfect Real-Time Decisions,Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs. **Constraint Satisfaction Problems (CSP):** Defining CSP, Inference in CSP,Backtracking Search for CSP, Local search for CSP, Structure of Problems.	**10**	**L3**

Module 4		
Knowledge Representation Logic Agents: Logic, Propositional Logic, Propositional Theorem Proving, First-Orderlogic, Knowledge representation issues, Using predicate logic. **Inference in First Order Logic:** Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.	**10**	**L3**
Module 5		
Expert Systems Introduction: Introduction to Prolog, what an expert system is; how it works and how it is built, Basic components of an expert system, Expert System Architectures, Building Expert Systems.Rule-based Expert systems: Structure of rule based expert system, Conflict resolution, Uncertainty Management, Advantages & disadvantages of rule-based expert systems, Example, Introduction to JESS. **Frame-based Expert systems:** Inheritance in frame-based expert systems, Methods and demons, Interactions of frames and rules, Example. Artificial Neural Network and Neural Expert Systems.	**10**	**L3**

Course Outcomes:

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

CO1	Identify appropriate idealizations for converting real world problems into AI search problems formulated using the appropriate search algorithm.
CO2	Explain important search concepts, such as the difference between informed and uninformed search
CO3	Implement A* and iterative deepening search. Derive heuristic functions for A* search that are appropriate for a given problem.
CO4	Implement proofs in first order and propositional logic using techniques such as resolution, unification, backward and forward chaining.
CO5	Design an expert system that would solve the real-world problems.

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. Artificial Intelligence – A Modern Approach‖, by Stuart J. Russell and Peter Norvig,3rd EditionPearson 2015.
2. Artificial Intelligence‖, by E. Rich and Knight, 3rd Edition, McGraw Hill International, 2016.
3. Artificial Intelligence: A Guide to Intelligent Systems‖, by M. Negnevitsky, Addison Wesley.

Reference Books:

1. Logic Programming with Prolog‖, by Max Bramer, Springer, 2005.
2. Principles of Artificial Intelligence‖, by N.J. Nilsson, Narosa, 2002.

E-Books / Web References:

1. NPTEL Lecture https://nptel.ac.in/courses/112/103/112103280/

MOOCs:

1. https://online.stanford.edu/courses/cs221-artificial-intelligence-principles-and-techniques
2. https://www.edx.org/course/cs50s-introduction-to-artificial-intelligence-with-python?index=product&queryID=074f81e5b869895899f1b3989470f1c5&position=1

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	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 – III

DATA STRUCTURES USING C

Semester:	**3**	**CIE Marks**	**50**
Course Code	**20ADS33**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PC**	**Credits**	**04**

Prerequisites (if any): C programming language.

Course Learning Objectives: The course will enable students to:

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

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.

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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

DATABASE MANAGEMENT SYSTEMS

Semester:	**3**	**CIE Marks**	**50**
Course Code	**20ADS34**	**SEE Marks**	**50**
Hours/Week (L: T: P)	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course	**PC**	**Credits**	**04**

Prerequisites (if any): NA

Course Learning Objectives: The course will enable students to:

Sl. No	Course Learning Objectives (CLO)
1	Explain the concept of databases, database management systems, database structures and how theywork.
2	Make use of Entity-Relationship modelling for creating simple databases from the real-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.	**10**	**L3**

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. **More SQL: Complex Queries, Triggers, Views, and Schema Modification** - MoreComplex 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

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	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 – III

OPERATING SYSTEM

Semester:	**3**	**CIE Marks:**	**50**
Course Code:	**20ADS35**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): NA

Course Learning Objectives: The course will enable students to:

Sl. No	Course Learning Objectives (CLO)
1	To apply various types of system calls and to find the stages of various process states.
2	To understand scheduling algorithm to compute various scheduling criteria
3	To understand page replacement algorithms, memory management problems.
4	To understand file systems, Virtualization concepts, security of operating systems.

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, Security and Protection Virtualization, Distributed Systems, Kernel Data Structures, Computing Environments. **Operating-System Services:** User and Operating-System Interface, System Calls, System Services, Linkers and LoadersWhy Applications Are, Operating-System Specific, Operating-System Design and Implementation, Operating-System Structure, Building and Booting an Operating System, Operating-System Debugging	**08**	**L2**
Module 2		
Process Management: Processes, Process Concept, Process Scheduling, Operations on Processes, InterprocessCommunication, IPC in Shared-Memory Systems, IPC in Message-Passing Systems Examples of IPC Systems, Communication in Client–Server Systems **Threads & Concurrency:** Overview, Multicore Programming, Multithreading ModelsThread Libraries	**08**	**L2**
Module 3		
CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multi-Processor Scheduling, Real-Time CPU Scheduling, Operating-System Examples **Deadlocks:** System Model, Deadlock in Multithreaded Applications, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	**08**	**L2**
Module 4		
Memory Management: Main Memory management- Contiguous Memory Allocation, Caching -Virtual Memory Hardware TLB - Virtual Memory OS techniques Paging Segmentation Page FaultsPage Replacement, Thrashing, Working Set.	**08**	**L2**
Module 5		
Case Study: Unix, Windows, MacOS, Virtual Machines and Dual OS with respect to architecture, CPUscheduling, Process scheduling and Memory Management.	**08**	**L2**

Course Outcomes:

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

CO1	Understand the Operating system functionality with system calls.
CO2	Discuss the different process scheduling mechanisms.
CO3	Interpret inter process communication and synchronization.
CO4	Understand the memory management methods .
CO5	Understand the different Operating system using use cases.

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. 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 . RamezElmasri, 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

MOOCs:

4. https://www.coursera.org/learn/os-power-user
5. 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:

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 –III

PYTHON FOR DATA SCIENCE

Semester:	**3**	**CIE Marks:**	**50**
Course Code:	**20ADS36**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): Programming with Python.

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To build the 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, 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-OrientedProgramming 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		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 Pythonhttps://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 (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.

SEMESTER – III

Course: Additional Mathematics

Course Code	20MADIP31	CIE Marks	50
Hours/Week (L: T: P)	3:0:0	SEE Marks	50
No. of Credits	3	Examination Hours	03

Course Objectives:

CLO1	Derivatives, Polar curves and Radius of curvature
CLO2	Partial Derivatives and Jacobians
CLO3	Multiple integrals, beta & gamma functions.
CLO4	Ordinary differential equations of first and second order

Content	No. of Hours/ RBT levels
Module 1 Successive differentiation - simple problems. Polar Curves - angle between radius vector and tangent, angle between two curves, Pedal equation. Curvature and Radius of Curvature – Cartesian and Polar forms (without proof) –problems. Taylor's and Maclaurin's theorems for function of one variable (statement only)- problems.	10 Hours L3
Module 2 Evaluation of Indeterminate forms. Partial derivatives, Euler's theorem on homogeneous functions. Differentiation of implicit and composite functions. Jacobians. Taylor's theorem for functions of two variables. Maxima and Minima of functions of two variables.	10 Hours L3
Module 3 Multiple Integrals-Double integrals-introduction, direct evaluation, change of order of integration, change of variables. Triple integrals-introduction and direct evaluation. Beta and Gamma functions, relation between beta and gamma function, problems	10 Hours L3
Module 4 Solution of first order and first-degree differential equations – Variable	10 Hours L3

Separable, Exact, reducible to exact and Bernoulli's differential equations. Applications: Orthogonal trajectories, Newton's law of Cooling and Electric Circuits.	
Module 5 Second order linear ODE's with constant Coefficients-Inverse differential operators, method of variation of parameters, Cauchy's and Legendre's Linear differential equations.	**10 Hours** **L3**

COURSE OUTCOMES:

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

CO1	Apply the knowledge of differential calculus to solve problems related to curvature, maxima & minima of a function and Jacobians
CO2	Find area and volume of solids using multiple integrals.
CO3	Evaluate definite integrals using beta and gamma functions
CO4	Solve linear differential equations of first and second order with constant/variable coefficients.

Textbooks:

1. **B.S. Grewal,** Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
2. **B V Raman,** Higher Engineering Mathematics, Tata McGraw-Hill, 2006

Reference books:

1. **E Kreyszig**, Advanced Engineering mathematic, John Wiley & Sons10th Edition, 2016.
2. **N.P.Bali and Manish Goyal,** A Text Book of Engineering Mathematics, Laxmi Publications, 6th Edition, 2014.

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 questionfrom each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component.
CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two 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	**20**	**50**
	CIE Test-2	**20**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
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
CO1	3	2	1	--	--	--	--	--	--	--	--	2	--	--
CO2	3	2	1	--	--	--	--	--	--	--	--	2	--	--
CO3	3	2	1	--	--	--	--	--	--	--	--	2	--	--
CO4	3	2	1	--	--	--	--	--	--	--	--	2	--	--
Average	**3**	**2**	**1**	--	--	--	--	--	--	--	--	**2**	--	--

Low-1: Medium-2: High-3

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – III

DATA STRUCTURES LABORATORY

Subject Code:	**20ADSL37**	**CIE Marks:**	**50**
Hours/Week (L: T: P):	**0:0:2**	**SEE Marks:**	**50**
Total Hours:	**30**	**Examination Hours:**	**03**
Credits: 01			

Course Objectives: The course will enable students to:

CLO1	Understand elementary data structures with an emphasis on problem solving.
CLO2	Develop skills to design and analyze simple linear and non-linear data structures.
CLO3	Strengthen the ability to the students to identify and apply the suitable data structure for the givenreal-world problem.
CLO4	Enables them to gain knowledge in practical applications of data structures.

S. No.	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.	**03 L3**
2	Write a program to demonstrate: a) Tower of Hanoi problem and b) Ackermann's function	**03 L3**
3	Develop a program to convert INFIX notation to POSTFIX.	**03 L3**
4	Develop a program for evaluation of POSTFIX notation.	**03 L3**
5	Develop a menu driven program for QUEUE that performs following primitive operations: insert, delete and display.	**03 L3**
6	Develop a menu driven program for CIRCULAR QUEUE that performsfollowing primitive operations: insert, delete and display.	**03 L3**
7	Develop a menu driven program to perform primitive operations on single linkedlist.	**03 L3**
8	Develop a program to reverse a single linked list.	**03 L3**
9	Develop a program to traverse a tree using in-order, pre-order and post-order.	**03 L3**
10	Develop a program to perform insertion, deletion and traversal of a binary searchtree.	**03 L3**

Note:

1) Every program should have algorithm before writing the program.
2) Code should be traced with minimum of two test cases
3) To be implemented using UBUNTU as OPEN SOURCE (Either GEDIT or VI Editor)

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

CO1	Develop program related to stacks and its applications
CO2	Develop program related to queues and its variations
CO3	Develop program related to linked lists
CO4	Develop program related to non-linear data structures trees and its variations

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –III

DATABASE MANAGEMENT SYSTEM LABORATORY

Subject Code:	**20ADSL38**	**CIE Marks:**	**50**
Hours/Week (L: T: P):	**0:0:2**	**SEE Marks:**	**50**
Total Hours:	**30**	**Examination Hours:**	**03**
No. of Credits: 01			

Course Objectives: The course will enable students to:

CLO1	Implement the basic knowledge of SQL queries and relational algebra.
CLO2	Construct database models for different database applications.
CLO3	Apply normalization techniques for refining of databases.
CLO4	Practice various triggers, procedures, and cursors using PL/SQL.

S. No.	Programs	No. of Hours/ RBT levels
1	**Creation of Tables** I. Create a table called Employee with the following structure. Name | Type Empno | Number Ename | Varchar2(20) Job | Varchar2(20) Mgr | Number Sal | Number 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. II. Create a table called reserves table Name | Type Boat id | Integer Sid | Integer Day | Integer 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	**03** **L3**
2	**Queries using DDL and DML.** I. 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.	**03** **L3**

<table>
<tr><td></td><td>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.

II.
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
d. Delete constraint not null to the table column.</td><td></td></tr>
<tr><td>3</td><td>Queries using aggregate functions.
I.
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.

II.
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
I.
a. Write a PL/SQL program to swap two numbers.
b. Write a PL/SQL program to find the largest of three numbers.

II.
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
I. Write a function to accept employee number as parameter and return Basic +HRA together as single column.
II. 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
I. 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>
</table>

7	**Procedures** I. Write the PL/SQL programs to create the procedure for factorial of given number. II. Write the PL/SQL programs to create the procedure to find sum of N natural number.	**02** **L3**
8	**Cursors** I. Write a PL/SQL block that will display the employee details along with salary using cursors. II. To write a Cursor to display the list of employees who are working as a managers or Analyst.	**02** **L3**
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.	**03** **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.	**03** **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. Similarly, the cash inflow coming from all sources: Car hire, car sales, insurance	**03** **L3**

	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 adeposit 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, telephonenumber, 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.	
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).	**03** **L3**

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

CO1	Apply the underlying concepts of Database techniques for a given problem.
CO2	Design and implement a database schema for a given problem domain.
CO3	Construct a database using SQL commands.
CO4	Apply integrity constraints on a database using state of the art RDBMS.
CO5	Demonstrate PL/SQL including stored procedures, stored functions, cursors and triggers techniques.

SEMESTER – III/IV

Course Code	20KVK39/49	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
No. of Credits	0	Examination Hours	-

Course: Kannada for Administration

(ಕನ್ನಡ ಮಾತೃಭಾಷೆಯ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)

(ಕನ್ನಡಿಗರಿಗಾಗಿ – for Kannadigas - Common to all branches)

[As per Outcome Based Education (OBE) and Choice Based Credit System (CBCS) scheme]

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡದಲ್ಲಿ ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನಗಳ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಹಲವಾರು ವಿಷಯಗಳನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಪರಿವಿಡಿ

ಭಾಗ – ಒಂದು ಲೇಖನಗಳು

ಕನ್ನಡ ನಾಡು, ನುಡಿ ಮತ್ತು ಸಂಸ್ಕೃತಿಗೆ ಸಂಬಂಧಿಸಿದ ಲೇಖನಗಳು

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ : ಹಂಪ ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.

ಭಾಗ – ಎರಡು

ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ ಪೂರ್ವ)

೪. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರ ದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ.

೫. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸ
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೆ – ಕನಕದಾಸ

೬. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಷರೀಫ
ಶಿವಯೋಗಿ – ಬಾಲಲೀಲಾ ಮಹಾಂತ ಶಿವಯೋಗಿ

೭. ಜನಪದ ಗೀತೆ : ಬೀಸುವ ಪದ, ಬಡವರಿಗೆ ಸಾವ ಕೊಡಬೇಡ

ಭಾಗ – ಮೂರು

ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ)

ಭಾಗ – ನಾಲ್ಕು

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

ಭಾಗ – ಐದು

ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ

* (ಅಧ್ಯಾಯ 3, 19, 20 ಮತ್ತು 21 ಇವುಗಳು ವಿತಾವಿ ಯದಿಂದ ಪ್ರಕಟಿತ " **ಆಡಳಿತ ಕನ್ನಡ** "

ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನಗಳು – **ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ** ಮತ್ತು **ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.**

ಸಂಪಾದಕರು

ಡಾ. ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ
ವಿಶ್ರಾಂತ ಕುಲಪತಿಗಳು, ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಹಂಪಿ.

ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ
ಸಹಾಯಕ ಪ್ರಾಧ್ಯಾಪಕರು ಮತ್ತು ಮುಖ್ಯಸ್ಥರು,
ಮಾನವಿಕ ಮತ್ತು ಸಾಮಾಜಿಕ ವಿಜ್ಞಾನಗಳ ವಿಭಾಗ,
ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜು, ಹಾಸನ.

ಪ್ರಕಟಣೆ

ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

2020

SEMESTER – III/IV

Course: Kannada for Communication (for Non-Kannadiga Students)

Course Code	20KVK39/49	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
No. of Credits	0	Examination Hours	-

Course Learning Objectives:

The course will enable the non Kannadiga students to understand, speak, read and write Kannada language and communicate (converse) in Kannada language in their daily life with kannada speakers.

Table of Contents

ಬಳಕೆ ಕನ್ನಡ - baLake Kannada (Kannada for Usage)

Part – I Lessons to teach and Learn Kannada Language

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ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ
ಸಹಾಯಕ ಪ್ರಾಧ್ಯಾಪಕರು ಮತ್ತು ಮುಖ್ಯಸ್ಥರು
ಮಾನವಿಕ ಮತ್ತು ಸಾಮಾಜಿಕ ವಿಜ್ಞಾನಗಳ ವಿಭಾಗ
ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜು - ಹಾಸನ

ಪ್ರಕಟಣೆ
ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.
2020

SEMESTER – III/IV

Course: Constitution of India, Professional Ethics and Cyber Law

Course Code	20CPH39/49	CIE Marks	100
Hours/Week (L: T: P)	1:0:0	SEE Marks	-
No. of Credits	0	Examination Hours	-

Course Objectives:

CLO1	Know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens.
CLO2	Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
CLO3	Know about the cybercrimes and cyber laws for cyber safety measures.

Content	No. of Hours
Module 1 Introduction to Indian Constitution: The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.	03 Hours
Module 2 Union Executive and State Executive: Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States.	03 Hours
Module 3 Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74,75, 86, and	03 Hours

91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences. Constitutional special provisions: Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.	
Module 4 Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.	**03 Hours**
Module 5 Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.	**03 Hours**

COURSE OUTCOMES:

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

CO39.1	Have constitutional knowledge and legal literacy.
CO39.2	Understand Engineering and Professional ethics and responsibilities of Engineers.
CO39.3	Understand the cybercrimes and cyber laws for cyber safety measures.

TEXTBOOKS:

1. Constitution of India, Professional Ethics and Human,0 Shubham Singles, Charles E. Haries, and et. al., Cengage Learning India, 2018.
2. Cyber Security and Cyber Laws, Alfred Basta and et. al., Cengage Learning India, 2018

REFERENCE BOOKS:

1. Introduction to the Constitution of India, Durga Das Basu, Prentice –Hall, 2008.
2. Engineering Ethics, M. Govindarajan, S. Natarajan, V. S. Senthilkumar, Prentice –Hall, 2004

Scheme of Examination:
There is no Semester End Examination for this course. The assessment is based on Continuous Internal Evaluation only.

Continuous Internal Evaluation (CIE):
CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests.
Two quizzes are to be conducted and each quiz is evaluated for 10 marks adding up to 20 marks.
All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes

effectively. Typical Evaluation pattern for this course is shown in Table 2.

Table 2: Distribution of weightage for CIE

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**100**
	CIE Test-2	**40**	
	Quiz 1/AAT	**10**	
	Quiz 2/AAT	**10**	
Grand Total			**100**

SEMESTER – IV

Course: Graph Theory, Probability and Sampling Techniques

Course Code	20MAT41A	CIE Marks	50
Hours/Week (L: T: P)	3:2:0	SEE Marks	50
No. of Credits	4	Examination Hours	03

Course Objectives:

To enable students to apply the knowledge of Mathematics in various fields of engineering by making them to learn:

CLO1	Graph Theory
CLO2	Probability distributions
CLO3	Stochastic process and Markov chains
CLO4	Sampling distributions and testing of hypothesis

Content	No. of Hours/ RBT levels
Module 1 Graphs, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits. Planar Graphs, Hamiltonian paths and Cycles.	10 Hours L3
Module 2 Trees, Rooted Trees, Trees and Sorting, Weighted Trees and Prefix Codes. Dijkstra's Shortest Path Algorithm, Minimal Spanning Trees: The algorithms of Kruskal and Prim.	10 Hours L3
Module 3 Probability, Axioms of probability, Conditional probability, Bayes theorem,Discrete and continuous random variables, Moments, Moment generatingfunctions, Binomial, Poisson, exponential and Normal distributions.	10 Hours L3
Module 4 Joint distributions, Marginal and conditional distributions, Covariance, Correlation and linear regression. Stochastic processes, probability vector, stochastic matrices, fixed points, regular stochastic matrices, Markov chains, higher transition probability.	10 Hours L3

Module 5	10 Hours
Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, student's t-distribution, chi-square distribution as a test of goodness of fit, F- test.	L3

COURSE OUTCOMES:

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

CO41.1	Solve problems using basic graph theory
CO41.2	Solve problems associated with random variables using probability distributions
CO41.3	Solve problems related to testing of hypothesis

Textbooks:

1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2004.
2. **B. S. Grewal** , Higher Engineering Mathematics, Khanna Publishers 44th Edition, 2017

Reference books:

1. **Kenneth H. Rosen:** Discrete Mathematics and its Applications, 6th Edition, McGraw Hill, 2007
2. **E. Kreyszig John Wiley & Sons**, Advanced Engineering Mathematics 10th Edition, 2016
3. **N.P.Bali and Manish Goyal** , A Textbook of Engineering Mathematics Laxmi Publications 6 th Edition, 2014

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 questionfrom each module.**

Continuous Internal Evaluation (CIE):
Two Tests are to be conducted for 50 marks each. Marks scored in each test is reduced to 20 and added to test component.
CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two 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	**20**	**50**
	CIE Test-2	**20**	
	Quiz 1/AAT	**05**	
	Quiz 2/AAT	**05**	
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
CO41.1	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO41.2	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO41.3	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:	**20ADS42**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 2: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

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

Course Learning Objectives: The course will enable students to:

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 Computationally 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/

Scheme of Examination (CIE):

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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.
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- There will be two full questions (with a maximum of four sub questions) from each module.
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –IV

MACHINE LEARNING - I

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**20ADS43**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 2: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

Prerequisites (if any): Python for Data Science.

Course Learning Objectives: The course will enable students to:

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=Cj0KCQjw29CRBhCUARIsAOboZbJrDLSTHJKj8iIKyhQzv9srD_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

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 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 - IV

FUZZY SYSTEMS AND APPLICATIONS

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**20ADS44**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 2: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits**	**04**

Prerequisites (if any): Discrete Mathematics.

Course Learning Objectives: The course will enable students to:

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

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Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER - IV

FOUNDATIONS OF DATA SCIENCE

Semester:	**04**	**CIE Marks:**	**50**
Course Code	**20ADS45**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): Basics of Probability

Course Learning Objectives: The course will enable students to:

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**
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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

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- There will be two full questions (with a maximum of four sub questions) from each module.
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER - IV

DATA COMMUNICATION AND COMPUTER NETWORKS

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**20ADS46**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 0: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): NA

Course Learning Objectives: The course will enable students to:

Sl. No	Course Learning Objectives (CLO)
1	Comprehend the transmission technique of digital data between two or more computers and a computer network that allows computers to exchange data.
2	Explain with the basics of data communication and various types of computer networks
3	Disseminate the Wireless and Mobile Networks covering IEEE 802.11 Standard
4	Demonstration of OSI, TCP/IP models
5	Illustrate concepts of Multimedia Networking, Security and Network Management

Module 1	No. of Hours	RBT Level
Introduction to Networking and Communication: Data communication, communication system, Signal and Data, Analog and Digital Signals, Networking: Needs and Advantages, Network, Types- Client, Server and Peers, Introduction to various types of servers, client/server architecture. Transmission Media types: Wired & Wireless transmission, properties & specialty of various media – types, comparative study. Classification of Networks: LAN, MAN, WAN Network Topology: Bus, Star, Ring, Star bus, Star ring, Mesh – Features, Advantages and disadvantages of each type. Transmission technology: Signal Transmission, Digital Signaling, Analog Signaling, Transmission Modes: simplex, half duplex and full duplex, Asynchronous & synchronous Transmission, Parallel and Serial Transmission, Baseband and Broadband transmission.	**08**	**L2**
Module 2		
Standard Networks and Connectivity : Connectivity Devices: Modem, Repeater, NIC, Network adapters,Connectors, Transceiver, Hub – Active, Passive and Intelligent, Bridge-Local, Remote, Wireless, Routers-Static and Dynamic, Switches, Routers andGateways, NOS. Real World Networks: Ethernet, Fast Ethernet, Token Rings, FDDI, ATM, ARC net and AppleTalk. IEEE 802 standards: 802.3, 802.4, 802.5 Addressing: physical, port, logical Addresses (IPv4): class full and classless Addressing, subnetting, NAT, IPv6.	**08**	**L2**
Module 3		
OSI and TCP/IP Models: Standards Organizations, Protocols and Standards OSI reference model TCP/IP suite Comparison between OSI and TCP/IP Models, TCP/IP protocols: IP, ARP, RARP, ICMP, TCP, UDP, TCP/IP Services Protocols: DHCP, DNS, FTP, TFTP, SMTP, TELNET, and NFS, WWW, URL, e-mail, HTTP, Subnet & subnet mask.	**08**	**L2**
Module 4		
Data Transmission: Modulation: PCM, ASK, FSK, PSK Connectionless and Connection oriented Services, Multiplexing: FDM, TDM, CDM and WDM Switching: circuit, Packet, and message switching, Routing: routing methods, routing protocols: distance vector, link state, path vector, Transmission impairments, flow control and error control.	**08**	**L2**

Module 5		
Network Security: Network security issues, approaches to network security, hacking. **Firewalls:** types of firewall technology- network level and application level, IP packets filter screening routers, limitations of firewalls. **Encryption and Decryption**: Cryptography, Public/Private key encryption. Overview of Digital Signature and Digital Certificates technology.	**08**	**L2**

Course Outcomes:

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

CO1	Explain the various components of data communication.
CO2	Explain the fundamentals of digital communication and switching.
CO3	Discuss different data communication models, protocols with applications.
CO4	Compare different routing methods.
CO5	Describe Network Security Management systems with application.

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	3	
CO2	2	3	1		2							2	3	
CO3	1	2	3		2							2	3	
CO4	1	2	3		2							2	3	
CO5	3	3	3		2							2	3	
Average	2	2	2		2							2	3	

High-3: Medium-2: Low-1

Text Books:

1. Data Communications and Networking‖, by Fourauzan B, TataMcGraw-Hill Publications, 5th Edition, 2013.
2. Computer Networks‖ , by Tanenbaum A , PHI , 4th Edition.

Reference Books:

1. An Engineering Approach to Computer Networking‖, by Keshav S, Pearson Education, 1st Edition.
2. Computer Networks and Internet‖, by Comer D, PearsonEducation, 2nd Edition.
3. Data and Computer Communication‖, by William Stallings, Pearson Education, 10th Edition.

E-Books / Web References:

1. https://en.wikipedia.org/wiki/Lists_of_network_protocols
2. https://www.idc-online.com/resources/technical-references/data-communications-technical-references.html
3. https://www.ietf.org/about/
4. https://wiki.wireshark.org/ProtocolReference
5. https://www.omnisecu.com/tcpip/transmission-control-protocol-tcp.php

6. https://access.itxlearning.com/data/cmdata/NETPLUSN10004/Books/ec2_netplus004c04.pdf
7. https://www.eventhelix.com/

MOOCs:

1. https://www.cisco.com/c/en/us/training-events/training-certifications/training/digital-learning.html?ccid=digitallearning&dtid=sem&oid=rsa&gclid=Cj0KCQjwuMuRBhCJARIsAHXdnqMq7NSgKYOIS0N7PsLZLAiEkO3r0kB4_T2ZkQFxQN5o_mb8IUrDrosaAl3REALw_wcB
2. https://www.classcentral.com/course/data-communication-network-services-9160
3. https://www.udemy.com/course/data-networking-101/
4. https://www.youtube.com/watch?v=sG6WGvzmVaw
5. Lecture Series on Data Communication by Prof.A. Pal, Department of Computer Science Engineering,IIT Kharagpur. For more details on NPTEL visit http://nptel.iitm.ac.in

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	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 - IV
DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**20ADSL47**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**0: 0: 2**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**01**

Prerequisites: C Programming Lab

Course Objectives: The course will enable students to:

1	To Design and implement various algorithms.
2	To learn algorithm design techniques and data structures to solve real world problems.
3	To Employ various design strategies for problem solving.
4	To Measure and compare the performance of different 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**

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

CO1	Apply divide and conquer, Decrease and conquer strategies for a given problem
CO2	Interpret Dynamic Programming and transform and conquer to solve the given problem.
CO3	Apply Graph algorithms for greedy method approach to model engineering problems.
CO4	Demonstrate Back Tracking, Branch and Bound and approximation algorithm design technique for solving computationally hard problems.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER - IV

MACHINE LEARNING LABORATORY

Semester:	**04**	**CIE Marks:**	**50**
Course Code:	**20ADSL48**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**0: 0: 2**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**01**

Course Objectives: The course will enable students to:

1	Implement the basic programming skills of Python.
2	To develop skills to analyze simple machine learning algorithms.
3	To strengthen the ability to the students to identify and apply the suitable algorithm for the given real world problem.
4	Enables to gain knowledge in practical applications of machine learning.

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**

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

CO1	Understand, appreciate and effectively explain the underlying concepts of Machine Learning concepts.
CO2	Code, debug and demonstrate the working nature of different types of learning algorithms
CO3	Apply the concept of classification to write program for KNN
CO4	Implement various classification algorithms
CO5	Choose the appropriate algorithm for solving real world problem

SEMESTER – III/IV

Course Code	20KVK39/49	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
No. of Credits	0	Examination Hours	-

Course: Kannada for Administration

(ಕನ್ನಡ ಮಾತೃಭಾಷೆಯ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)

(ಕನ್ನಡಿಗರಿಗಾಗಿ – for Kannadigas - Common to all branches)

[As per Outcome Based Education (OBE) and Choice Based Credit System (CBCS) scheme]

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡದಲ್ಲಿ ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನಗಳ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದ ಹಲವಾರು ವಿಷಯಗಳನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.
- ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು.

ಪರಿವಿಡಿ

ಭಾಗ – ಒಂದು ಲೇಖನಗಳು

ಕನ್ನಡ ನಾಡು, ನುಡಿ ಮತ್ತು ಸಂಸ್ಕೃತಿಗೆ ಸಂಬಂಧಿಸಿದ ಲೇಖನಗಳು

೧. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ : ಹಂಪ ನಾಗರಾಜಯ್ಯ

೨. ಕರ್ನಾಟಕದ ಏಕೀಕರಣ : ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ – ಜಿ. ವೆಂಕಟಸುಬ್ಬಯ್ಯ

೩. ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.

ಭಾಗ – ಎರಡು

ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ ಪೂರ್ವ)

೪. ವಚನಗಳು : ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಅಲ್ಲಮಪ್ರಭು, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ, ಜೇಡರ ದಾಸಿಮಯ್ಯ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ.

೫. ಕೀರ್ತನೆಗಳು : ಅದರಿಂದೇನು ಫಲ ಇದರಿಂದೇನು ಫಲ – ಪುರಂದರದಾಸ
ತಲ್ಲಣಿಸದಿರು ಕಂಡ್ಯ ತಾಳು ಮನವೆ – ಕನಕದಾಸ

೬. ತತ್ವಪದಗಳು : ಸಾವಿರ ಕೊಡಗಳ ಸುಟ್ಟು – ಶಿಶುನಾಳ ಷರೀಫ
ಶಿವಯೋಗಿ – ಬಾಲಲೀಲಾ ಮಹಾಂತ ಶಿವಯೋಗಿ

೭. ಜನಪದ ಗೀತೆ : ಬೀಸುವ ಪದ, ಬಡವರಿಗೆ ಸಾವ ಕೊಡಬೇಡ

ಭಾಗ – ಮೂರು

ಕಾವ್ಯ ಭಾಗ (ಆಧುನಿಕ)

ಭಾಗ – ನಾಲ್ಕು

ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿ ಪರಿಚಯ, ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ

ಭಾಗ – ಐದು

ವಿಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ

* (ಅಧ್ಯಾಯ 3, 19, 20 ಮತ್ತು 21 ಇವುಗಳು ವಿತಾವಿ ಯದಿಂದ ಪ್ರಕಟಿತ " **ಆಡಳಿತ ಕನ್ನಡ** "

ಪುಸ್ತಕದಿಂದ ಆಯ್ದ ಲೇಖನಗಳು – **ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ** ಮತ್ತು **ಪ್ರೊ. ವಿ. ಕೇಶವಮೂರ್ತಿ.**

ಸಂಪಾದಕರು

ಡಾ. ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ
ವಿಶ್ರಾಂತ ಕುಲಪತಿಗಳು, ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಹಂಪಿ.

ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ
ಸಹಾಯಕ ಪ್ರಾಧ್ಯಾಪಕರು ಮತ್ತು ಮುಖ್ಯಸ್ಥರು,
ಮಾನವಿಕ ಮತ್ತು ಸಾಮಾಜಿಕ ವಿಜ್ಞಾನಗಳ ವಿಭಾಗ,
ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜು, ಹಾಸನ.

ಪ್ರಕಟಣೆ

ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.

2020

SEMESTER – III/IV

Course: Kannada for Communication (for Non-Kannadiga Students)

Course Code	20KVK39/49	CIE Marks	100
Hours/Week (L: T: P)	0:2:0	SEE Marks	-
No. of Credits	0	Examination Hours	-

Course Learning Objectives:

The course will enable the non Kannadiga students to understand, speak, read and write Kannada language and communicate (converse) in Kannada language in their daily life with kannada speakers.

Table of Contents

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Part – I Lessons to teach and Learn Kannada Language

ಲೇಖಕರು
ಡಾ. ಎಲ್. ತಿಮ್ಮೇಶ
ಸಹಾಯಕ ಪ್ರಾಧ್ಯಾಪಕರು ಮತ್ತು ಮುಖ್ಯಸ್ಥರು
ಮಾನವಿಕ ಮತ್ತು ಸಾಮಾಜಿಕ ವಿಜ್ಞಾನಗಳ ವಿಭಾಗ
ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜು - ಹಾಸನ

ಪ್ರಕಟಣೆ
ಪ್ರಸಾರಾಂಗ, ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಬೆಳಗಾವಿ.
2020

SEMESTER – III/IV

Course: Constitution of India, Professional Ethics and Cyber Law

Course Code	20CPH39/49	CIE Marks	100
Hours/Week (L: T: P)	1:0:0	SEE Marks	-
No. of Credits	0	Examination Hours	-

Course Objectives:

CLO1	Know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens.
CLO2	Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
CLO3	Know about the cybercrimes and cyber laws for cyber safety measures.

Content	No. of Hours
Module 1 Introduction to Indian Constitution: The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.	03 Hours
Module 2 Union Executive and State Executive: Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States.	03 Hours
Module 3 Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74,75, 86, and	03 Hours

91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences. Constitutional special provisions: Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.	
Module 4 Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.	**03 Hours**
Module 5 Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.	**03 Hours**

COURSE OUTCOMES:

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

CO 49.1	Have constitutional knowledge and legal literacy.
CO 49.2	Understand Engineering and Professional ethics and responsibilities of Engineers.
CO 49.3	Understand the cybercrimes and cyber laws for cyber safety measures.

TEXTBOOKS:

1. Constitution of India, Professional Ethics and Human,0 Shubham Singles, Charles E. Haries, and et. al., Cengage Learning India, 2018.
2. Cyber Security and Cyber Laws, Alfred Basta and et. al., Cengage Learning India, 2018

REFERENCE BOOKS:

1. Introduction to the Constitution of India, Durga Das Basu, Prentice –Hall, 2008.
2. Engineering Ethics, M. Govindarajan, S. Natarajan, V. S. Senthilkumar, Prentice –Hall, 2004

Scheme of Examination:
There is no Semester End Examination for this course. The assessment is based on Continuous Internal Evaluation only.

Continuous Internal Evaluation (CIE):
CIE is executed by way of two quizzes / Alternate Assessment Tools (AATs), and two tests.
Two quizzes are to be conducted and each quiz is evaluated for 10 marks adding up to 20 marks.
All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes

effectively. Typical Evaluation pattern for this course is shown in Table 2.

Table 2: Distribution of weightage for CIE

	Component	Marks	Total Marks
CIE	CIE Test-1	**40**	**100**
	CIE Test-2	**40**	
	Quiz 1/AAT	**10**	
	Quiz 2/AAT	**10**	
Grand Total			**100**

GLOBAL ACADEMY OF TECHNOLOGY

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V SEMESTER –UG

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	HSMC	20ADS51	Management and Entrepreneurship for IT Industry*	Respective Department	3	-	--	03	50	50	100	3
2	PC	20ADS52	Machine Learning – II		3	2	--	03	50	50	100	4
3	PC	20ADS53	Big Data Analytics: Tools and Techniques		3	2	--	03	50	50	100	4
4	PC	20ADS54	Image Processing		3	2	--	03	50	50	100	4
5	PC	20MAT55	Linear Algebra for Machine Learning		3	-	--	03	50	50	100	3
6	PE1	20ADS56X	Professional Elective 1		3	-	--	03	50	50	100	3
7	PC	20ADSL57	Machine Learning II Laboratory		--	-	2	03	50	50	100	1
8	PC	20ADSL58	Big Data Analytics Laboratory		--	-	2	03	50	50	100	1
9	HSM	20CIV59	Environmental Science	Civil	2	-	-	-	50	-	50	0
10	NCMC	NCMC5	Non Credit Mandatory Course 5	**Social Awareness Programs & Physical Activities such as Sports /Yoga**								
			TOTAL		**20**	**06**	**04**	**24**	**450**	**400**	**850**	**23**

Note: BSC: Basic Science, PC: Professional Core, PE: Professional Elective, HSM: Humanity and Social Science, NCMC: Non-credit mandatory course.

NCMC 5: Student can participate in any of the physical activities such as Sports, Marathon, Yoga conducted by college or any organization. Student should produceparticipation certificate for clearing this mandatory course from the Physical Director/ the competent authorities of the organisation in which the student has undergone training. Physically challenged students can produce participation certificate of any technical/cultural events conducted by college/department clubs.

Student can participate in social awareness programs like:

- Dissemination of information on Govt. Schemes to village folk
- Guidance to village school children
- Organising awareness programs on health issues, cleanliness, sanitisation and hygiene.
- Participation in NSS activities like Swatch Bharat, Youth Red Cross, and Environmental Awareness programs etc.
- Certificate of participation from a competent authority like Headmaster of the school, Village Panchayath president, Village Panchayath member, NSS/ Youth Red
- Cross Coordinator is required for clearing this mandatory course. **This should be completed by the student before entering 7th Sem.**
- ***Management and Entrepreneurship:** The syllabus for this course can be suitably set to cater to the requirements of individual program.

Professional Elective 1

Sl. No.	Course Code	Course Title
1	20ADS561	Introduction to NOSQL
2	20ADS562	Java & J2EE

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VI SEMESTER –UG

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PC	20ADS61	Deep Learning	Respective Department	3	2	--	03	50	50	100	4
2	PC	20ADS62	Data Visualization		3	2	--	03	50	50	100	4
3	PC	20ADS63	Optimization Techniques for Data Science		3	-	--	03	50	50	100	3
4	PE2	20ADS64X	Professional Elective 2		3	-	--	03	50	50	100	3
5	PE3	20ADS65X	Professional Elective 3		3	-	--	03	50	50	100	3
6	OE1	20ADS66X	Open Elective 1	Respective Offering Department	3	-	--	03	50	50	100	3
7	PC	20ADSL67	Deep Learning Laboratory	Respective Department	--	-	2	03	50	50	100	1
8	PC	20ADSL68	Data Visualization Laboratory		--	-	2	03	50	50	100	1
9	PC	20ADSP69	Mini project		-	-	4	03	50	50	100	2
10	NCMC	NCMC6	Non Credit Mandatory Course 6	**Career oriented training/Value added training/software training.**								
				TOTAL	**18**	**04**	**08**	**24**	**450**	**450**	**900**	**24**

Note: PC: Professional Core, PE- Professional Elective, OE- Open Elective, HSM: Humanity and Social Science, NCMC -Non-credit mandatory course.

Open Elective-1: Students can select any one of the open electives offered by **other Department**. Selection of an open elective is not allowed provided if:

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme. Registration to electives shall be documented under the guidance offaculty advisor.

Mini Project: Under this Mini Project, students should get exposure to advanced technologies in respective streams and the guide should direct them to take up such projects involving latest technologies. Students can form a group with a minimum of two and maximum of four. Teacher allotted for project work should guide the students in choosing the topic & enable them to complete the project work and evaluate assigned students. The evaluation of project work will be based on the rubrics set by the department.
under the committee of HOD, guide, UG NBA coordinator, one Professor and one Associate Professor.

NCMC6:

Student can opt any of the following Training programs:

1. **Career oriented training programs** (of minimum 30 hours) conducted by GAT –Website development, Animation, CNC technology, Hydraulics and Pneumatics, interior design and Architecture, PLC design, etc.
2. **Value added programs** (of minimum 30 hours) conducted by industries- training on LAB view, Embedded systems, HVAC, IoT, mobile app development etc.
3. **Software Training programs** (minimum one week) conducted by GAT, any other Institution, or industries – like CFD, Solid works, Mastercam, MATLAB, SCADA, Piping design, Ansys, STAAD-Pro, Electrical software packages, Microsoft, CISCO, SAP, IBM etc.

The student should submit a training program clearance certificate. Students can also take up interdisciplinary training programs conducted by the industries. The certificate should clearly indicate that the student has successfully completed the training program.

The student should complete this course before entering VII sem.

Professional Elective 2

Sl. No.	Course Code	Course Title
1	20ADS641	Cloud Computing
2	20ADS642	Computer Networks

Professional Elective 3

Sl. No.	Course Code	Course Title
1	20ADS651	Introduction of Quantum Computing
2	20ADS652	Web Technologies

Open Elective 1

Teaching Dept.	Sl. No.	Course Code	Course Title
AI & Data Science	1	20ADS661	Machine Learning Algorithms
	2	20ADS662	Foundations of DataScience

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER - V
MANAGEMENT AND ENTREPRENEURSHIP FOR IT INDUSTRY

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20ADS51**	**SEE Marks**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**HSMC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Explain the principles of management, organization and entrepreneur.
2	Realize the importance of planning, organizing, staffing, directing and controlling and gainthe leadership qualities required to run an enterprise.
3	Acquire 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	Realize and plan how to launch and make an entrepreneurial career.

Module 1	No. of Hours	RBT Level
Introduction: Meaning, Nature and characteristics of management, Scope and Functional areas ofmanagement, Goals of management, Levels of management. Planning- Nature, importance, typesof 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, Intrapreneur- An Emerging Class, various stages in entrepreneurial process,role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, Market feasibility study, Technical feasibility study, Financial feasibility study and Social feasibility study. **Case Study:** Kiran Mazumdar Shaw & Biocon, Sunil Bharthi Mittal & Bharti Airtel, 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. **Case Study**: Naresh Goyal & Jet Airways.	**08**	**L2**

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 microand small enterprises, Government of India indusial policy 2007 on micro and small enterprises. **Case Study**: Shahnaz Husain- The Ayurveda Entrepreneur, Microsoft, Captain G R Gopinath, N R Narayana Murthy & Infosys **Institutional support:** MSME-DI, NSIC, SIDBI, KIADB, KSSIDC, TECSOK, KSFC, DIC and District level single window agency, Introduction to IPR.	**08**	**L2**

Course Outcomes:

Upon successful 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	Identify the business opportunities and analyze the management skills for the economic growth of the society.
CO3	Design and prepare project proposals and reports for the effective management of an organization.
CO4	Recognize the importance of Small scale industries in economic development.
CO5	Analyze 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	3	3		2		3	3	3	2	3	3	
CO2		3	3	3		2		3	3	3	2	3	3	
CO3		3	3	3		2		3	3	3	2	3	3	
CO4		3	3	3		2		3	3	3	2	3	3	
CO5		3	3	3		2		3	3	3	2	3	3	
Average		3	3	3		2		3	3	3	2	3	3	

High-3: Medium-2: Low-1

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 PublishingHouse.
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 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/ 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

MACHINE LEARNING II

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20ADS52**	**SEE Marks**	**50**
Hours/Week (L: T: P):	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

Prerequisites (if any): Machine Learning I

Course Learning Objectives: The course will enable students to:

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. **Unsupervised Learning**: Introduction to **U**nsupervised Learning, Clustering, k-Means Clustering, Bisecting k-means	**10**	**L3**
Module 3		
Unsupervised Learning: 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		
Hyper parameter Tuning: Overview, Performance Metrics, Cross-Validation, Manual Search, Grid Search, Random Search, Random Search with Hyperopt, BayesianOptimization, 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, student 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

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/ 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

BIG DATA ANALYTICS: TOOLS AND TECHNIQUES

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20ADS53**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

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 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		
Big Data Management : NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared - Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.	**10**	**L3**
Module 3		
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. **Essential Hadoop Tools:** Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase. **Applications:** 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 4		
Mining Data Streams: Introduction To Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams – Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real-time Analytics Platform (RTAP) Applications, Case Studies – Real-Time Sentiment Analysis, Stock Market Predictions.	**10**	**L3**

Module 5		
Hive – What is Hive? Hive Architecture, Hive Data Types, Hive File Format, Hive Query Language (HQL), **Pig**-What is Pig? Pig on Hadoop, Datatypes in Pig, Running Pig, Execution modes of Pig, HDFS Commands, Relational operators, Eval Function, Complex Data Types, User Defined Functions, Word Count example using Pig.	**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 withHadoop 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

Text Books:

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 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/ 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

IMAGE PROCESSING

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20ADS54**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

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	**10**	**L2**
Module 2		
Image Formation: Introduction, Geometric Model, Photometric Model. **Digitalization:** Introduction, Sampling, Quantization, Digital Image, Elements of Digital Geometry.	**10**	**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.	**10**	**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.	**10**	**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.	**10**	**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):

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	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

LINEAR ALGEBRA FOR MACHINE LEARNING

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20MAT55**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 0: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Solving systems of linear equations.
2	Understanding vector spaces, linear transformations.
3	Understanding Eigenvalues, Eigenvectors, diagonalization and Singular valuedecomposition

Module 1	No. of Hours	RBT Level
System of linear equations: System of linear equations, row reduction and echelon form, vector equations, The matrix equation AX = b. Linear independence and introduction to linear transformations.	**08**	**L3**
Module 2		
Linear Transformation: Matrix of linear transformation, matrix operations, invertible matrix, inverse of a matrix by Gauss Jordan method. Vector space, subspaces, linearly independent sets, Bases.	**08**	**L3**
Module 3		
Coordinate systems: Coordinate systems, The dimensions of a vector space, Rank, Change of basis. Eigen vectors and Eigen values, diagonalization, Eigen vectors and linear transformations.	**08**	**L3**
Module 4		
Inner products: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization.	**08**	**L3**
Module 5		
Least square solutions and fittings: Least square solutions and fittings, diagonalization of symmetric matrices, quadratic forms, constrained optimization; Singular value decomposition.	**08**	**L3**

Course Outcomes:

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

CO1	Solve systems of linear equations.
CO2	Work within vector spaces.
CO3	Manipulate matrices and do matrix algebra
CO4	Use computational techniques for the study of Eigenvalues, Eigenvectors, anddiagonalization

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		
CO3	3	2	1									3		
CO4	3	2	1									3		
Average	3	2	1									3		

High-3: Medium-2: Low-1

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 Books:

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 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 –V

INTRODUCTION TO NOSQL

Professional Elective - I

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20ADS561**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type o Course:	**PE1**	**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-orientedNoSQL 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 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**

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –V

JAVA & J2EE

Professional Elective - I

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20ADS562**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE1**	**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**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

MACHINE LEARNING II LABORATORY

Semester:	**5**	**CIE Marks:**	**50**
Course Code:	**20ADSL57**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**0:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**01**

Prerequisites: Basics of Probability

Course Objectives: The course will enable students to:

1	Implement the advanced programming skills of Python.
2	To develop skills to analyze Unsupervised, Semi-supervised machine learning algorithms.
3	To strengthen the ability to the students to identify and apply the suitable algorithm for the given real-world problem.
4	Enables to gain knowledge in practical applications of machine learning.

Sl. No.	Programs	No. of Hours/ RBT levels
1	Write a program to demonstrate Support Vector Machine using different Kernel functions.	**03 L3**
2	Write a program to implement Bagging and Boosting classifiers.	**03 L3**
3	Write a program to demonstrate pipeline in Machine Learning.	**03 L3**
4	Write a program to classify the data using Multiclass classification algorithm 1.	**03 L3**
5	Write a program to classify the data using Multiclass classification algorithm 2.	**03 L3**
6	Write a program to cluster the data using K-Means clustering algorithm.	**03 L3**
7	Write a program to implement Label Propagation algorithm (Semi – Supervised Learning)	**03 L3**
8	Write a program to demonstrate Random Forest algorithm and improve the performanceusing different Hyper Parameter Tuning Techniques (Randomized and Grid search CV).	**03 L3**
9	Write a program to demonstrate on classification algorithm and improve the performanceusing different Hyper Parameter Tuning Techniques (Bayesian and Optuna).	**03 L3**
10	Write a program to implement Q-Learning.	**03 L3**

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

CO1	Understand, appreciate and effectively explain the underlying concepts of Machine Learning algorithms.
CO2	Code, debug and demonstrate the working nature of different types of Ensemble algorithms.
CO3	Choose the appropriate Unsupervised learning algorithm on any given dataset.
CO4	Implement Semi-supervised learning algorithms on real-world problems.
CO5	Implement Q-Learning Reinforcement Learning algorithm on any gaming dataset.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of the answer script tobe strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedurepart to be made zero.

Scheme of Examination (CIE):

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

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/concept videos/ partial reproduction of research work/ oral presentation.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

BIG DATA ANALYTICS LABORATORY

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20ADSL58**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**0:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**01**

Prerequisites: Basics of Probability

Course Objectives: The course will enable students to:

1	Familiarization and working with different big data framework and platform
2	Execution of map-reduce program using java and python
3	Implementation of a Machine learning algorithm in Spark.

S. No.	Programs	No. of Hours/ RBT levels
1	Study of Big Data Framework and Tools: Apache Hadoop, Apache Spark, Apache Flink,Apache Mahout, and MOA.	**03 L3**
2	Familiarization with Apache Ambari and Hortonworks Data platform	**03 L3**
3	Install Hadoop and Configure single and multi-node cluster	**03 L3**
4	Learn HDFS and execute general and user commands.	**03 L3**
5	Write and execute Map-reduce word-count program in a single node as well as a multimode cluster.	**03 L3**
6	Write and execute a Java/ python program to calculate the average salary of the employeesin a company. (should refer to any pre-existing file or may generate their own).	**03 L3**
7	Write and execute a Map-reduce Java program for printing the maximum salary for a giveninput file.	**03 L3**
8	Write and execute a Map-reduce Java program to print year wise sales of a company froma given CSV file	**03 L3**
9	Install Hive, and Hbase and run basic SQL commands.	**03 L3**
10	Install Scoop and import data using sqoop.	**03 L3**
11	Install Apache Spark (single and multi-node cluster) and learn to use basic commands andRDD creation and Implement SVM, Regression, classification etc. using Spark MLib	**03 L3**
12	Write and Execute word count program using spark shell.	**03 L3**

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

CO1	Install Hadoop and configure the multinode cluster.
CO2	Execute map-reduce program in Java and Python
CO3	Run general HDFS commands
CO4	Use spark, pig, hive, and scoop
CO5	Implement machine learning algorithm in spark

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of the answer script tobe strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedurepart to be made zero.

Scheme of Examination (CIE):

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

Possible AATs are - seminar/ assignments/term paper/ open ended experiments/ mini-projects/concept videos/ partial reproduction of research work/ oral presentation.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – V

ENVIRONMENTAL SCIENCE

Semester:	**05**	**CIE Marks:**	**50**
Course Code:	**20CIV59**	**SEE Marks:**	**--**
Hours/Week (L: T: P):	**2:0:0**	**Examination Hours:**	**--**
Type of Course:	**HSM**	**Credits:**	**00**

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): No SEE will be conducted.

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**	
		Grand Total	**50**

CO/PO Mapping															
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
20CIV59.1	2	-	-	-	-	-	3	-	-	-	-	-	1	-	-
20CIV59.2	2	1	-	-	-	-	3	-	-	-	-	1	1	-	1
20CIV59.3	2	-	2	-	-	2	3	1	-	-	-	1	1	-	1
20CIV59.4	2	2	-	-	-	2	3	-	-	-	-	-	-	-	1
20CIV59.5	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

DEEP LEARNING

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS61**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

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

Course Learning Objectives: The course will enable students to:

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 winnerarchitectures, Implementation of CNN, Building the model from the scratch.	**10**	**L3**
Module 3		
Gradient based approaches 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 LayersImplementation 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-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/

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	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 –VI

DATA VISUALIZATION

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS62**	**SEE Marks;**	**50**
Hours/Week (L: T: P):	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

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 4 C'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, 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 DataVisualization.
CO2	Learn ways to create dashboards as well as story points to develop a strong, powerfuldata story.
CO3	Learn ways and methods to analyze and apply design principles to Tableauvisualization.
CO4	Acquaint themselves with various functions available in Advanced Tableau, Power BItools.
CO5	Familiarize themselves well with current trends in Data Visualization through relevantcase 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

E-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: 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 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 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

OPTIMIZATION TECHNIQUES FOR DATA SCIENCE

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS63**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Analyze the underlying mathematical concepts behind optimization
2	Understand the fundamental algorithms for unconstrained optimization
3	Mathematically characterize solution for non-linear optimization models.
4	Specialize the algorithms for Data Science problems
5	Implement the algorithms to maximize effectivity of Machine Learning Models

Module 1	No. of Hours	RBT Level
Linear Programming Problem: Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, Big-M method, two-phase method, degeneracy.	**08**	**L3**
Module 2		
Transportation Problem: Introduction and Mathematical Formulation of Transportation problem, Initial basic feasible solution of Transportation problem by North West corner rule, Least cost entry method and Vogel's approximation method. MODI method of solving Transportation problem, Degeneracy in TP.	**08**	**L3**
Module 3		
Game Theory: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games. Solving a game by the method of matrices.	**08**	**L3**
Module 4		
Gradient Methods and solving of non-differential convex problems: Gradient Methods Introduction, Method of Steepest Descent, Analysis of Gradient Descent Methods (Batch, Stochastic, Mini-batch) **Overview of Gradient Method Implementation:** Accelerated Gradient Methods, proximal gradient descent, mirror descent	**08**	**L3**
Module 5		
Subgradient Method: Properties of Subdifferential set, Directional Derivatives, Computing subgradients, Value Function, Lipschitz Continuity and Boundedness of Subgradients, Optimality Conditions **Stochastic gradient descent and variants:** Stochastic Gradient Descent Algorithm, Learning Rate, Mini-batch Gradient Descent, Numerical Examples involving Gradient Computation and Parameter Update, Applications (SVM, Logistic Regression)	**08**	**L3**

Course Outcomes:

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

CO1	Derive optimal solutions to linear programming problems.
CO2	Derive optimum solutions for transportation, Assignment and travellingsalesman problems.
CO3	Solve waiting line problems for M/M/1 and M/M/K queuing models.
CO4	Solve problems on game theory for pure and mixed strategy undercompetitive environment
CO5	Implement the various sub gradient methods and Stochastic Gradient Descent.

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. An introduction to optimization: Fourth Edition, by Edwin K P Chong, Stanislaw H. Zak.
2. First-Order Methods in Optimization, by Amir. Beck

Reference Books:

1. Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization, S. Bubeck
2. Learning with Submodular Functions: A Convex Optimization Perspective, Foundations and Trends in Machine Learning, F. Bach

E-Books / Web References:

1. NPTEL Lecture https://www.youtube.com/watch?v=4Xokcy8jeo

MOOCs:

1. https://www.coursera.org/learn/basic-modeling
2. https://www.udemy.com/course/optimisation/

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 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

CLOUD COMPUTING

Professional Elective 2

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS641**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE2**	**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/CloudComputingTheoryAndPractice.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 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	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 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

COMPUTER NETWORKS

Professional Elective - 2

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS642**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE2**	**Credits:**	**03**

Prerequisites (if any): Data Communication

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Understand the Application Layer of Computer Networks (AI,DS Apps interfaces withApplication layer)
2	Data centre networks is integral part of Data Analytics ecosystem. Understand the support ofDCN
3	Understanding Multimedia Networks
4	IoT is has pivotal role in dataset generation, understand extracting data from different sourcesand processing them is important
5	Software Defined Network is the next generation network and application of AI & DS

Module 1	No. of Hours	RBT Level
Application Layer of Computer Networks: Principles of Network Application, Architecture, Communication, using services of Transport layer. Application layer protocols, HTTP, Web. FTP, Mail, DNS, Resource Sharing, Socket programming for applications.	**08**	**L2**
Module 2		
Data Centre Networks: Data Centre topology, Concept of Load balancing, Hierarchical Architecture Trends in Data Centre Networks.	**08**	**L2**
Module 3		
Multimedia Networking: Applications of multimedia networking, Types of multimedia networking applications, Content Delivery Network (CDN), Network support for multimedia, dimensioning best-effort networks, providing multiple classes of service and Leaky bucket operation & algorithm.	**08**	**L2**
Module 4		
Network for IoT: Introduction to Internet of Things (IoT), Elements, characteristics, protocol stack, IoT Challenges. **Protocols for IoT:** Messaging and Transport Protocols, MQTT, BLE, UWB **Cloud for IoT:** IoT with cloud, Edge, Fog Computing, security considerations, Low Latency Networks	**08**	**L2**
Module 5		
Software Defined Networks: Traditional Computer Network System, Evolution of SDN Introduction to SDN system architecture, Openflow protocol, VxLAN Advantages of Software Defined Network	**08**	**L2**

Course Outcomes:

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

CO1	The understanding Application layer of Computer Networks
CO2	Applying Components of Data Centre Networks, features that supports Big DataOperations, like load balancing on the real data.
CO3	Understanding Multimedia Computer Network Intensive, Understanding MultimediaNetworks and protocols.
CO4	Understanding Data acquisition techniques using IoT components, protocols and partitioning functions to make of Edge, Fog Computing
CO5	Understand the components, functions and Software Defined Network being a strongapplication for AI and DS.

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. James F Kurose and Keith W Ross, Computer Networking, A Top-Down Approach, Sixth edition, Pearson,2017, **Module 1 and 3**
2. Nur Zincir-Heywood (Editor), Marco Mellia (Editor), Yixin Diao (Editor), **Module 2.**
3. Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, **Module 4**
4. Introduction to Software Defined Networking - OpenFlow & VxLAN Paperback – June 18, 2013 by Vishal Shukla (Author), **Module 5**

Reference Books:

1. Advanced Data Communications and Networks, By Bill Buchanan 1st Edition.
2. Data Communications, Computer Networks, and Open Systems. Author: Fred Halsall.

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 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/ 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 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 –VI

INTRODUCTION OF QUANTUM COMPUTING

Professional Elective 3

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS651**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE3**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	To understand Quantum Machine Learning - What Quantum Computing Means To Data Mining.
2	To understand the basics of quantum machine learning
3	Provide an overview to implement quantum classification algorithms on the real dataset
4	Provide an overview to apply regression algorithm on the real dataset
5	Provide an overview to implement pattern recognition on real dataset

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**	**L3**
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. Learn Quantum Computing with Python and IBM Quantum Experienceby Robert Loredo.	**08**	**L3**
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. 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 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 DataMining.
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 RobertLoredo.
2. Fundamentals of Quantum Computing Theory and Practice, VenkateswaranKasirajan, 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 andIBM Qiskit by Santanu Pattanayak.

E-Books / Web References:

1. QISKIT textbook: https://qiskit.org/textbook/content/ch-ex/
2. https://medium.com/@SPX701/quantum-machine-learning-a-beginners-guide- 7c7f1d349693

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):

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CIE TEST 2	20	
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Quiz 2 / AAT	05	

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VI

WEB TECHNOLOGIES

Professional Elective 3

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS652**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE3**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

Sl. No.	Course Learning Objectives (CLO)
1	Illustrate the Semantic Structure of HTML and CSS
2	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
Introduction to HTML: What is HTML and Where did it come from? HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTMLElements, HTML5 Semantic Structure Elements. **Introduction to CSS:** What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.	**08**	**L2**
Module 2		
HTML Tables and Forms: Introducing Tables, Styling Tables, IntroducingForms, 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, ResponsiveDesign	**08**	**L2**
Module 4		
JavaScript: Client-Side Scripting, Where does JavaScript Go?, Syntax, JavaScript bjects, The Document Object Model (DOM), JavaScript Events, Forms	**08**	**L3**
Module 5		
PHP: Quick Tour of PHP, Program Control, Functions, PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions ?, PHPError Reporting, PHP Error and Exception Handling.	**08**	**L3**

Course Outcomes:

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

CO1	Adapt HTML and CSS 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 contentsdynamically.

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

High-3: Medium-2: Low-1

Text Books:

1. Fundamentals of Web Development, Randy Connolly, Ricardo Hoar, Pearson EducationIndia, (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 (CIE):

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CIE TEST 1	20	50
CIE TEST 2	20	
Quiz 1 / AAT	05	
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Scheme of Examination (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
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- 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

MACHINE LEARNING ALGORITHMS

Open Elective 1

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS661**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**3: 0: 0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**OE1**	**Credits:**	**03**

Prerequisites (if any): Python for Data Science.

Course Learning Objectives: The course will enable students to:

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: Evolution, Types of ML, Applications, Basic steps of ML, Perspectives and Issues. **Data Pre-processing:** Data Normalization, Data Integration, Data Scaling, Outliers Removal.	**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. **Feature Engineering:** Feature Engineering Processes, Techniques.	**10**	**L2**
Module 3		
Supervised learning - Regression Algorithms: Linear Regression, Polynomial Regression, Regularization methods: Ridge, Lasso and Elastic Net Regression, Regression loss functions, Categorical Variables in Regression. **Use Cases:** 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.	**08**	**L3**
Module 4		
Supervised Learning - Classification Algorithms: Logistic Regression, k-Nearest Neighbors, Naive Bayes, SVM, Decision Trees, Random Forest. **Use Cases:** Prediction of Customer buying Intension due to Digital Marketing, Measuring Acceptability of a New Product, Predicting phishing websites, Loan categorization.	**08**	**L3**
Module 5		
Unsupervised Learning: Dimensionality Reduction, Factor Analysis, PCA, LDA, K-Means Clustering, Agglomerative Hierarchical Clustering, DBSCAN. **Use Cases:** Balanced Score Card Model for Measuring Organizational Performance, Employee Attrition in an Organization, Market Capitalization Categories, Performance Appraisal in Organizations.	**08**	**L3**

Course Outcomes:

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

CO1	Understand the different data pre-processing techniques
CO2	Understand ways to handle missing, noisy data and feature engineering techniques.
CO3	Demonstrate Supervised Learning techniques on real data using regression algorithms
CO4	Demonstrate Supervised Learning techniques on real data using classification algorithms
CO5	Demonstrate Unsupervised Learning techniques on real data using clustering algorithms.

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=Cj0KCQjw29CRBhCUARIsAOboZbJrDLSTHJKj8iIKyhQzv9srD_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

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Quiz 1 / AAT	05	
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- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER - VI

FOUNDATIONS OF DATA SCIENCE

Open Elective 1

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADS662**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**OE1**	**Credits:**	**03**

Prerequisites (if any): Basics of Probability

Course Learning Objectives: The course will enable students to:

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**
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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

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

DEEP LEARNING LABORATORY

Subject Code	**20ADSL67**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
Total Hours	**30**	**Examination Hours**	**03**
No. of Credits: 01			

Course Objectives: The course will enable students to:

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

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**

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of the answer script tobe strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedurepart to be made zero.

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.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

DATA VISUALIZATION LABORATORY

Subject Code	**20ADSL68**	**CIE Marks**	**50**
Hours/Week (L: T: P)	**0:0:2**	**SEE Marks**	**50**
Total Hours	**30**	**Examination Hours**	**03**
No. of Credits: 01			

Course Objectives: The course will enable students to:

CLO1	To become familiar with components and fields available in Tableau desktop.
CLO2	To get exposed to access data and connect data.
CLO3	To learn concepts of charts, plots, maps and mathematical functions to analyze real time data.
CLO4	To become familiar to build dashboard in Tableau.

Prog. No.	Lab 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**

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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – VI

MINI PROJECT

Semester:	**06**	**CIE Marks:**	**50**
Course Code:	**20ADSP69**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**0:0:4**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**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**

GLOBAL ACADEMY OF TECHNOLOGY

(Autonomous Institution Affiliated to VTU)

B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2020-21

VII SEMESTER –UG

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours / Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PC	20ADS71	Deep Learning for Computer Vision	Respective Department	3	2	--	03	50	50	100	4
2	PC	20ADS72	Natural Language Processing		3	-	--	03	50	50	100	3
3	PE4	20ADS73X	Professional Elective 4		3	-	--	03	50	50	100	3
4	PE5	20ADS74X	Professional Elective 5		3	-	--	03	50	50	100	3
5	OE2	20XXX75X	Open Elective 2	Respective Offering Department	3	-	--	03	50	50	100	3
6	PC	20ADSL76	Deep Learning for Computer Vision Laboratory	Respective Department	-	-	2	03	50	50	100	1
7	PC	20ADSL77	Natural Language Processing Laboratory		--	-	2	03	50	50	100	1
8	PC	20ADSP78	Project work Phase I		--	-	4	-	100	-	100	2
9	NCMC	NCMC7	Non Credit Mandatory Course 7	**Industry certified courses**								
10	Internship			(If not completed during the vacation of VI and VII semesters, it shall be carried out during the vacation of VII and VIII semesters)								
			TOTAL		**15**	**02**	**08**	**21**	**450**	**350**	**800**	**20**

Note: PC: Professional Core, PE- Professional Elective, OE- Open Elective, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

Open Elective-2: Students can select any one of the open electives offered by any other Department. Selection of an open elective is **not allowed** provided:

i. The candidate has studied the same course during the previous semesters of the programme.

ii. The syllabus content of open elective is similar to that of Departmental core courses or professional electives.

iii. A similar course, under any category, is prescribed in the higher semesters of the programme. Registration to open electives shall be documented under the guidance of Faculty Advisor.

Project Work Phase-1: Students can form a group with minimum of two and maximum of four. Under the allotted guide, student group should choose the Project title. For the chosen project title, the student group should carry out detailed Literature Survey, Problem Formulation, and Planning and design. CIE evaluation will be through a committee constituted with Guide as one of the members. Committee shall be constituted by HOD and UG project coordinator. CIE evaluation shall be as per the rubrics set by the department. Rubrics design will be done by HOD, UG project coordinator, one Professor, and one Associate Professor. Project Guide should direct and guide the student group to carry out project work.
Internship: 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. SEE 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 SEE examination after satisfying the internship requirements.
NCMC7: The student can take industry (IT/core) certified courses (in campus or off campus) offered by industries and submit course clearance certificate. Students can also take up interdisciplinary certification courses conducted by the industries. The course duration shall be a minimum of 30 hours. The certificate should clearly indicate that the student has cleared the course. The student should complete this course before entering VIII semester.

Professional Elective 4

Sl. No.	Course Code	Course Title
1	20ADS731	Full Stack Web Development
2	20ADS732	Cryptography

Professional Elective 5

Sl. No.	Course Code	Course Title
1	20ADS741	Advanced-Data Visualization Tools
2	20ADS742	Social Network Analysis

Open Elective 2

Teaching Dept.	Sl. No.	Course Code	Course Title
AI & Data Science	1	20ADS751	Data Analytics and Visualization using Tableau
	2	20ADS752	Neural Networks and Deep Learning

Note: Industry certified course is introduced in this semester enabling the student to pursue courses offered by the industries making him industry ready. Student can choose an industry relevant course which can give an edge for placements.

GLOBAL ACADEMY OF TECHNOLOGY

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B.E. in Artificial Intelligence and Data Science

Scheme of Teaching and Examinations 2020-21

VIII SEMESTER –UG

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical / Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PC	20ADS81	Predictive and Time Series Analysis	Respective Department	3	-	--	03	50	50	100	3
2	PE6	20ADS82X	Professional Elective 6		3	-	-	03	50	50	100	3
3	PC	20ADSP83	Project work Phase II		-	-	20	03	50	50	100	10
4	PC	20ADSS84	Technical Seminar		-	-	2	03	50	50	100	1
5	PC	20ADSI85	Internship	Completed during the vacation/s of VI and VII semesters and /or VII and VIII semesters.)				03	50	50	100	3
				TOTAL	**06**	**-**	**22**	**15**	**250**	**250**	**500**	**20**

Note: PC: Professional Core, PE- Professional Elective, OE- Open Elective, HSM: Humanity and Social Science, Non-credit mandatory course.

CIE procedure for Project Work Phase - 2:

(i) 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 skilland question and answer session. CIE evaluation shall be as per the rubrics set by the department. Rubrics design will be done by HOD, UG project coordinator, One professor, One Associate professor and One Assistant Professor. Project Guide should direct and guide the student group to carry out project work.

(ii) 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.

SEE for Project Work Phase - 2:

i. 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.

ii. 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 belongs to.

Internship: Those who have not pursued /completed the internship, shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements.

CIE evaluation shall be as per the rubrics set by the department. Rubrics design will be done by HOD and two senior professors. CIE evaluation will be through a committee constituted by HOD consisting of HOD, guide and two senior faculty.

Technical Seminar: Technical Seminar consists of:

i. Research paper presentation based on review of Research Publications or Patent.

ii. Research papers chosen should be at least from an IEEE conference, Springer Journal, Elsevier Journal

iii. The research paper should be related to the specific domain of engineering to which the student belongs.

CIE evaluation shall be as per the rubrics set by the department. Rubrics design will be done by HOD and two senior professors. CIE evaluation will be through a committee constituted by HOD consisting of HOD, guide and two senior faculty members.

NCMC8: Student can take up any competitive exams like TOFEL, GRE etc., or MOOC course.

For clearing this Non-Credit course:

i. For the Competitive exam, the student should submit the passing score card.

ii. For MOOC course, student should submit certificate (or screen shot) from the registered online platforms (i.e., NPTEL, Coursera, Edx, Udacity etc.). The certificate or thescreenshot should indicate that the student has cleared the online course.

The student can also take industry certified courses offered by industries in campus or off campus and submit course clearance certificate. Students can also take upinterdisciplinary certification courses conducted by the industries. The industry certified courses taken in the seventh semester should not be repeated.

Student must complete this course to become eligible for awarding the degree.

Professional Elective 6

Sl. No.	Course Code	Course Title
1	20ADS821	Data Science for Security
2	20ADS822	Quantum Machine Learning

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER-VII

DEEP LEARNING FOR COMPUTER VISION

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS71**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:2:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**04**

Prerequisites (if any): Image Processing & Deep Learning

Course Learning Objectives: This course will enable students to:

Sl. No	Course Learning Objectives (CLO)
1	To impart the fundamentals of image formation, the major ideas, methods, and techniquesof 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 Objectdetection and Face Recognition systems
4	To provide the student with programming experience from implementing computer visionand 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, gridcells, 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 betweenVAEs & 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, PracticalImplementation.	**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'sautonomy (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 Studiesand 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

NATURAL LANGUAGE PROCESSING

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS72**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**03**

Prerequisites (if any): Machine Learning and Deep Learning

Course Learning Objectives: This course will enable students to:

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 mediaand 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**

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 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/ developinga 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 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 –VII
FULL STACK WEB DEVELOPMENT
Professional Elective 4

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS731**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**3: 0 :0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PE4**	**Credits:**	**03**

Prerequisites: HTML, CSS and JavaScript

Course Learning Objectives: This course will enable students to:

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, passingmethods 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, FormValidation, 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, AriLerner, 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 , KamilPrzeorski, 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 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.

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

Table 1: CIE Evaluation		
Components	**Marks**	**Total**
CIE 1	40	50
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CIE 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 –VII
CRYPTOGRAPHY
Professional Elective 4

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS732**	**SEE Marks:**	**50**
Hours/Week (L:T:P):	**3: 0 :0**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PE4**	**Credits:**	**03**

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:

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/ 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 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 –VII
ADVANCED DATA VISUALIZATION TOOLS
Professional Elective 5

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS741**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE5**	**Credits:**	**03**

Prerequisites (if any): None
Course Learning Objectives: This course will enable students to:

Sl. No	Course Learning Objectives (CLO)
1	To introduce students to the fundamental problems, concepts and approaches in the design andanalysis 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 futureindustry.
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: Data Modelling in Tableau, Performing Data Analysis on a relational model, Building Relationships in Tableau, working on creating calculated fields, Building Visualizationsusing 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: Level of Details Expression (LOD) fundamentals. FIXED, INCLUDE and EXCLUDE LODs and their application to solve complexproblems, 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 averageschart. Reference bands and distribution bands with parameterization. Students will Perform analysis on various datasets to understand the above concepts.	**12**	**L3**

Module 3		
Machine Learning using Tableau/Python: Machine Learning using Tableau/Python, Installation of TabPy server. Connectingbetween Tableau and Python using TapPy. Passing Data from Tableau to Python, Simple and Multiple Linear regression inTableau 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 TabPyServer. 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		
Power BI: Importing Data into PowerBI, Creation of Various charts – Stacked Bar chart, stackedcolumn 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, CreateModel 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 datastory.
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	2	2	3		3	2			2		2	2	3	2
CO4	1	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 forData 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 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 createinnovative 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/ reportbased on participation in create-a-thon/make-a-thon/ code-a-thon/ hack-a-thon conducted by reputed organizations/ anyother.

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 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 SCIENCESEMESTER –VII

SOCIAL NETWORK ANALYSIS

Professional Elective 5

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS742**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE5**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	Understand the theoretical foundations of social network analysis.
2	Acquire proficiency in collecting and preprocessing network data.
3	Analyze and interpret network structures and properties.
4	Apply network analysis techniques to real-world datasets.
5	Evaluate research literature and communicate findings effectively.

Module 1	No. of Hours	RBT Level
Introduction to Social Network Analysis: Definition, Historical development, Nodes and edges, Directed vs. undirected networks, Weighted vs. unweighted networks, Types of ties: friendship, communication, collaboration, Types of Networks: Social, Technological, Biological, Properties of networks: density, centrality, clustering coefficient	**08**	**L3**
Module 2		
Network Data Collection and Representation: Methods of data collection, Ethical considerations in network data collection, Data preprocessing techniques: cleaning, transforming, and formatting, Types of Network Data Representation: adjacency matrices, edge lists, and node lists, Introduction to network visualization and analysis tools (Gephi, NetworkX)	**08**	**L3**
Module 3		
Network Measures and Centrality Analysis: Network measures: degree, centrality, betweenness, closeness, and eigenvector centrality, Interpretation of centrality measures, Visualization techniques for centrality analysis, Applications of centrality measures in identifying influential nodes, detecting communities, and understanding network dynamics	**08**	**L3**
Module 4		
Community Detection and Network Dynamics: Community detection algorithms: modularity-based methods, hierarchical clustering, and spectral clustering, Identification and interpretation of network communities, Dynamic networks: temporal network analysis and evolution of networks over time, Introduction to diffusion and contagion models in networks, Case studies and practical applications of community detection and dynamic network analysis	**08**	**L3**
Module 5		
Applied SNA: Network resilience and robustness analysis, Multiplex networks and their analysis, Network motifs and structural patterns, Social influence and opinion dynamics in networks, Case studies and real-world applications of advanced SNA techniques	**08**	**L3**

Course Outcomes:

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

CO1	Define and explain fundamental concepts in social network analysis.
CO2	Preprocess raw network data to clean, transform, and format it for analysis.
CO3	Interpret the implications of network analysis for understanding social phenomena.
CO4	Apply network analysis techniques to real-world datasets to investigate social networks in various domains.
CO5	Evaluate research literature on social network analysis and synthesize key findings.

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

High-3: Medium-2: Low-1

Text Books:

1) "Social Network Analysis" by John Scott, 2016.
2) "Networks, Crowds, and Markets: Reasoning About a Highly Connected World" by David Easley and Jon Kleinberg, 2012.

Reference Books:

1. "Analyzing Social Networks" by Stephen P. Borgatti, Martin G. Everett, and Jeffrey C. Johnson, 2018.
2. "Handbook of Social Network Analysis" edited by Peter J. Carrington, John Scott, and Stanley Wasserman, 2012.

Books / Web References:

1. Social Network Analysis for Startups, by Maksim Tsvetovat, Alexander Kouznetsov, O'Reilly Media, 2011. https://www.ebooks.com/en-in/book/837470/social-network-analysis-for-startups/maksim-tsvetovat/
2. Social Network Analysis: A Complete Guide, by Gerardus Blokdyk, 2020. https://www.everand.com/search?query=2.%09Social%20Network%20Analysis%3A%20A%20Complete%20Guide%2C%20By%20%20Gerardus%20Blokdyk

MOOCs:

1. https://www.coursera.org/learn/social-network-analysis
2. https://onlinecourses.nptel.ac.in/noc22_cs117/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 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 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

DATA ANALYTICS AND VISUALIZATION USING TABLEAU

Open Elective 2

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS751**	**SEE Marks;**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**OE2**	**Credits:**	**03**

Prerequisites (if any): None

Course Learning Objectives: The course will enable students to:

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 presenteffective 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 4 C's of Data Visualization, Best practices (examples).	**08**	**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.	**08**	**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.	**08**	**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.	**08**	**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.	**08**	**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 DataVisualization.
CO2	Learn ways to create dashboards as well as story points to develop a strong, powerfuldata story.
CO3	Learn ways and methods to analyze and apply design principles to Tableauvisualization.
CO4	Acquaint themselves with various functions available in Advanced Tableau, Power BItools.
CO5	Familiarize themselves well with current trends in Data Visualization through relevantcase 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

E-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: 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 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
NEURAL NETWORKS AND DEEP LEARNING
Open Elective 2

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADS752**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**OE2**	**Credits:**	**03**

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

Course Learning Objectives: The course will enable students to:

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.	**08**	**L2**
Module 2		
Convolutional Neural Networks: Mathematics behind CNN, Layers, Architectures of CNN, ILSVRC winnerarchitectures, Implementation of CNN, Building the model from the scratch.	**08**	**L3**
Module 3		
Gradient based approaches Introduction: Gradient based approaches, Visualizing gradients, Saliency map, Class Model, SmoothGRAD, DeConvolution, Guided Back Propagation Grad-CAM, Occlusion sensitivity.	**08**	**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 LayersImplementation example using Keras in Python: sentiment analysis	**08**	**L3**
Module 5		
Other Deep Learning Architectures: Encoder-Decoder Architecture, Attention Mechanism, Transformer Architecture, Generative Adversarial Networks, Unet.	**08**	**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/

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 autonomv (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 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 – VII

DEEP LEARNING FOR COMPUTER VISION LABORATORY

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADSL76**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**0: 0: 2**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**01**

Prerequisites: Deep Learning Lab

Course Objectives: This course will enable students to:

1	To develop skills to preprocess the images.
2	To apply the concepts of YOLO and Faster R-CNN for object detection.
3	To demonstrate the concept of Image Captioning and generate the images using VAE
4	To develop the skills to detect the face using Eigenface.

S. No.	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.	**03 L3**
3	Write a python program to implement Faster R-CNN.	**03 L3**
4	Write a python program to demonstrate the Image captioning.	**03 L3**
5	Write a python program to implement the VAE.	**03 L3**
6	Write a python program to demonstrate the diffusion model from the scratch.	**03 L3**
7	Write a program for face detection using Eigenface.	**03 L3**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER – VII
NATURAL LANGUAGE PROCESSING LABORATORY

Semester:	**07**	**CIE Marks:**	**50**
Course Code:	**20ADSL77**	**SEE Marks:**	**50**
Hours/Week(L:T:P):	**0: 0: 2**	**Duration of SEE(Hours):**	**03**
Type of Course:	**PC**	**Credits:**	**01**

Prerequisites: Deep Learning Lab

Course Objectives: This course will enable students to:

1	To develop skills to analyze text processing algorithms.
2	To analyze Natural Language Generation and apply machine translation.
3	To understand statistical approaches for different types of NLP applications.
4	To gain knowledge in practical applications of Natural Language Processing.

S. No.	Programs	No. of Hours/ RBT levels
1	Write a Python program to demonstrate Lemmatization and Stemming.	**03 L3**
2	Write a program to implement TF-IDF technique and demonstrate Word2vec embedding.	**03 L3**
3	Write a program for implementing POS tagging and Named Entity Recognition using NLTK.	**03 L3**
4	Write a program for spam detection using NLTK.	**03 L3**
5	Write a program to demonstrate Neural machine translation with attention.	**03 L3**
6	Write a program to build an NLP classifier which can use input text parameters to determine the label/s of theblog.	**03 L3**
7	Write a program to design and test a sequential model that analyses the customer's sentiments based on theirreviews in the IMDB database.	**03 L3**
8	Write a program to implement transfer learning, paraphrasing from iNLTK.	**03 L3**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –VII

PROJECT WORK PHASE I

Semester:	**07**	**CIE Marks:**	**100**
Course Code:	**20ADSP78**	**SEE Marks:**	**-**
Hours/Week (L: T: P):	**0:0:4**	**Duration of SEE (hours):**	**-**
Type of Course:	**PC**	**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

PREDICTIVE & TIME SERIES ANALYSIS

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**20ADS81**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**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**	**L2**

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	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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:

1) Hamilton, James D. *Time series analysis*. Princeton university press, 2020.
2) Montgomery, Douglas C., Cheryl L. Jennings, and Murat Kulahci. *Introduction to time series analysis and forecasting*. John Wiley & Sons, 2015.
3) 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.

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 & DATA SCIENCE

SEMESTER - VIII

DATA SCIENCE FOR SECURITY

Professional Elective 6

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**20ADS821**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE 6**	**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

QUANTUM MACHINE LEARNING

Professional Elective 6

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**20ADS822**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**3:0:0**	**Duration of SEE (hours):**	**03**
Type of Course:	**PE 6**	**Credits:**	**03**

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

Course Learning Objectives:

Sl. No	Course Learning Objectives (CLO)
1	To understand in detail the bagging and boosting algorithms
2	To enhance the understanding of basic principle of classical deep learning
3	To explore quantum Convolutional Neural Networks.
4	To understand sequence to sequence models in the quantum deep neural networks.

Module 1	No. of Hours	RBT Level
Boosting and Adiabatic Quantum Computing: Quantum Annealing, Quadratic Unconstrained Binary Optimization, Ising Model, QBoost, Nonconvexity, Sparsity, Bit Depth, and Generalization Performance, Mapping to Hardware, Computational Complexity.	**8**	**L2**
Module 2		
Principles: Basic principles of classical deep learning, principles of quantum computing, Quantum Neural Networks: Representing the input, modeling the quantum network, observing the output, learning network parameters, QNN variants.	**8**	**L2**
Module 3		
Quantum CNN: Paradigm of QCNN, Build QCNN, BUILD ARSITEKTUR, Hybrid QCNN.	**8**	**L2**
Module 4		
Quantum RNN, Quantum LSTM : Quantum RNN, Quantum LSTM	**8**	**L2**
Module 5		
Quantum Deep Neural Networks: Particle implementation of quantum deep neural networks	**8**	**L3**

Course Outcomes:

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

CO1	Understand the fundamental concepts of bagging and boosting algorithms.
CO2	Understand the working principle of deep neural networks.
CO3	Understand the Quantum convolutional neural networks to images.
CO4	Understand QRNN and QLSTM on time series data
CO5	Apply the knowledge obtained from the quantum deep neural networks on the real 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. "Quantum Machine Learning : An Applied Approach: The Theory and Application of Quantum Machine Learning in Science and Industry." Santanu Ganguly, Ashford, UK, ISBN-13 (pbk): 978-1-4842-7097-4 https://doi.org/10.1007/978-1-4842-7098-1 Copyright © 2021 by Santanu Ganguly.

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 & DATA SCIENCE

SEMESTER – VIII

PROJECT WORK PHASE – II

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**20ADSP83**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**0:0:20**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**Credits:**	**10**

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	**50**	**50**
	Review-2		
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VIII

TECHNICAL SEMINAR

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**20ADSS84**	**SEE Marks:**	**50**
Hours/Week (L: T: P):	**0:0:2**	**Duration of SEE (hours):**	**03**
Type of Course:	**PC**	**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.

SEE for Seminar:

Contribution to the seminar 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 and SEE of Regular courses

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

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER – VIII

INTERNSHIP

Semester:	**08**	**CIE Marks:**	**50**
Course Code:	**20ADSI85**	**SEE Marks:**	**50**
Type of Course:	**PC**	**Credits:**	**03**

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	**50**	**50**
	Review-2		
SEE	Semester End Examination	**50**	**50**
Grand Total			**100**

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