Proceedings of the Meetings of the Board of Studies in BCA (Artificial Intelligence & Data Science) (UG) Universal Institute For Private Training, Kuwait, held on 30-05-2025 at 3.00 p.m. through Virtual Mode.

Members Present:

1. Prof. Suresha - Chairperson, BOS
2. Ms. Syeda Roshmi Ahmed - Member
3. Ms. Shaistha Naaz - Member
4. Ms. Renuka Devi G - Member
5. Mrs. Syeda Fathima - Member

The meeting was initiated with a welcome speech by Chairman of the board through Virtual Mode. The importance of the meeting was presented along with the agenda of framing the 2nd and 3rd year syllabus and regulation for **BCA (Artificial Intelligence & Data Science)** programme as per SEP.

After detailed discussion among the members, the following were resolved to be recommended through Virtual Mode.

The proposed BCA (Artificial Intelligence & Data Science) program offered under the SEP regulations being followed by the university from time to time.

The 2nd and 3rd year Syllabus and methodology of assessment and evaluation for BCA (Artificial Intelligence & Data Science) program- Prepared & approved.

Finally, the chairman of BoS thanked all the members for their valuable time, support and valuable suggestions.

(Prof. Suresha)
Chairperson, BOS

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BCA (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

Under SEP System

(With effect from the academic year 2024-2025)

Proposed SEP Regulations for 3-Year Semester Course Leading to

BCA (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

Regulations - 2024

NOTE:

These regulations are applicable to students taking admission to I semester **BCA (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)**

The duration of the course shall be 3 years consisting of 06 semesters.

1. Each semester shall extend over a minimum period of SIXTEEN weeks teaching duration.

1.0 NAME OF THE COURSE AND DURATION OF THE COURSE.

2.0 BCA (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)

The duration of the **BCA (ARTIFICIAL INTELLIGENCE & DATA SCIENCE)**course shall be of 03 years of 6 semesters. A candidate shall complete his/her degree within 06 academic years from the date of admission to the course

3.0 ELIGIBILITY FOR ADMISSION

Students who have passed Pre-University Examination (10+2) or equivalent examination with maths / Computer science / Business mathematics / Accounting or 3 years diploma after SSLC/10th with CS engineering/ Information Science or Engineering or equivalent.

3.0 SCHEME OF INSTRUCTIONS:

In the first four semesters, there shall be 19 subjects from Discipline SpecificCourses and 10 subjects from Ability Enhancement Compulsory Courses. In the last two semesters, there shall be 6 subjects each Discipline Specific Elective. For each subject, there shall be lecture classes, tutorials/practicals. The credits for each subject vary between 3 and 5 per subject per week as prescribed in the curriculum.

Credits Matrix :

Course		Total credits
Discipline Specific Course	19 Papers	84
Discipline Specific Elective	06 Papers X 5 Credits	30
Ability Enhancement Compulsory Courses	10 Papers X 3 Credits	30
TOTAL (36 Papers)		144

4.0 SCHEME OF EXAMINATION AND EVALUATION:

There shall be university examination at the end of each semester for maximum marks of 80 for Theory examination and the Internal Assessment will be for 20marks.

All papers of this course except papers that are common to all other graduate courses of the University of Mysore, shall be set/valued/reviewed by BOE for a maximum of 80 marks. The pattern of question paper will be as follows:

Part- A: Answer any three out of five questions. 3*15=45

Part- B : Answer any two out of four questions. 2*10=20

Part- C : Answer any three out of five questions. 3*05=15

TOTAL **80**

Evaluation of each subject is divided into internal assessment (IA) and end term examination with marks allocated as shown in the table. Internal assessment will be carried out in two stages: One, after the eight weeks of instructions designated as C1, the second, after sixteen weeks of instruction designated as C2. The end of term examination designated as C3 will be held between eighteenth andtwentieth week of the semester. IA marks will be awarded on the basis of continuous assessment that include announced and surprise tests, term papers / seminars / quizzes / case discussions, viva, and practical's.

The breakup of marks for the AECC will be as follows:

a. C1 (Covering the first half of the syllabus) – 10 Marks

b. C2 (Covering the second half of the syllabus) - 10 Marks

c. C3 (Covering entire syllabus) – 80 Marks

Total –100 Marks

The breakup of marks for the DSC WITHOT PRACTICAL will be as follows:

a. C1 (Covering the first half of the syllabus) – 35 Marks

b. C2 (Covering the second half of the syllabus) - 35 Marks

c. C3 (Covering entire syllabus) – 80 Marks

Total –150 Marks

The breakup of marks for the DSC WITH PRACTICAL will be as follows

a. C1 (Covering the first half of the syllabus) – 10 Marks

d. C2 (Covering the second half of the syllabus) - 10 Marks

e. C3 (Covering entire syllabus) – 80 Marks

f. Practical Marks - 50 Marks

Total –150 Marks

Term end examination (C3) will be of 3 hours duration for each subject.

Evaluation of each subject is divided into internal assessment (IA) and end term examination with marks allocated as shown in the table. Internal assessment will be carried out in two stages: One, after the eight weeks of instructions designated as C1, the second, after sixteen weeks of instruction designated as C2. The end of term examination designated as C3 will be held between eighteenth andtwentieth week of the semester. IA marks will be awarded on the basis of continuous assessment that include announced and surprise tests, term papers / seminars / quizzes / case discussions, viva, and practical's.

Scheme of Assessment

Course Type	C1	C2	C3	PRACTICAL		Total
	Marks	Marks	Marks		Duration (Hrs)	
AECC	10	10	80		3	100
DSE	10	10	80		3	100
DSC(WITHOUT PRACTICAL)	35	35	80		3	150
DSC(WITHPRACTICAL)	10	10	80	50	3	150
PRACTICAL 1	05	05	40		2	50
PRACTICAL 2	05	05	40		2	50

Courses in the programme are of three types: Ability Enhancement Compulsory Courses, Discipline Specific Elective and Discipline Specific Course

5.0 ATTENDANCE:

- Each semester shall be taken as a unit for the purpose of calculating attendance and a student shall be considered to have put in the required attendance for that semester if the candidate has attended not less than 75% of the number of working days (lectures during each semester)
- A candidate who does not satisfy the requirement of attendance shall not be eligible to take the examination of the concerned semester.
- A candidate who fails to satisfy the requirement of attendance in a semester shall re-join the same semester by obtaining prior permission from the University.

6.0 MEDIUM OF INSTRUCTION:

The medium of instruction shall be English.

7.0 APPEARANCE FOR THE EXAMINATION:

A candidate shall apply for all the papers of a semester when he appears for examination of each semester for the first time.

8.0 BOARD OF EXAMINERS, VALUATION:

- There shall be a Board of Examiners for scrutinizing and approving the question papers and scheme of valuation constituted by the University.
- There will be single valuation for all the papers.

9.0 DECLARATION OF RESULT:

DECLARATION OF RESULT:

- Minimum for a pass in each paper shall be 35%, and for all the papers in the semester average shall be 40%. However, a candidate has to score minimum of 35% of theory component of semester end examination i.e. 28(rounded off) marks out of 80 marks.
- There shall be no minimum marks for C1 and C2.
- Classification of successful candidates and Gradation of results shall be as per the University regulations as shown below;

Letter grade	Grade point
O (Outstanding)	10
A+(Excellent)	9
A (Very Good)	8
B+(Good)	7
B (Above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

10.0 PROVISION FOR REPEATERS:

- A candidate is allowed to carry all the previous un-cleared paper/s to the subsequent semester/s.
- The candidate shall take the examination as per the syllabus and scheme of examination in force during the subsequent appearances.
- **PROVISION FOR RE-ADMISSION**:
- Such of those candidates who have discontinued the course/failed to take admission to the next semester, shall get admitted to the concerned semester in the immediate next academic year only. This provision is available to a student only two times in the entire duration of the course.
- **Any other issue not envisaged above** shall be resolved by the Vice Chancellor in consultation with the appropriate bodies of the University which shall be final and binding.
- Wherever the regulation is silent, the provisions of University regulations shall be applicable.

DSC = Discipline Specific Course

DSE = Discipline Specific Elective

AECC = Ability Enhancement Compulsory Courses

* Any one of the languages from
Kannada/Sanskrit/Urdu/Tamil/Telugu//Marathi//Hindi/French/German/Persian/Arabic

SEMESTER 1

Sl No.	Subject	Courses Category	Credits	L:T:P Pattern
	Semester – I			
1	English	AECC	3	2-1-0
2	Kannada-1/Sanskrit/Urdu/Tamil/ Telugu//Marathi/Hindi	AECC	3	2-1-0
3	Foundations of Data Science, ML and AI	DSC	5	3-2-0
4	Python for Machine Learning & Artificial Intelligence	DSC	3	3-0-0
5	Fundamentals of IT& Programming in C	DSC	3	3-0-0
6	Environmental studies	DSC	2	2-0-0
7	Practical 1: Python for Machine Learning & Artificial Intelligence	DSC	2	0-0-2
8	Practical 2:Fundamentals of IT & Programming in C	DSC	2	0-0-2
	Total Credits		23	

	Semester - II			
1	English	AECC	3	2-1-0
2	Kannada-1/Sanskrit/Urdu/Tamil/ Telugu//Marathi/Hindi	AECC	3	2-1-0
3	Data structure & Algorithm using Python	DSC	3	3-0-0
4	Object-Oriented Programming with Java	DSC	3	3-0-0
5	Constitution of India	DSC	2	2-0-0
6	Statistical Methods for Data Science	DSC	5	3-2-0
7	Practical 1: Data structure & Algorithm using Python	DSC	2	0-0-2
8	Practical 2: Object-Oriented Programming with Java	DSC	2	0-0-2
	Total Credits		23	
	Semester - III			
1	English	AECC	3	2-1-0
2	Kannada-1/Sanskrit/Urdu/Tamil/ Telugu//Marathi/Hindi	AECC	3	2-1-0
3	Big Data Processing and Analytics	DSC	5	3-2-0
4	Data Science and Business Analytics using Python	DSC	4	3-1-0
5	RDBMS for Data Analytics & Data Science	DSC	4	3-1-0
6	Machine Learning applications in Data Science	DSC	5	3-2-0
7	Practical 1: Data Science and Business Analytics using Python	DSC	2	0-0-2
8	Practical 2 :RDBMS for Data Analytics & Data Science	DSC	2	0-0-2
	Total Credits		28	
	Semester – IV			
1	English	AECC	3	2-1-0
2	Kannada-1/Sanskrit/Urdu/Tamil/ Telugu//Marathi/Hindi	AECC	3	2-1-0
3	Datawarehouse and Data mining techniques	DSC	4	3-1-0
4	Operating Systems	DSC	4	3-1-0
5	Mathematical foundations for ML, AI & Data Science	DSC	5	3-2-0
6	Introduction to Cybersecurity	DSC	5	3-2-0

7	Practical 1: Mathematical foundations for ML, AI & Data Science	DSC	2	0-0-2
8	Practical 2: Datawarehouse and Data mining techniques	DSC	2	0-0-2
	Total Credits		28	
	Semester - V			
1	Data Visualization Tools and Techniques	DSC	4	3-1-0
2	Cloud Computing Fundamentals	DSC	4	3-1-0
3	Entrepreneurship Development	DSE	4	3-1-0
4	AI and Data Science Project	DSC	16	0-4-12
5	Management Information System (MIS)	DSE	4	3-1-0
6	Computer Networks and Data Communication technology	DSC	4	3-1-0
	Total Credits		36	
	Semester - VI			
1	Internship in Company	DSC	20	0-4-16
2	Fundamentals of Natural Language Processing	DSC	4	3-1-0
3	AI Ethics & Law	DSE	4	3-1-0
4	Introduction to Deep Learning techniques	DSE	4	3-1-0
	Total Credits		32	
	Award of Bachelor of Computer Applications With Research (After 3 Years: 170 Credits)			

L	Lecture
T	Tutorial
P	Practical
AECC	Ability Enhancement Compulsory Courses
DSC	Discipline Specific Core
DSE	Discipline Specific Elective

SEMISTER III

1.ENGLISH

2. KANNADA-1/SANSKRIT/URDU/TAMIL/

TELUGU//MARATHI/HINDI/FRENCH

3. Big Data Processing and Analytics

Course Objective:

1. To understand the characteristics and challenges of Big Data.
2. To familiarize students with the technologies and tools used for storing and processing Big Data.
3. To develop skills for analyzing and extracting insights from large datasets.
4. To explore real-world applications of Big Data in different domains.

Course Content:

Modules	Course Topics
I	Definition and characteristics of Big Data, Types of Big Data: structured, unstructured, and semi-structured data, Challenges and opportunities in Big Data analytics Overview of Hadoop ecosystem: HDFS, MapReduce, YARN, Introduction to Apache Spark and its ecosystem, Comparison of batch and stream processing in Big Data.
II	**Distributed file systems**: HDFS and its architecture, NoSQL databases: types and characteristics, Introduction to key-value stores, column-family stores, and document-oriented databases MapReduce paradigm and its implementation, Introduction to Spark RDDs (Resilient Distributed Datasets), Hands-on exercises on writing MapReduce and Spark applications.
III	Introduction to data analytics and its lifecycle, Exploratory data analysis (EDA) techniques, Introduction to machine learning algorithms for Big Data analytics, Overview of cloud-based Big Data platforms (e.g., AWS, Google Cloud), Introduction to containerization and orchestration tools (e.g., Docker, Kubernetes), Hands-on experience with deploying Big Data applications on cloud platforms.
IV	**Big Data in healthcare**: predictive analytics and personalized medicine, Big Data in finance: fraud detection and risk management, **Big Data in e-commerce**: recommendation systems and customer segmentation. Ethical considerations in Big Data analytics, Privacy issues and data protection regulations, Strategies for ensuring ethical and responsible use of Big Data.

Reference:

1. "Big Data: Principles and Best Practices of Scalable Realtime Data Systems" by Nathan Marz and James Warren
2. "Hadoop: The Definitive Guide" by Tom White
3. "Spark: The Definitive Guide" by Bill Chambers and Matei Zaharia

4.Data Science & Business Analytics using Python

Course Objective:

1. Using the frameworks necessary to analyze and interpret data
2. To acquire technical expertise using popular open source analytics frameworks for Data Science
3. To define the Demonstrate knowledge of statistical data analysis techniques utilized in business decision making
4. To learn how to Use data mining software to solve real-world problems.

Course Content:

Modules	Course Topics
I	**INTRODUCTION OF PYTHON** What is Python, Its advantages and disadvantages, How to run python scripts, How to use variables, String operator and functions, Inputting the data, Working with Boolean and other statements, Use of pandas library for data analysis, Different types of errors that one can encounter while working with Python.
II	**INTRODUCTION TO DATA SCIENCE** What is Data Science, what does a data scientist do, various examples of Data Science in the industries, How Python is deployed for Data Science applications, Various steps in Data Science process like data wrangling, data exploration and selecting the Model
III	**DATA MANIPULATION AND VISUALIZATION** Introduction to NumPy, Pandas and Matplotlib, How to Import NumPy module, what is a data Manipulation using Panda's library? Series object in pandas, Data Frame in Pandas, Loading an handling data with Pandas, Introduction to Matplotlib, Using Matplotlib for plotting Graphs and charts like Scatter, Bar, Pie, Line, Histogram and more

IV	**SUPERVISED AND UNSUPERVISED LEARNING** What is linear regression? Logistic Regression, what is classification? Decision Tree, Confusion Matrix, Random Forest, Naïve Bayes classifier, support vector machine, use cases of unsupervised learning, what is clustering and Types 15 Hours 1 of clustering. What is K-means clustering and Hierarchical Clustering? Step by step calculation of k-means algorithm.
V	**Business Analytics using Python** Building predictive models, Answering business questions through data Analysis

Reference:

1. Analytics: Data Science, Data Analysis and Predictive Analytics for Business" by Daniel Covington.
2. Machine Learning for Big Data: Hands-On for Developers and Technical Professionals" by Jason Bell

5. RDBMS for Data Analytics & Data Science

Course Objective:

1. To present the fundamental concepts of Database Management. To understand conceptual and physical design of a database.
2. To understand RDBMS and to design Relational database and perform various SQL commands.
3. To develop skill of Database Design, Database Languages and Database-System Implementation with respect to Relational Database Management System.
4. To develop the concepts of Transaction Processing System, Concurrency control and Recovery procedures in database.

Course Content:

Modules	Course Topics
I	**Introduction:** Meaning of data and information, need for data, data processing and information. Meaning of persistent data, Meaning of file and file management system. File Structure and Organization, Introduction, Logical and Physical Files, Basic File Operations, File Organization, Types of file organization. **Database Management System:** Introduction, Definition of DBMS, Evolution of DB & DBMS, Characteristics of the Database Approach, Components of Database System, database management system vs. file management system, Advantages and Disadvantages of DBMS, Users of

	DBMS, DBMS Architecture, Capabilities of good DBMS, Database Schemas and Instances, Classification of Database Management Systems, database languages; **Data Models**: Introduction Data Models: Object Based Logical Model; Record Based Logical Model: Relational Model, Network Model, Hierarchical Model; Entity Relationship Model.
II	**Relational Database Management System & Data Modeling:** Introduction to relational database, Structure of Relational Database, Data Modeling Using the **EntityRelationship Model**: Entity Types, Entity Sets, Attributes, and Keys, Relationships, Relationship Types, Rules, and Structural, Constraints, Weak Entity Types, ER Diagrams, Naming Conventions, and Design Issues. Relational Data Model, Relational Constraints, Relational model terminology; domains, Attributes, Tuples, Relations, Relational Algebra: Basic operations selection and projection, Set Theoretic operations Union, Intersection, set difference and division, Codd's Rules for relational algebra, Relational Database Schemas, Examples of Queries in Relational Algebra
III	**SQL and Database Design Theory**: The Relational Database Standard: Data Definition, Constraints, and Schema Changes in SQL, Types of SQL Commands(DDL, DML, DCL), SQL Operators and their Precedence, Insert, Delete, and Update Operations and Dealing with Constraint Violations, Queries and Sub Queries, Aggregate Functions, Joins, Unions, Intersection, Minus, Views (Virtual Tables) in SQL. **Functional Dependencies andNormalization**: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Anomalies in a Database ,Armstrong Rules, Closure of Attributes, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Forms.
IV	**Transaction Processing & Concurrency Control**: Transaction Processing Concepts; Introduction to Transaction Processing, Consistency and Isolation, Atomicity and Durability, Transaction and System Concepts, Desirable Properties of Transactions. Transaction logs, Importance of backups. Database recovery. Data storage. Causes, of failures. Recovery concepts and terminology. Concurrency Control: Definition of concurrency, lost update, dirty read and incorrect summary problems due to concurrency.

Reference:

1. Korth, Silbertz, Sudarshan —Data Base Concepts, McGraw-Hill.
2. Elmasri, Navathe —Fundamentals Of Data Base Systems, Addision Wesley.
3. Date C. J.—An Introduction to Data Base System, Addision Wesley.
4. Bipin C. Desai —An introduction to Data Base Systems, Galgotia Publication.
5. Ramakrishnan, Gehrke —Data Base Management System, McGraw-Hill.
6. Connolly & Begg —Database Systems: A Practical Approach to Design, Implementation and Management, Pearson Education.

R. S. Despandey --SQL/PL SQL forOra

6.Machine Learning applications in Data Science

Course Objective:

To acquire the fundamental knowledge of Machine Learning. Course Outcomes

1. Understand the basics of machine learning concepts.
2. Learn various algorithms of machine learning.
3. Learn and apply extended concepts of machine learning.
4. Learn and solve the Neural Network concepts and problems.

Course Content:

Modules	Course Topics
I	**Introduction**: Definition of Machine Learning, Key elements of Machine Learning, The origins of Machine Learning, Machine learning in practice, Design of a Learning System, Types of Machine Learning: Supervised Learning, Semi Supervised Learning, Unsupervised Learning, Reinforcement Learning and Artificial Neural Network, Applications of Machine Learning; Data Pre-Processing: Overview and Need of Data Preprocessing, Data Quality, Factors Affecting Data Quality; Major Task in Data Pre-processing: Cleaning, Integration, Reduction, Transformation, and discretization; Scaling: Types of Scaling, Normalization and Standardization.
II	**Supervised Learning**: Classification and Regression, Generalization, Overfitting, and Underfitting, Supervised Machine Learning Algorithms, K-Nearest Neighbors (KNN), Support Vector Machine (SVM): Working of SVM, Implementation; Decision Tree: Working and Implementation; Naïve Bayes Classifier: Introduction to Naïve Bayes Algorithm, building a model Using Naïve Bayes;
III	**Supervised Learning**: Classification and Regression, Generalization, Overfitting, and Underfitting, Supervised Machine Learning Algorithms, K-Nearest Neighbors (KNN), Support Vector Machine (SVM): Working of SVM, Implementation; Decision Tree: Working and Implementation; Naïve Bayes Classifier: Introduction to Naïve Bayes Algorithm, building a model Using Naïve Bayes;
IV	**Artificial Neural Network:** Motivation, Neural Network Representation, Perceptron, Training Rule, Activation Functions and types of Activation Functions, Introduction to Gradient Descent and Delta Rule. Feed Forward Neural Network, Back Propagation Network: Overview, Back Propagation Algorithm.

References:

1. Tom M. Mitchell, "Machine Learning", First Edition by Tata McGraw-Hill Education, 2013.

2. Jiawei Han, Micheline Kamber, Jian Pie, "Data Ming Concept and Techniques", Morgan Kaufmann, 3 rd Addition, 2011.
3. Fengxiang He and Dacheng Tau, "Machine Learning Foundation, Methodologies and Application", Springer 2023.
4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly, 201

SEMESTER IV

1.ENGLISH

2. KANNADA-1/SANSKRIT/URDU/TAMIL/

TELUGU//MARATHI/HINDI/FRENCH

3.Data Warehouse & Data Mining techniques

Course Objective:

The primary objective of this course is to provide students with a comprehensive understanding of Data Warehousing and Data Mining concepts, techniques, and applications within the context of Computer Applications. By the end of this course, students will:

1. **Understand the Fundamentals:** Gain a solid foundation in the concepts, principles, and architecture of Data Warehousing and Data Mining systems.
2. **Master Data Warehousing:** Acquire the knowledge and skills necessary to design, implement, and manage data warehouses effectively.
3. **Explore Data Mining Techniques:** Learn various data mining techniques, algorithms, and methodologies for extracting useful patterns, trends, and insights from large datasets. Understand the applications of data mining in real-world scenarios.

Course Content:

Modules	Course Topics
I	Data Mining overview, Data Warehouse and OLAP Technology ,Data Warehouse Architecture, Steps for the Design and Construction of Data Warehouses, A Three-Tier Data Warehouse Architecture ,OLAP, OLAP queries, metadata repository, Data Preprocessing – Data Integration and Transformation, Data Reduction, Data Mining Primitives: What Defines a Data Mining Task? Task-Relevant Data, The Kind of Knowledge to be Mined,KDD
II	Mining Association Rules in Large Databases, Association Rule Mining, **Market Basket Analysis:** Mining A Road Map, The Apriori Algorithm: Finding Frequent Item sets Using Candidate Generation ,Generating Association Rules from Frequent Item sets, Improving the Efficiently of Apriori, Mining Frequent Item sets without Candidate Generation, Multilevel Association Rules, Approaches to Mining Multilevel Association Rules, Mining Multidimensional Association Rules for Relational Database and Data Warehouses, Multidimensional Association Rules, Mining Quantitative

	Association Rules, Mining Distance-Based Association Rules, From Association Mining to Correlation Analysis
III	What is Classification? What Is Prediction? Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Bayes Theorem, NaïveBayesian Classification, Classification by Backpropagation, A Multilayer Feed-Forward Neural Network, Defining a Network Topology, Classification Based of Concepts from Association Rule Mining, Other Classification Methods, k-Nearest Neighbor Classifiers, Genetic Algorithms, Rough Set Approach, Fuzzy Set Approachs, Prediction, Linear and Multiple Regression, Nonlinear Regression, Other Regression Models, Classifier Accuracy
IV	What Is Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, **Classical Partitioning Methods**: k-Means and k-Medoids, Partitioning Methods in Large **Databases**: From k-Medoids to CLARANS, Hierarchical Methods, Agglomerative and Divisive Hierarchical Clustering, Density-Based Methods, **Wave Cluster**: Clustering Using Wavelet Transformation, **CLIQUE:** Clustering High-Dimensional Space, Model-Based Clustering Methods, Statistical Approach, Neural Network Approach.

References:

1. "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals" Author: Paulraj Ponniah

4. FOUNDATIONS OF OPERATING SYSTEM

Course Content:

Modules	Course Topics
I	Introduction: Definition of Operating System, Computer-System Organization, Computer- System Architecture, Operating-System Structure, Operating System Structures: Operating- System Services, System Calls, Types of System Calls. Process: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication, Threads: Overview, Multi core Programming, Multithreading Models, Threading Issues. CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.
II	Process Synchronization: Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors.

	Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.
III	Main Memory: Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. Virtual Memory: Background, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Mass-Storage Structure, Overview of Mass- Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Formatting, RAID Structure.
IV	File-System Interface: File Concept, Access Methods, Directory and Disk Structure, Protection. File-System Implementation: File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance. I/O Systems: Overview, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Hardware Operations.
V	Protection: Goals of Protection, Principles of Protection, Domain of Protection Access Matrix, Implementation of the Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems. Security: The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication.

Reference:

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, "Operating System Concepts", Ninth Edition, John wiley and sons publication, 2013.

2. A.Tanenbaum,"Modern Operation Systems", Third Edition, Pearson Education, 2008.

3. William Stallings, "Operating Systems", Fifth Edition, Pearson Education, 2005.

4. Ida M.Flynn, "Understanding Operating Systems", Sixth Edition, Cengage, 2011.

5. D.M.Dhamdhere,"Operating systems a concept based approach", Second Edition, McGraw-Hill,

5.Mathematical foundations for ML, AI & Data Science

Course Objective:

1. To understand the fundamental principles of discrete mathematics.
2. To learn various concepts of linear algebra and basic operations.
3. To develop skills for analyzing the statistical and probability concepts.
4. To gain practical experience in implementing calculus concepts.

Course Content:

Modules	Course Topics
I	**Discrete Mathematics** Set theory: sets, subsets, operations on sets, Relations and functions: equivalence relations, partial orders, Combinatorics: permutations, combinations, counting principles, Graph theory: basic concepts, types of graphs, graph representation, Trees: properties, tree traversal algorithms
II	**Linear Algebra** Introduction to vectors and matrices, Basic operations: addition, subtraction, scalar multiplication, Matrix multiplication and its properties, Determinants and inverses of matrices, Vector spaces and subspaces, Eigenvalues and eigenvectors
III	**Probability and Statistics** Basic probability concepts: sample space, events, probability axioms, Conditional probability and Bayes' theorem, Random variables and probability distributions (discrete and continuous), Mean, variance, and standard deviation, Common probability distributions: Bernoulli, Binomial, Gaussian (Normal), Poisson, Statistical inference: estimation, hypothesis testing, confidence intervals
IV	**Calculus** Limits, continuity, and differentiability, Derivatives and their applications: optimization, gradient descent, Integration and its applications: area under curves, probability density functions, Multivariate calculus: partial derivatives, gradients, Jacobian matrices, Optimization techniques: unconstrained and constrained optimization

Reference:

Reference Books:

1) "LinearAlgebraandItsApplications"byDavidC.Lay,StevenR.Lay,andJudiJ.McDonald

2) "ProbabilityandStatisticsforEngineeringandtheSciences"byJayL.Devore

3) "Calculus:EarlyTranscendentals"byJamesStewart

6.Introduction to Cybersecurity

Course Objective:

1. To understand the fundamental concepts of cyber security.
2. To learn various malware and its types.
3. To develop skills for analysing the different kinds of cybercrimes.
4. To gain practical experience in implementing cyber security concepts.

Course Content:

Modules	Course Topics
I	**Introduction** History of internet, intro to cyber crime, malware and its types, kinds of cyber crime
II	**Encryption** Authentication, Encryptions, digital signature, antivirus, firewall, steganography
III	**Computer forensic** Computer forensic, secure password, two step verification, password manager, firewall for Mac, windows
IV	**Online security** Safe browsing, clearing cache, LAN, WLAN, Social sites safety, Email security, smartphone security

Reference:

Reference Books:

1) "Introduction to Cyber Security by Jeetendra Pande

SEMESTER V

1.Data Visualization tools & techniques

Course Objective:

1. To learn different statistical methods for Data visualization
2. To learn basics of Watson Studio R and Python.
3. To learn about packages Numpy, pandas and matplotlib
4. To learn functionalities and usages of Seaborn.

Course Content:

Modules	Course Topics
I	**Introduction of Statistics:** Introduction to Statistics, Difference between inferential statistics and descriptive statistics, Inferential Statistics-Drawing Inferences from Data, Random Variables, Normal Probability Distribution, Sampling, Sample Statistics and Sampling Distributions. R overview and Installation-Overview and About R, R and R studio Installation, Descriptive Data analysis using R, Description of basic functions used to describe data in R.
II	**Data Visualization with Watson Studio and Python**: Introduction to data visualization, Adding data to data refinery, Visualization of Data on Watson Studio, Data manipulation packages, Data visualization with R. Introduction to Python, installation, Introduction to Jupyter Notebook, Python scripting basics, Numpy and Pandas, Matplotlib overview, Basic plots using matplotlib, Specialized Visualization Tools using Matplotlib, Advanced Visualization Tools using MatplotlibWaffle Charts, Word Clouds.

Reference:

1. R Graphics Essentials for Great Data Visualization by AlboukadelKassambara
2. Core Python Programming -Second Edition, R. Nageswara Rao, Dreamtech Press.
3. The Visual Display of Quantitative Information (2nd Edition). E. Tufte. Graphics Press, 2001. Envisioning Information, E. Tufte. Graphics Press, 1990

2.Cloud Computing Fundamentals

Course Objective:

1. Understand how deep our industries rely on the cloud computing global infrastructure, Explore the existing ecosystems developed around the concept of API integration.
2. Develop the ability to use the concepts of DevOps, Toolchain and Cloud Foundry.
3. Develop the ability to use services in the IBM Cloud catalog that you can enrich the cloud apps needed to solve a variety of business problems.

Course Content:

Modules	Course Topics
I	Introduction to cloud computing, characteristics of Cloud., benefits of Cloud and the factors contributing to its growth., cloud services models (IaaS, PaaS and SaaS), cloud deployment options (Private, Public, Hybrid), cloudnative applications and development methods
II	Introduction to DevOps- Illustration of DevOps, describe the capabilities of IBM Cloud Continuous Delivery, identify the web-based integrated development environment features in IBM Cloud Continuous Delivery. how to use source code management and Issue tracking, learn how to build and deploy applications using DevOps tools on IBM Cloud.
III	REST architecture and Watson APIs- Architecture of Representational State Transfer (REST),representation format of data in REST, advantages of the JavaScript Object Notation (JSON) data format, list the IBM Watson services on IBM Cloud.
IV	Introduction to data services on IBM Cloud- Describe different services and databases types and capabilities, types of data services in IBM Cloud, benefits of IBM Cloudant, access Cloudant databases and documents on IBM Cloud, use HTTP APIs to interact with Cloudant database.

References:

1. Cloud Computing Concepts And Technologies- Sunil Kumar Manvi, Gopal Shyam
2. The Enterprise Cloud: Best Practices For Transforming Legacy It- James Bond

3. ENTREPRENEURSHIP DEVELOPMENT

Course Content:

Modules	Course Topics
I	Meaning, definition of Entrepreneur, Enterprise, Entrepreneurship, Characteristics of successful entrepreneur, Functions, Role of entrepreneur in economic development,women entrepreneur, Rural entrepreneur, Agricultural entrepreneur-meaning and challenges
II	Entrepreneurship development program(EDP), meaning, objective, importance, institutions doing EDP in India, DIC, CEDOCK, SSI, NSIC, EDII, AWAKE, KVIC,RUDSET, Industrial estate-Meaning and importance.
III	Financing of small business in India, institutional and non-institutional assistance-SFCs, banks, SIDBI, NBFC-meaning and schemes; venture capital, billsdiscounting, factoring, state and central government subsidies and incentives forSSI(existing)-recent industrial policy(2011), PM MUDRA yojana- meaning, objectives,procedures for obtaining loan under MUDRA.
IV	Setting up of new business, forms for small business- small proprietorship,partnership, private company, cooperative society-meaning and nature, project formulation
V	Business ethics-meaning, ethics in business, importance, various social responsibility of an entrepreneur towards customers, suppliers, government and society, self-employment- recent trends in the areas of self-employment-event management-meaning and areas of business in event management(partyorganizing , catering, wedding plan and corporate event plan)

BOOKS FOR REFERNCE

1. Entrepreneurship And Small Business Management- C B GupthaAnd S S Khanka
2. Entrepreneruship Development – C B GupthaAnd Srinivasan
3. Entreprenership development development –Shankaraiah
4. Entrepreneurship development-S S Khanka
5. Management of small scale business and entreprenership- Vasantha Desai

4.AI AND DATA SCIENCE PROJECT

TOTAL CREDITS :16

5.Management Information Systems (MIS)

Course Objective:

1. To understand the fundamental concepts and components of Management Information Systems.
2. To learn about the role of MIS in supporting organizational functions and decision-making processes.
3. To develop skills in analyzing, designing, and implementing information systems solutions.
4. To explore the use of databases, business intelligence, and other MIS tools for data-driven decision-making.
5. To understand the ethical, social, and legal issues related to MIS implementation and use.

Course Content:

Modules	Course Topics
I	**Introduction to Management Information Systems:**Definition and scope of Management Information Systems, Role and importance of MIS in organizations, Overview of information systems theory and frameworks. **Organizational Information Systems:** Types of organizational information systems: transaction processing systems, management reporting systems, decision support systems, executive information systems, Business process reengineering and automation. **Information Technology Infrastructure:** Overview of information technology infrastructure: hardware, software, networks, and telecommunications,Cloud computing and virtualization, Security and privacy considerations in IT infrastructure.
II	**Fundamentals of Neural Networks**Perceptrons and the McCulloch-Pitts model **Database Management Systems** • Introduction to database management systems (DBMS) • Relational database concepts: tables, rows, columns, keys • SQL fundamentals: querying, updating, and managing database **Data Warehousing and Business Intelligence** • Introduction to data warehousing • Data extraction, transformation, and loading (ETL) processes • Business intelligence tools and techniques for data analysis and reporting

III	**Decision Support Systems** • Overview of decision support systems (DSS) • Components of DSS: database, model base, user interface • Types of DSS: data-driven DSS, model-driven DSS, knowledge-driven DSS **Enterprise Resource Planning (ERP) Systems** • Definition and features of ERP systems • Implementation considerations for ERP systems • Case studies of ERP implementation in organizations **Customer Relationship Management (CRM) Systems** • Overview of CRM systems • Components of CRM systems: sales automation, marketing automation, customer service Benefits and challenges of CRM implementation
IV	**Emerging Trends in MIS** • Big data and analytics: challenges and opportunities • Internet of Things (IoT) and its impact on MIS • Artificial intelligence and machine learning in MIS **Ethical, Social, and Legal Issues in MIS** • Ethical considerations in MIS: privacy, security, and data ownership • Social implications of MIS implementation: job displacement, digital divide • Legal issues related to MIS: intellectual property, data protection regulations

References:

1. "Management Information Systems: Managing the Digital Firm" by Kenneth C. Laudon and Jane P. Laudon
2. "Information Systems for Business and Beyond" by David T. Bourgeois
3. "Database Systems: Design, Implementation, and Management" by Carlos Coronel and Steven Morris
4. Various academic journals, case studies, and online resources on Management Information Systems.

6.Computer Networks and Data Communication technology

Course Objective:

The primary objective of this course is to provide students with a comprehensive understanding of Computer Networks and their applications within the context of Computer Applications. By the end of this course, students will:

1. A solid foundation in the fundamental concepts of computer networks including network architecture, protocols, OSI model, TCP/IP stack, and network topologies.
2. **Acquire** knowledge of various network protocols such as HTTP, FTP, SMTP, DNS, TCP, and UDP.
3. Learn the principles of network design and implementation including LANs, WANs, VLANs, and sub netting.

Course Content:

Modules	Course Topics
I	Data Transmission Basic Concepts and Terminology: Data Communication Model, Communication Tasks, Parallel & Serial Transmission, Transmission Models, Transmission Channel, Data Rate, Bandwidth Signal Encoding Schemes, Data Compression, Transmission Impairments, Layering and Design Issues, OSI Model, Services and Standards. Computer Network:Network Topology, Performance of Network, Network Classification, Advantages & Disadvantagesof Network, Transmission Media (guided and unguided), Network Architecture, OSI Reference Model, TCP/IP, SNA and DNA.
II	Data Line Devices: Modems, DSL, ADSL, Multiplexer and Different Multiplexing Techniques: (FDM, TDM). Physical Layer: Function and interface, physical layer standard, null modem. Local Area Network: Definition of LAN, LAN topologies, Layered architecture of LAN, MAC, IEEE standard. Ethernet LAN, CSMA, CSMA/ CD, Token passing LAN. Network Security: Security Requirement, Dataencryption strategies, authentication protocols, Firewalls. Data Link Layer: Need for Data Link Control, Frame Design Consideration, Flow Control & Error Control (Flow control mechanism, Error Detection and Correction techniques) Data LinkLayer Protocol, HDLC.
III	Network Layer: Routing, Congestion control, Internetworking principles, Internet Protocols (IPv4 packet format, Hierarchal addressing sub netting, ARP, PPP), Bridges, Routers. Transport Layer; Session Layer; Presentation Layer; Application Layer. Basic Applications: Telnet, FTP, NFS, SMTP, SNMP and HTTP.Fundamental of Distributed System: An Introduction – Client/ Server Technology, classification. Distributed Computing Environment: introduction, DCE architecture. Types of CS architecture: 2-tier architecture, 3-tier rchitecture, Distributed collaborative enterprise architecture – Object Request Broker (ORB).

IV	Complementary technology to 3-tier : Object oriented design, Database Two phase. Commit processing , Remote procedure call, Message Oriented middle-ware. Distributed Computing Environment interoperability , C/S Model , Defining a distributed Environment. Motivation for distributed computing ,developing the distributed computing architecture framework, Fundamental technologies, requirements of distributed system.

Reference:

1. Prakash C. Gupta – Data Communications & Computer Networks, PHI, New Delhi.
2. Behrouz Forouzan – Introduction to Data Communication & Networking; T. M. H.
3. William Stallings – Data and Computer Communications; Pearson.

SEMESTER VI

1.INTERNSHIP IN COMPANY

TOTAL CREDITS :20

2.Fundamentals of Natural Language Processing

Course Objective:

1. To articulate natural language processing and importance of word representation.
2. To build deep learning model for solving natural language problems such as language modelling, machine translation, POS tagging, Seq2Seq generation.
3. To implement state-of-the-art Machine Learning and Deep Learning solutions to NLP problems in Global & Indian context.

Course Content:

Modules	Course Topics
I	**Natural Language Processing**: Need, applications, industry demand, Challenges in NLP: Ambiguity in language, Contextual words and phrases and homonyms, Coreference, Domain-specific language, Low-resource languages, Segmentation, Stemming, Lemmatization, Spelling correction, Synsets, Hypernyms, Tokenization, N-grams, Stops Words, WordNet, WordNet Similarity, Language Corpus, N-gram Language Models, Hidden Markov Models.
II	iNLTK (Natural Language Toolkit for Indic Languages), Text normalisation, script normalisation, Parallel Corpus, Handling Code-mix text, Cross Lingual Information Retrieval, Word representation, Sentence representation, Word embedding, Vector space model, Term Frequency, TF-IDF Representation,

	Distributional representation, Word2vec: CBOW(20), Word embedding for regional language, Word2Vec, GloVe, Document to Vector.
III	Neural Networks for text, Recurrent Neural Networks, Vanishing Gradients, Exploding gradient, LSTM (Long sort term memory), GRU (Gated recurrent Unit), Seq2Seq Modelling, Bidirectional Model, Contextual Representations, Transformers, BERT, Multilingual Embedding, Transfer Learning in Word Embeddings, MUSE, POS tagging, Named Entity Recognition, Sentiment Analysis, Text Clustering.
IV	Topic Modeling, Latent Semantic Analysis, Statistical Machine Translation, Neural Machine Translation, Self-Attention for Generative Models, Natural Language Generation, Attention, Question Answering Bot, 1D-CNN for NLP, Sub-word Models, OpenAI's GPT, Google's ALBERT, ULMFiT, Facebook's RoBERTa, Text Summarization, Extractive, Abstractive Text summarization, Transformer models for Text Summarization.

References:

1. Delip Rao and Brian McMahan,, Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning (1 ed.), O'Reilly Media, 2019. ISBN 978-1491978238.
2. Jacob Eisenstein, Introduction to Natural Language Processing (1 ed.), The MIT Press; Illustrated edition, 2019. ISBN 9780262042843.
3. b) Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta and Harshit Surana, Practical Natural Language Processing (1 ed.), O'Reilly, 2020. ISBN 978149205402X.

3. AI Ethics and Law

Course Objective:

1. To understand the ethical considerations in the development and deployment of AI systems.
2. To familiarize students with the legal frameworks governing AI technologies.
3. To analyze case studies and real-world examples to evaluate ethical and legal implications.
4. To develop critical thinking skills for making ethical and legal decisions in AI-related contexts.
5. To explore emerging trends and debates in AI ethics and law

Course Content:

Modules	Course Topics
I	**Introduction to AI Ethics and Law** • Definition and scope of AI ethics and law • Historical perspectives on AI ethics • Importance of ethical and legal considerations in AI development

	Ethical Frameworks • Utilitarianism, deontology, virtue ethics, and other ethical theories • Ethical principles for AI: fairness, transparency, accountability, privacy, and autonomy • Ethical decision-making frameworks for AI development **Legal Principles** • Overview of legal frameworks relevant to AI: data protection, intellectual property, liability, and regulation • Case studies of legal challenges in AI development and deployment
II	**Privacy and Data Protection** • Privacy considerations in AI systems • Data protection laws and regulations (e.g., GDPR, CCPA) • Privacy-preserving techniques in AI **Fairness and Bias** • Understanding algorithmic bias • Fairness metrics and techniques for mitigating bias in AI • Legal perspectives on algorithmic fairness **Accountability and Transparency** • Challenges of accountability in AI systems • Transparency in AI decision-making • Regulatory approaches to accountability and transparency
III	**Ethical and Legal Issues in AI Applications** • AI in healthcare: ethical and legal challenges • AI in criminal justice: bias and fairness concerns • AI in employment: ethical implications of automation and job displacement **Emerging Trends and Debates** • Ethical considerations of emerging AI technologies (e.g., autonomous vehicles, deep learning) • Debates on AI personhood and moral agency • Ethical and legal implications of AI in warfare and security

IV	**Case Studies and Ethical Dilemmas** • Analysis of real-world case studies in AI ethics and law • Ethical decision-making exercises and discussions **Future Directions and Conclusion** • Ethical and legal challenges in AI research and development • Future trends and directions in AI ethics and law • Course review and conclusion • Legal issues related to MIS: intellectual property, data protection regulations

References:

1. "Ethics of Artificial Intelligence and Robotics" by Vincent C. Müller (Ed.)
2. "Robot Ethics: The Ethical and Social Implications of Robotics" by Patrick Lin, Keith Abney, and Ryan Jenkins
3. "Law and Ethics for Autonomous Weapon Systems: Why a Ban Won't Work and How the Laws of War Can" by Matthew C. Waxman
4. Various academic papers and articles on AI ethics and law.

4.Introduction to Deep Learning techniques

Course Objective:

1. **Understand Fundamentals of Deep Learning:** Gain a solid foundation in the fundamental concepts of Deep Learning including neural networks, activation functions, backpropagation, optimization algorithms, and regularization techniques.
2. **Master Neural Network Architectures:** Acquire knowledge of various neural network architectures such as feedforward neural networks, convolutional neural networks (CNNs), etc
3. **Explore Deep Learning Frameworks:** Gain practical experience in using popular Deep Learning frameworks such as TensorFlow, Keras, and PyTorch.
4. **Data Preprocessing and Feature Engineering:** Learn techniques for data preprocessing and feature engineering to prepare data for Deep Learning tasks. Understand the importance of data normalization, dimensions.

Course Content:

Modules	Course Topics
I	**Introduction to Deep Learning** Definition and importance of Deep Learning, Historical overview and milestones in Deep Learning, Comparison with traditional machine learning approaches, Basic concepts: neural networks, activation functions, layers, etc., Applications of Deep Learning in various

	domains.
II	**Fundamentals of Neural Networks**Perceptrons and the McCulloch-Pitts model, Feedforward neural networks: architecture, forward propagation, backpropagation, Activation functions: sigmoid, tanh, ReLU, etc., Loss functions and optimization techniques: gradient descent, stochastic gradient descent, etc., Regularization techniques: dropout, L2 regularization, etc.
III	**Convolutional Neural Networks** (CNNs) Introduction to CNNs and their applications in computer vision, Convolutional layers: filters, feature maps, receptive fields, Pooling layers: max pooling, average pooling, CNN architectures: LeNet, AlexNet, VGG, ResNet, etc., Transfer learning and fine-tuning pre-trained CNNs
IV	**Recurrent Neural Networks** (RNNs) Introduction to RNNs and their applications in sequential data analysis, Basic RNN architecture: recurrent connections, hidden states, time-series data, Long Short-Term Memory (LSTM) networks and Gated Recurrent Units (GRUs), Applications of RNNs: natural language processing, time series prediction, etc., Challenges and limitations of RNNs Unit V Advanced Topics in Deep Learning Generative Adversarial Networks (GANs) and their applications in generative modeling, Autoencoders and dimensionality reduction techniques, Attention mechanisms in Deep Learning, Reinforcement Learning and its integration with Deep Learning, Future trends and emerging technologies in Deep Learning

Reference:

1. "Deep Learning for Computer Vision" by Rajalingappaa Shanmugamani 2) "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal 3) "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville