K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.व.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी –'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४–२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 25/04/2025

NOTIFICATION

Sub :- CBCS Syllabi of BCA (Sem. III & VI)

Ref. :- Decision of the Academic Council at its meeting held on 22/04/2025.

The Syllabi of BCA (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2024 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2025-26.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

Khandesh College Education Society's

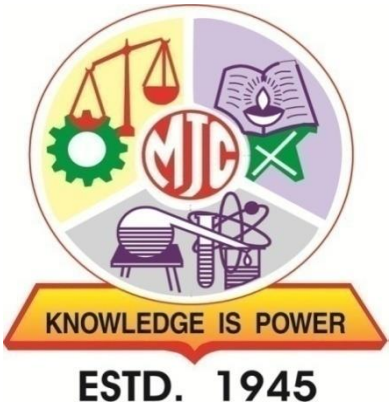
Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to

KavayitriBahinabai Chaudhari

North Maharashtra University, Jalgaon-425001



STRUCTURE

B.C.A. Honours

as per AICTE Guidelines

[w.e.f. Academic Year: 2025-26]

SYBCA Structure and Syllabus (A.Y. 2025-26)

Sem	Course / Module	Hours / week	Credit	L	T	P	Code	Title
III	**3 WEEKS COMPULSORY INDUCTION PROGRAM (UHV-I)**							
	CC	2	2	2	0	0	BCA-CC-231	Probability and Statistics
	CC	4	4	4	0	0	BCA-CC-232	Software Engineering
	CC	2	2	2	0	0	BCA-CC-233	Database Management System
	CC	4	2	0	0	4	BCA-CC-234	Practical on Database Management System
	SEC	2	2	2	0	0	BCA-SEC-231	Python Programming
	SEC	4	2	0	0	4	BCA-SEC-232	Practical on Python Programming
	DSE	2	2	2	0	0	BCA-DSE-231	Professional Elective–I Choose any one (Data Science or Artificial Intelligence & Machine Learning)
	DSE	2	2	0	0	4	BCA-DSE-231	Practical on Professional Elective–I Choose any one (Data Science or Artificial Intelligence & Machine Learning)
	VAC	2	2	2	0	0	BCA-VAC-231	Management Information System (MIS)
	Total Credits		**20**					

Sem	Course / Module	Hours / week	Credit	L	T	P	Code	Title
IV	CC	2	2	2	0	0	BCA-CC-241	Entrepreneurship and Startup Ecosystem
	CC	4	4	4	0	0	BCA-CC-242	Design and Analysis of Algorithm
	CC	2	2	2	0	0	BCA-CC-243	Computer Networks
	CC	4	2	0	0	4	BCA-CC-244	Practical on Computer Networks
	SEC	2	2	2	0	0	BCA-SEC-241	Artificial Intelligence
	SEC	4	2	0	0	4	BCA-SEC-242	Practical on Artificial Intelligence
	DSE	2	2	2	0	0	BCA-DSE-241	Professional Elective – II Choose any one (Data Science or Artificial Intelligence & Machine Learning)
	DSE	2	2	0	0	4	BCA-DSE-241	Practical on Professional Elective – II Choose any one (Data Science or Artificial Intelligence & Machine Learning)
	VAC	2	2	2	0	0	BCA-VAC-241	Design Thinking and Innovation
	Total credits		**20**					

*To be selected from the Proposed Streams with Discipline-Specific Electives -

Data Science / Artificial Intelligence and Machine Learning proposed by College as indicated at the appendix

Proposed Streams with Discipline-Specific Electives (DSE)

1. Data Science

Sr. No.	**Semester**	**Course Code**	**Professional Elective**
1	III	BCA-DSE - 231	Basics of Data Analytics using Spreadsheet
2	IV	BCA-DSE - 241	Data Visualization
3	V	BCA-DSE - 351	Introduction to Data Science
4	V	BCA-DSE - 352	Time Series Analysis
5	V	BCA-DSE - 353	Machine Learning
6	VI	BCA-DSE - 361	Big Data Analytics
7	VI	BCA-DSE - 362	Exploratory Data Analysis
8	VII	BCA-DSE - 471	Business Intelligence & Analytics
9	VII	BCA-DSE - 472	Data Mining & Warehousing
10	VIII	BCA-DSE - 481	Advanced Data Visualization
11	VIII	BCA-DSE - 482	Cloud Computing for Data Analytics
12	VIII	BCA-DSE - 483	Data Security & Privacy

Proposed Streams with Discipline-Specific Electives (DSE)

2. Artificial Intelligence & Machine Learning

Sr. No.	**Semester**	**Course Code**	**Professional Elective**
1	III	BCA-DSE - 231	Feature Engineering
2	IV	BCA-DSE - 241	Introduction to ML
3	V	BCA-DSE - 351	Neural Network
4	V	BCA-DSE - 352	Digital Image Processing
5	V	BCA-DSE - 353	Natural Language Processing
6	VI	BCA-DSE - 361	Deep Learning for Computer Vision
7	VI	BCA-DSE - 362	Predictive Analysis
8	VII	BCA-DSE - 471	Explainable AI
9	VII	BCA-DSE - 472	Evolutionary Algorithm
10	VIII	BCA-DSE - 481	Speech Recognition
11	VIII	BCA-DSE - 482	Augmented Reality & Virtual Reality
12	VIII	BCA-DSE - 483	Security aspects of ML

S.Y.BCA
SEMESTER-III

BCA-CC-231: Probability and Statistics

Total Hours: 30 **Credits: 2**

Course objectives	• This course aims to make the students trained to handle randomness scientifically using theory of probability. • This course intends to make the students able to represent the statistical data in a systematic way and analyze it to draw meaningful information from them. • Through plentiful examples and exercises, this course provides the students scope to apply probabilistic and statistical techniques to deal with the real-life problems.	
Course outcomes	**After successful completion of this course, students are expected to:** • Understand fundamental concepts of probability and different types of probability distributions. • Apply statistical techniques to analyze and interpret real-world data. • Perform hypothesis testing and make data-driven decisions. • Utilize correlation and regression analysis for predictive modeling. • Implement probability and statistical methods using computational tools like Excel, R, or Python.	
Unit	**Content**	**Hours**
Unit I	**Basic concepts of Statistics**, • Qualitative and quantitative data, classification of data, construction of frequency distribution, diagrammatic representation of data. • **Measures of Central Tendency**: Arithmetic mean, median and mode- their properties • **Measures of Dispersion**: Range, mean deviation, quartile deviation, variance and standard deviation.	**7**
Unit II	**Correlation and Regression** • **Correlation:** Definition, scatter diagram, types of correlation, measures- Karl Pearson's correlation coefficient and Spearman's rank correlation coefficient. • **Regression**: Linear regression-fitting by least square method and interpretation.	**8**
Unit III	**Probability** • **Concepts of probability:** Experiment and sample space, events and operations with events, probability of an event, basic probability rules, applications of probability rules, conditional probability. • **Random Variables:** Discrete and continuous random variable**,** probability distribution of a random variable**,** probability mass function, probability density function, expectation and variance of a random variable. • **Standard Probability Distributions:** Binomial probability distribution, Poisson probability distribution, Normal probability distribution.	**7**
Unit IV	**Sampling Distribution and Hypothesis Testing** • **Sampling Distribution:** Concept of Population and Sample, parameter and statistic, sampling distribution of sample mean and sample	**8**

	proportion. • **Statistical Inference:** Estimation and Hypothesis Testing (only concept). • **Hypothesis Testing for a Single Population:** Concept of a hypothesis testing, tests involving a population mean and population proportion (z test and t test). • **Chi square test for independence of attributes and goodness of fit**.	
Study Resources	• Manish Sharma, Amit Gupta, The Practice of Business Statistics, Khanna Book Publishing Company, 2010 (AICTE Recommended Textbook) • Das N. G., Statistical Methods, Combined Edition, Tata McGraw Hill, 2010. • Ross Sheldon M., Introduction to Probability and Statistics for Engineers and • Scientists, 6th Edition, Elsevier, 2021. • Miller Irwin and Miller Marylees, Mathematical Statistics with Applications, Seventh Edition, Pearson Education, 2005 • Pal Nabendu and Sarkar Sahadeb, Statistics: Concepts and Applications, Second Edition, PHI, 2013 • Montgomery Douglas and Runger George C., Applied Statistics and Probability for Engineers, Wiley, 2016. • Reena Garg, Engineering Mathematics, Khanna Publishing House, 2024. • https://nptel.ac.in/courses/111106112 • https://nptel.ac.in/courses/111105041	

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SEMESTER-III

BCA-CC-232: Software Engineering

Total Hours: 60 **Credits: 4**

Course objectives	• To acquire a comprehensive understanding of the software development lifecycle and its application in contemporary software engineering practices. • To develop proficiency in project management methodologies and strategic decision making for successful software project execution. • To Master the art of software design, development, and testing to produce robust and efficient software solutions.	
Course outcomes	**After successful completion of this course, students are expected to:** • Understand fundamental software engineering principles, models, and methodologies. • Apply software development life cycle (SDLC) models to real-world projects. • Analyze and design software systems using structured and object-oriented approaches. • Implement software testing techniques to ensure quality and reliability. • Utilize software project management techniques for effective planning, estimation, and risk management.	
Unit	**Content**	**Hours**
Unit I	**Basic of software process** • The evolving role of software, changing nature of software, layered technology, a process framework, Process models: The waterfall model, incremental process models, evolutionary process models, the unified process. • Agile software development: Agility Principles, Agile methods, Plan-driven and agile development, Extreme programming, Scrum, A Tool Set for the Agile Process.	**15**
Unit II	**Software Requirements Engineering** • Functional and non-functional requirements, the software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management. • **Risk management:** Reactive Vs proactive risk strategies, software risks, risk identification, risk projection, risk refinement, RMMM plan. • **Project planning-** Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.	**15**
Unit III	**Design and Testing** • **Design:** Design process and design quality, design concepts, the design model, software architecture, data design, architectural design, Basic structural modeling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams. • **Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, black-box and white-box testing, validation testing, system testing, the art of debugging.	**15**

	• **Product metrics:** Software quality, metrics for analysis model, design model, source code, testing and maintenance.	
Unit IV	**Quality Assurance** • **Quality Management:** Quality concepts, software quality assurance, software reviews, formal technical reviews, statistical software quality assurance, software reliability. • **Release Management:** Release planning, development and build plans, release strategies, risk management, and post-deployment monitoring. • **Product Sustenance:** Maintenance, updates, End of life, migration strategies.	**15**
Study Resources	• Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007 • Software Engineering: Principles and Practice Hans van Vliet • Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE Recommended Textbook) • Software Engineering, Ian Somerville, 9th edition, Pearson education. • Software Engineering A practitioner's Approach, 8th edition, Roger S Pressman, BruceR. Maxim. McGraw Hill Education, 2015.	

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SEMESTER-III

BCA-CC-233: Database Management System

Total Hours: 30 **Credits: 2**

Course objectives	• Understanding Core Concepts of DBMS • Proficiency in Database Design and SQL • Application of Advanced Database Techniques • Understand the fundamental concepts of database management systems and their applications.	
Course outcomes	**After successful completion of this course, students are expected to:** • Design and model databases using Entity-Relationship (ER) diagrams and normalization techniques. • Implement Structured Query Language (SQL) for database creation, manipulation, and retrieval. • Apply transaction management, concurrency control, and recovery techniques for database security and integrity. • Utilize modern database technologies such as NoSQL and distributed databases in real-world scenarios.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Databases** • Definition of Data, Database and DBMS, Overview of Database • Applications, Advantages and Disadvantages of DBMS, Roles of Database Users and Administrators • **Data Models:** Introduction to Data Models, Types of Data Models (Hierarchical, Network, Relational, Object-oriented), Importance of Data Models in DBMS • **Database Design:** Keys: Primary Key, Candidate Key, Super Key, Foreign Key, Composite Key, Alternate Key, Unique Key, Surrogate Key, Constraints in a table: Primary Key, Foreign Key, Unique Key, NOT NULL, CHECK, Entity-Relationship (ER) Model, Entities and Entity Sets, Attributes and Relationships, ER Diagrams, Key Constraints and Weak Entity Sets, Extended ER Features, Introduction to the Relational Model and Relational Schema	**7**
Unit II	**SQL and Normalization** • **Relational Algebra and Calculus:** Introduction to Relational Algebra, Operations- Selection, Projection, Set Operations, Join Operations, Division,Tuple and Domain Relational Calculus • **Structured Query Language (SQL):** SQL Basics- DDL and DML, Aggregate Functions (Min(), Max(), Sum(), Avg(), Count()), Logical operators (AND, OR, NOT), Predicates (Like, Between, Alias, Distinct), Clauses(Group By, Having, Order by, top/limit), Inner Join, Natural Join, Full Outer Join, Left Outer Join, Right outer Join, Equi Join • **Advanced SQL:** Analytical queries, Hierarchical queries, Recursive	**8**

	queries, Views, Cursors, Stored Procedures and Functions, Packages, Triggers, Dynamic SQL • **Normalization and Database Design:** Functional Dependencies: Armstrong's Axioms, Definition, Properties (Reflexivity, Augmentation, Transitivity), Types (Trivial, Non-Trivial, Partial and Full Functional Dependency), Closure of Functional Dependencies, Normal Forms (1NF, 2NF, 3NF, BCNF), Denormalization.	
Unit III	**Transaction Management and Indexing** • **Transaction Management:** ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL, Introduction to Crash Recovery, 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlocks • **Database Storage and Indexing:** Data on External Storage, File Organizations and Indexing, Index Data Structures, Comparison of File Organizations, Indexes and Performance Tuning, Guidelines for Index Selection, Basic Examples of Index Selection	**7**
Unit IV	**NoSQL Databases** • Introduction to NoSQL, Data Models: Document, Key value, Column family, Graph. Uses and Features of NO/SQL document databases. CAP theorem, BASE vs ACID, CRUD operations.	**8**
Study Resources	• R.P. Mahapatra, Govind Verma, "Database Management Systems", Khanna Publishing House, 2025. • Korth, Silbertz, Sudarshan," Database System Concepts", Seventh Edition, McGraw - Hill.(2019) • Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", third edition, McGraw – Hill, 2018 • Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", fifth edition, Prentice Hall, 2015 • Brad Dayley, "NoSQL with MongoDB in 24 Hours", 1st edition, Sams Publishing, 2024 • https://oracle-base.com/articles • https://forums.oracle.com/ords/apexds/domain/devcommunity/category/sql_and_pl_sql • https://asktom.oracle.com/ords/f?p=100:1:0	

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SEMESTER-III

BCA-CC-234: Practical on Database Management System

Total Hours: 60 **Credits: 2**

Batch Size : 12

Course objectives	• Understanding Core Concepts of DBMS • Proficiency in Database Design and SQL • Application of Advanced Database Techniques • Understand the fundamental concepts of database management systems and their applications.	
Course outcomes	**After successful completion of this course, students are expected to:** • Design and model databases using Entity-Relationship (ER) diagrams and normalization techniques. • Implement Structured Query Language (SQL) for database creation, manipulation, and retrieval. • Apply transaction management, concurrency control, and recovery techniques for database security and integrity. • Utilize modern database technologies such as NoSQL and distributed databases in real-world scenarios.	
	Content	**Hours**
1	Draw an ER Diagram of Registrar Office	4
2	Draw an ER Diagram of Hospital Management System	4
	Consider the following Schema Supplier (SID, Sname, branch, city, phone) Part (PID, Pname, color, price) Supplies(SID, PID, qty, date_supplied)	
3	DDL Commands: Create the above tables, Add a new attribute state in supplier table , Modify the data type of phone attribute, Remove attribute city from supplier table, Change the name of attribute city to address	4
4	DML Commands: Insert at least 10 records in tables supplier, part and supplies, Show the contents in tables supplier, part and supplies, Find the name and city of all suppliers, Find all distinct branches of suppliers, Delete all records of supplier table	4
5	DDL Commands: Find the supplier names which have 'lk' in any position, Find the supplier name where 'R' is in the second position, Change the city of all suppliers to 'BOMBAY', Change the city of supplier 'Vandana' to 'Goa'	4
6	Queries with Constraints: Create the supplier table with Primary Key Constraint, Create supplies table with Foreign key Constraint, Create a	4

	part table with UNIQUE Constraint	
7	Queries on TCL: Create Savepoints, Rollback to SavePoints, Use Commit to save on	4
8	Aggregate Functions: Find the minimum, maximum, average and sum of costs of parts, Count the total number of parts present, Retrieve the average cost of all parts supplied by 'Mike'	4
9	Queries on GROUP BY, HAVING AND ORDER BY Clauses	4
10	Demonstrate nested Queries.	4
11	Queries on Operators	4
12	Join Operators: Perform Inner join and Natural Join on two tables, Perform Left, Right and Full Outer Join on tables	4
13	Set Theory Operators: use of UNION, intersect, minus operator	4
14	PL/SQL Programs on Triggers.	4
15	PL/SQL Programs on Procedures and Functions	4
Study Resources	• R.P. Mahapatra, Govind Verma, "Database Management Systems", Khanna Publishing House, 2025. • Korth, Silbertz, Sudarshan," Database System Concepts", Seventh Edition, McGraw - Hill.(2019) • Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", third edition, McGraw – Hill, 2018 • Benjamin Rosenzweig, Elena Rakhimov, "Oracle PL/SQL by Example", fifth edition, Prentice Hall, 2015 • Brad Dayley, "NoSQL with MongoDB in 24 Hours", 1st edition, Sams Publishing, 2024 • https://oracle-base.com/articles • https://forums.oracle.com/ords/apexds/domain/devcommunity/category/sql_and_pl_sql • https://asktom.oracle.com/ords/f?p=100:1:0	

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SEMESTER-III

BCA-SEC-231: Python Programming

Total Hours: 30 **Credits: 2**

Course objectives	• Understand the fundamental concepts of Python programming, including syntax, data types, and control structures. • Develop modular Python programs. • Apply suitable Python programming constructs, built-in data structures using Python libraries to solve a problem. • Understand basic Data visualization and File handling in Python.	
Course outcomes	**After successful completion of this course, students are expected to:** • Develop programs using functions, modules, and file handling techniques in Python. • Implement object-oriented programming (OOP) concepts such as classes, objects, and inheritance in Python. • Apply Python libraries for data processing, visualization, and automation in real-world applications. • Develop problem-solving skills using Python for various computing applications.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Python** • History and Application areas of Python, Structure of Python Program, • Identifiers and Keywords, Operators and Precedence, Basic Data Types and type conversion, Statements and expressions, Input-Output statements. • **Strings:** Creating and Storing Strings, Built-in functions for strings; string operators, String slicing and joining, Formatting Strings. • **Control Flow Statements:** Conditional Flow statements; Loop Control Statements; Nested control Flow; continue and break statements, continue, Pass and exit.	**7**
Unit II	**Functions, Lists, Tuples** • **Functions:** Built-In Functions, Function Definition and call, Scope and Lifetime of Variables, Default Parameters, Command Line Arguments Lambda Functions, Assert statement, Importing User defined module • **Mutable and Immutable objects**: Lists, Tuples and Dictionaries, Commonly used Functions on Lists, Tuples and Dictionaries. Passing Lists, tuples and Dictionaries as arguments to functions. Using Math and Numpy module for list of integers and arrays.	**8**
Unit III	**Files and Exception Handling** • **Files:** Types of Files, Creating, Reading and writing on Text and Binary Files, The Pickle, Module, Reading and Writing CSV Files. Reading and writing of CSV and JSON files. • **Exception Handling:** Try-except-else-finally block, raise statement, hierarchy of exceptions, adding exceptions. • **Data visualization:** Plotting various 2D and 3D graphics, Histogram,	**7**

	Pi charts; Sine and cosine curves.	
Unit IV	**GUI with Python** • GUI Programming Toolkits for Python, Tkinter Introduction, • Creating GUI Widgets with Tkinter, • Resizing the Widget, • Creating Layouts, Packing Order, • Controlling Widget Appearances, Radio Buttons and Checkboxes, Dialog Boxes. • Python with MySQL **Introduction to MySQL** • Installing MySQL Driver - MySQL Connector or MySQLdb • MySQL Database connection with Python • Creating Database in MySQL using Python • Create a Table in MySQL with Python • Insert, Select, Update and Delete Operation in MySQL with Python • COMMIT, ROLLBACK Operation • Disconnecting Database	**8**
Study Resources	• Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021. • Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023. • Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017. • Think Python, by Allen Downey, 2 nd edition, 2015, O'Reilly. • An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ. • Introduction to Computation and Programming using Python, by John Guttag, 2 nd edition, 2016, PHI India. • https://www.learnpython.org/ • https://www.w3schools.com/python/default.asp	

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SEMESTER-III

BCA-SEC-232: Practical on Python Programming

Total Hours: 60 **Credits: 2**

Course objectives	• Understand the fundamental concepts of Python programming, including syntax, data types, and control structures. • Develop modular Python programs. • Apply suitable Python programming constructs, built-in data structures using Python libraries to solve a problem. • Understand basic Data visualization and File handling in Python.	
Course outcomes	**After successful completion of this course, students are expected to:** • Develop programs using functions, modules, and file handling techniques in Python. • Implement object-oriented programming (OOP) concepts such as classes, objects, and inheritance in Python. • Apply Python libraries for data processing, visualization, and automation in real-world applications. • Develop problem-solving skills using Python for various computing applications.	
	Content	**Hours**
1.	Write a program to find whether a number is a prime number.	4
2.	Write a program to print m raise to power n, where m and n are read from the user.	4
3.	Write a program having a parameterised function that returns True or False depending on whether the parameter passed is even or odd.	4
4.	Write a program different operation on strings using string built in functions.	4
5.	Write a function that takes a sentence as input from the user and calculates the frequency of each letter. Use a variable of dictionary type to maintain the count.	4
6.	Using Numpy module write menu driven program to do- Create an array filled with 1's, Find maximum and minimum values from an array,	4
7.	Consider a tuple t1=(1,2,5,7,9,2,4,6,8,10). Write a program to perform following operations: a) Print contents of t1 in 2 separate lines such that half values come on one line and other half in the next line. b) Print all even values of t1 as another tuple t2. c) Concatenate a tuple t2=(11,13,15) witht1. d) Return maximum and minimum value from t1..	4
8.	Write a Python program to handle a ZeroDivisionError exception when dividing a number by zero.	4
9.	Write a program that reads a list of integers from the user and throws an exception if any numbers are duplicates.	4

10.	Write a program that makes use of a function to display sine, cosine, polynomial and exponential curves.	4
11.	Design a simple GUI application using Tkinter with buttons, labels, and text input.	4
12.	Implement radio buttons and checkboxes in a Tkinter application.	4
13.	Create a basic calculator using Tkinter.	4
14.	Connect Python with MySQL and create a database.	4
15.	Perform INSERT, SELECT, UPDATE, and DELETE operations in MySQL using Python.	4
Study Resources	• Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021. • Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023. • Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017. • Think Python, by Allen Downey, 2 nd edition, 2015, O'Reilly. • An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ. • Introduction to Computation and Programming using Python, by John Guttag, 2 nd edition, 2016, PHI India. • https://www.learnpython.org/ • https://www.w3schools.com/python/default.asp	

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SEMESTER-III

Professional Elective–I

BCA-DSE-231A: Basics of Data Analytics using Spreadsheet

Total Hours: 30 **Credits: 2**

Course objectives	• To develop proficiency in using formulas and functions for data analysis and computation. • To explore advanced Excel functionalities such as PivotTables, macros, and data validation. • To enable students to create and format charts for effective data visualization. • To enhance problem-solving skills through hands-on practice with Excel tools and techniques.	
Course outcomes	**After successful completion of this course, students are expected to:** • Understand the basic structure and components of Excel spreadsheets. • Apply formulas and functions for performing calculations and data manipulation. • Utilize data analysis tools such as sorting, filtering, and PivotTables for decision-making. • Create and customize charts for better presentation of data. • Automate repetitive tasks using macros to improve efficiency in data handling.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Excel** • About Excel & Microsoft, Uses of Excel, Excel software, Spreadsheet window pane, Title Bar, Menu Bar, Standard Toolbar, Formatting Toolbar, the Ribbon, File Tab and Backstage View, Formula Bar, Workbook Window, Status Bar, Task Pane, Workbook & sheets • Columns & Rows : Selecting Columns & Rows, Changing Column Width & Row Height, Autofitting Columns & Rows, Hiding/Unhiding Columns & Rows, Inserting & Deleting Columns & Rows, Cell, Address of a cell, Components of a cell – Format, value, formula, Use of paste and paste special • Functionality Using Ranges: Using Ranges, Selecting Ranges, Entering Information Into a Range, Using AutoFill	**7**
Unit II	**Formulas** • Creating Formulas: Using Formulas, Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower, Using AutoSum, • Advance Formulas: Concatenate, Vlookup, Hlookup, Match, Countif, Text, Trim	**8**
Unit III	**Spreadsheet Charts** • Creating Charts, Different types of chart, Formatting Chart Objects, Changing the Chart Type, Showing and Hiding the Legend, Showing and Hiding the Data Table • Data Analysis : Sorting, Filter, Text to Column, Data Validation, What-	**7**

	If analysis. • PivotTables : Creating PivotTables, Manipulating a PivotTable, Using the PivotTable Toolbar, Changing Data Field, Properties, Displaying a PivotChart, Setting PivotTable Options, Adding Subtotals to PivotTables	
Unit IV	**Spreadsheet Tools** • Moving between Spreadsheets, Selecting Multiple Spreadsheets, Inserting and Deleting Spreadsheets Renaming Spreadsheets, Splitting the Screen, Freezing Panes, Copying and Pasting Data between Spreadsheets, Hiding , Protecting worksheets • Making Macros : Recording Macros, Running Macros, Deleting Macros	**8**
Study Resources	• Saxena, S. (2017). MS Office 2016: Step by Step. Vikas Publishing. • Agrawal, A. (2019). Advanced Excel with Tally ERP 9. Himalaya Publishing House. • Sharma, S. (2018). Excel for Beginners & Advanced Users. BPB Publications. • Rajaram, V. (2019). Mastering Microsoft Excel 2019: A Beginner to Advanced Guide. BPB Publications. • Gupta, P. K. (2016). Excel Data Analysis: A Comprehensive Guide. Dreamtech Press. • Mittal, R. (2021). Data Analytics Using Excel. BPB Publications. • Kumar, D. (2019). Practical Guide to Microsoft Excel for Beginners & Professionals. Technical Publications.	

S.Y.BCA

SEMESTER-III

BCA-DSE-232A: Professional Elective–I

Data Science- Practicals on Basics of Data Analytics using Spreadsheet

Total Hours: 60 **Credits: 2**

Batch Size: 12

Course objectives	• To develop proficiency in using formulas and functions for data analysis and computation. • To explore advanced Excel functionalities such as PivotTables, macros, and data validation. • To enable students to create and format charts for effective data visualization. • To enhance problem-solving skills through hands-on practice with Excel tools and techniques.	
Course outcomes	**After successful completion of this course, students are expected to:** • Understand the basic structure and components of Excel spreadsheets. • Apply formulas and functions for performing calculations and data manipulation. • Utilize data analysis tools such as sorting, filtering, and PivotTables for decision-making. • Create and customize charts for better presentation of data. • Automate repetitive tasks using macros to improve efficiency in data handling.	
	Content	**Hours**
1.	Create and save an Excel workbook with multiple sheets.	4
2.	Format a spreadsheet using cell styles, borders and colors, Adjust row height and column width, and hide/unhide rows and columns.	4
3.	Use basic formulas (SUM, AVERAGE, MIN, MAX, COUNT).	4
4.	Calculating measures of central tendency: mean, median, mode	4
5.	Computing measures of dispersion: range, variance, standard deviation	4
6.	Creating and interpreting frequency distributions and histograms	4
7.	Apply data validation to restrict input values in a cell, Use the AutoFill feature to complete a series. Use VLOOKUP and HLOOKUP to search for data.	4
8.	Creating various chart types: bar, line, pie, scatter	4
9.	Sort a dataset in ascending and descending order, Filter data based on specific criteria, Split and merge text using Text to Columns.	4
10.	Data visualization best practices: choosing the right chart, formatting, and styling, Creating and customizing PivotTables and Pivot Charts	4
11.	Implement the IF function to perform logical operations.	4
12.	Concatenate text values from multiple cells, Use COUNTIF to count	4

	specific values in a range.	
13.	Record and run a macro to automate a task.	4
14.	Protect a worksheet with a password.	4
15.	Creating data entry form using spreadsheet.	4
Study Resources	• Saxena, S. (2017). MS Office 2016: Step by Step. Vikas Publishing. • Agrawal, A. (2019). Advanced Excel with Tally ERP 9. Himalaya Publishing House. • Sharma, S. (2018). Excel for Beginners & Advanced Users. BPB Publications. • Rajaram, V. (2019). Mastering Microsoft Excel 2019: A Beginner to Advanced Guide. BPB Publications. • Gupta, P. K. (2016). Excel Data Analysis: A Comprehensive Guide. Dreamtech Press. • Mittal, R. (2021). Data Analytics Using Excel. BPB Publications. • Kumar, D. (2019). Practical Guide to Microsoft Excel for Beginners & Professionals. Technical Publications.	

S.Y.BCA

SEMESTER-III

BCA-DSE-231B: Professional Elective–I

Artificial Intelligence & Machine Learning - Feature Engineering

Total Hours: 30 **Credits: 2**

Course objectives	• Understand the importance of feature engineering in machine learning models. • Learn various techniques for handling and preprocessing different types of data. • Explore feature selection and dimensionality reduction methods to improve model performance. • Apply feature engineering techniques to real-world datasets for better predictive modeling. • Implement feature engineering in various domains like NLP, time-series, and image processing.	
Course outcomes	**After successful completion of this course, students are expected to:** • Understand the importance of features in machine learning and differentiate between various types of data and features (structured vs. unstructured, categorical, numerical, text, and date-time). • Apply basic feature preprocessing techniques such as handling missing data, data cleaning, and feature scaling and normalization. • Implement feature engineering techniques for numerical data, including binning, discretization, polynomial and interaction features, and log transformation. • Utilize categorical data techniques, such as one-hot encoding and label encoding and understand feature selection methods, including filter and wrapper methods. • Perform feature transformation using techniques like Principal Component Analysis (PCA) and understand its application in machine learning.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Feature Engineering** • Introduction to Data and Features: Importance of Features in Machine Learning. Data types and features: Numerical, Categorical, Ordinal, Discrete, Continuous, Interval and Ratio. • Basic Feature Preprocessing: Handling Missing Data, Data Cleaning, Feature Scaling, Normalization and Transformation.	**7**
Unit II	**Feature Engineering Techniques** • Techniques for Numerical Data: Binning and Discretization, Polynomial and Interaction Features. Categorical Data Techniques: One Hot Encoding, Label Encoding. Feature extraction vs. feature selection, Steps in feature selection. • Feature Selection Methods: Filter, Wrapper and Hybrid. • Feature Reduction: Introduction and application of Principal Components Analysis.	**8**
Unit III	**Feature Selection Methods** • Overview of Feature Selection: Importance and Applications.	**7**

	• Methods: Filter, Wrapper, and Hybrid Approaches. • Statistical Techniques for Feature Selection: Correlation, Chi-Square Test, and Mutual Information. • Linear Discriminant Analysis (LDA) and its application. • Manifold Learning: t-SNE, UMAP, and Autoencoders.	
Unit IV	**Advanced Feature Engineering & Applications** • Feature Engineering for Image Data: Feature Extraction with CNNs, Edge Detection and Color Histograms. • Feature Engineering in Real-World Applications: Fraud Detection, Recommender Systems and Autonomous Systems.	**8**
Study Resources	• Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167. • N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024. • M.C. Trivedi, Deep Learning and Neural Network_MC Trivedi, Khanna Publishing House, 2024. • Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500. • Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791. • Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). • Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047. • Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media, Inc. • Galli, Soledad. (2020). Python feature engineering cookbook: Over 70 recipes for creating,	

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SEMESTER-III

BCA-DSE-232 B: Professional Elective–I

Artificial Intelligence & Machine Learning – Practicals on Feature Engineering

Total Hours: 60 **Credits: 2**

Batch Size: 12

Course objectives	• Understand the importance of feature engineering in machine learning models. • Learn various techniques for handling and preprocessing different types of data. • Explore feature selection and dimensionality reduction methods to improve model performance. • Apply feature engineering techniques to real-world datasets for better predictive modeling. • Implement feature engineering in various domains like NLP, time-series, and image processing.	
Course outcomes	**After successful completion of this course, students are expected to:** • Understand the importance of features in machine learning and differentiate between various types of data and features (structured vs. unstructured, categorical, numerical, text, and date-time). • Apply basic feature preprocessing techniques such as handling missing data, data cleaning, and feature scaling and normalization. • Implement feature engineering techniques for numerical data, including binning, discretization, polynomial and interaction features, and log transformation. • Utilize categorical data techniques, such as one-hot encoding and label encoding and understand feature selection methods, including filter and wrapper methods. • Perform feature transformation using techniques like Principal Component Analysis (PCA) and understand its application in machine learning.	
	Content	**Hours**
1.	Handle missing values in column(s) of a dataset. For example, fill missing values with the mean/median/mode of the columns such as ‘Age’, ‘Height’, ‘Weight’, ‘Grade’ for a dataset.	4
2.	Clean a dataset by identifying and removing invalid data entries. For example, a dataset having columns 'Name', ‘Gender’ and 'Age' where 'Name' contains 'invalid data'.	4
3.	Scale numerical features using Min-Max normalization for a dataset with columns like ‘Height', ‘Weight’	4
4.	Perform exploratory data analysis and visualize data distributions using histograms and boxplots.	4
5.	Compute and visualize the correlation matrix of a dataset with 2 or more columns.	4
6.	Bin numerical data into discrete intervals for a dataset with a column containing numerical values.	4

7.	Apply logarithmic transformation to skewed numerical features in a dataset with column 'Distance'	4
8.	Perform one-hot encoding on categorical features in a dataset with column 'Category' containing categorical values. The distinct values in the Category feature are [Good, Better, Best] and Gender [Male, Female].	4
9.	Perform image augmentation (resizing, normalization, rotation, translation) for a set of images.	4
10.	Perform image augmentation resizing for a set of images.	4
11.	Perform image augmentation normalization for a set of images.	4
12.	Perform image augmentation rotation for a set of images.	4
13.	Perform image augmentation translation for a set of images.	4
14.	Perform image augmentation resizing for a set of images.	4
15.	Perform Principal Component Analysis (PCA) on a dataset and visualize the first two principal components.	4
Study Resources	• Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167. • N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024. • M.C. Trivedi, Deep Learning and Neural Network_MC Trivedi, Khanna Publishing House, 2024. • Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500. • Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791. • Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). • Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047. • Provost, Foster, & Fawcett, Tom. (2013). Data science for business: What you need to know about data mining and data-analytic thinking. O'Reilly Media, Inc. • Galli, Soledad. (2020). Python feature engineering cookbook: Over 70 recipes for creating,	

LAB Experiments

The lab experiments can be implemented in Python using relevant libraries such as numpy, pandas, sklearn, nltk, matplotlib, and seaborn. Kaggle datasets, public repositories (e.g., UCI, Machine Learning etc.), or generated datasets can be used for conducting the experiments. Experiments may be conducted on numerical, image datasets.

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SEMESTER-III

BCA-VAC-231: Yoga and Sports

Management Information System (MIS)

Total Hours: 30 **Credits: 2**

Course objectives	• To introduce students to the fundamental concepts of Management Information Systems (MIS) and their role in business decision-making. • To provide an understanding of database management systems, their components, and their importance in managing organizational data. • To explore various applications of information systems, including Decision Support Systems (DSS), Knowledge Management Systems (KMS), and Enterprise Resource Planning (ERP). • To familiarize students with project management principles, agile methodologies, and risk management in information systems.	
Course outcomes	**After successful completion of this course, students are expected to:** • Students will understand the fundamental concepts of MIS, its types, components, and benefits in modern organizations. • Students will gain knowledge of database management systems, their architecture, and their role in data-driven decision-making. • Students will analyze and apply MIS applications in different domains, including DSS, E-Business, and Business Process Reengineering. • Students will develop skills in managing information system projects using agile methodologies like SCRUM while addressing ethical and risk-related challenges.	
Unit	**Content**	**Hours**
Unit I	**Fundamentals concepts of MIS** • Basics concepts of MIS/ Types of MIS, Dimension and components of IS, Benefits of MIS, IT infrastructure, and IT infrastructure evolution, Components of IT infrastructure, • New approaches for system building in the digital firm era	**7**
Unit II	**Data base management system** • Objectives of data base approach- Characters of database Management systems • Data processing system- Components of DBMS packages - Data base administration- Entity – Relationship (conceptual)	**8**
Unit III	**Information system applications** • MIS applications, DSS – GDSS - DSS applications in E enterprise - Knowledge Management System and Knowledge Based Expert System - Enterprise Model System and E-Business, E- Commerce, E-	**7**

	communication, Business Process Reengineering**.**	
Unit IV	**Managing Projects** • Objectives of project management, Fundamentals of project management information systems with agile methodologies • Introduction of SCRUM, Roles and meetings, User stories, Project risk, Controlling risk factors, Ethical, social, and political issues in the information era.	**8**
Study Resources	• Laudon, K. C., & Laudon, J. P.. Management information systems: managing the digital firm. Fifteenth Edition. Pearson. • Coronel, C., & Morris, S.. Database systems: design, implementation, & management. Cengage Learning. • Olson, D. . Information systems project management (First;1; ed.). US: Business Expert Press. • Schiel, J. The ScrumMaster Study Guide. Auerbach Publications. • The Scrum Master Guidebook: A Reference for Obtaining Mastery" , CHANDAN LAL PATARY • Scrum: The Art of Doing Twice the Work in Half the Time", Jeff Sutherland, J.J. Sutherland • Stair, R., & Reynolds, G. Fundamentals of information systems. Cengage Learning.	

SEMESTER IV

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SEMESTER-IV

BCA-CC-241: Entrepreneurship and Startup Ecosystem

Total Hours: 30 **Credits: 2**

Course objectives	• To understand Entrepreneurship and its types • To understand that not all ideas can be turned into viable business models and guestimate business potential of an idea • To understand different type of finances available and financing methods • To be able to draft business plans on an identified idea • To know what is a Family Business and how is it different from Entrepreneurship	
Course outcomes	**After successful completion of this course, students are expected to:** • At the end of the course, the student would be able to - • Understand basic building blocks of creating a venture • Be able to identify a business opportunity and translate it into a viable business model • Identify the elements of the Indian entrepreneurship ecosystem and take relevant benefits from the constituents • Know the legacy of family businesses and key differentiations from entrepreneurship	
Unit	**Content**	**Hours**
Unit I	**Introduction to Entrepreneurship & Family Business** • Definition and Concept of entrepreneurship • Entrepreneur Characteristics • Classification of Entrepreneurs • Role of Entrepreneurship in Economic Development –Start-ups • Knowing the characteristics of Family business with discussion on few Indian cases of Family Business like Murugappa, Dabur, Wadia, Godrej, Kirloskar etc.	**7**
Unit II	**Evaluating Business opportunity** • Sources of business ideas and opportunity recognition • Guesstimating the market potential of a business idea • Feasibility analysis of the idea • Industry, competition and environment analysis	**8**
Unit III	**Building Blocks of starting ventures** • Low cost Marketing using digital technologies • Team building from scratch • Venture Funding	**7**

	• Establishing the value-chain and managing operations • Legal aspects like IPR and compliances	
Unit IV	**Start-up Ecosystem** • Know the components of the start-up ecosystem including Incubators, Accelerators, Venture Capital Funds, Angel Investors etc. • Know various govt. schemes like Start-up India, Digital India, MSME etc. • Sources of Venture Funding available in India • Source of Technology, Intellectual Property management	**8**
Study Resources	• Startup India Leaning Program by Start Up India available at www.startupindia.gov.in • Entrepreneurship, Rajeev Roy, Oxford University Press • Entrepreneurship: Successfully Launching New Ventures by R. Duane Ireland Bruce R. Barringer, Pearson Publishing • Family Business Management by Rajiv Agarwal, Sage Publishing • Anish Tiwari (2003), "Mapping the Startup Ecosystem in India", Economic & Political Weekly • Ramachandran, K, Indian Family Businesses: Their survival beyond three generations, ISB Working Paper Series.	

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SEMESTER-IV

BCA-CC-242: Design and Analysis of Algorithm

Total Hours: 60 **Credits: 4**

Course objectives	• To envisions imparting to students the understanding of basic algorithm designing paradigms. • To introduces the basic knowledge on how to analyse an algorithm. • To enable a student to synthesize efficient algorithms in common design situations and real-life problems. • To understand fundamental concepts of algorithm design, including time and space complexity analysis.	
Course outcomes	**After successful completion of this course, students are expected to:** • Apply various algorithm design techniques such as divide and conquer, greedy methods, and dynamic programming. • Analyze the efficiency of different sorting, searching, and graph algorithms. • Solve computational problems using appropriate algorithmic strategies. • Evaluate and compare different algorithms based on their performance and optimization techniques.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Algorithm** • What is an algorithm? Design and performance analysis of algorithms, time complexity, space complexity. • Asymptotic notations (O, Ω, Θ) to measure growth of a function and application to measure complexity of algorithms. • Analysis of sequential search, bubble sort, selection sort, insertion sort, matrix multiplication. Recursion: Basic concept. Analysis of recursive algorithms.	**14**
Unit II	**Sort and Technique** • **The Divide & Conquer Design Technique:** The general concept. Binary search, finding the maximum and minimum, merge sort, quick sort. Best and worst case analysis for the mentioned algorithms. Strassen's matrix multiplication. • **The Greedy Design Technique:** The general concept. Applications to general Knapsack problem, finding minimum weight spanning trees: Prim's and Kruskal's algorithms, Dijkstra's algorithm for finding single source shortest paths problem.	**16**
Unit III	**Graphs** • **The Dynamic Programming Design Technique:** The general concept. A ll pair shortest paths problem (Floyd-Warshall's	**18**

	algorithm), 0/1 Knapsack problem. • **Algorithms on Graphs:** Breadth First Search, Depth First Search, finding connected components, depth first search of a directed graph, topological sorting.	
Unit IV	**Backtracking Method** • **Limitations of Algorithmic Power:** Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit problem/vertex cover problem.	**12**
Study Resources	• Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook) • Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009. • Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012. • Levitin Anany, Introduction to Design and Analysis of Algorithms, 3rd Edition, Pearson, 2012 • Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983. • Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006. • https://nptel.ac.in/courses/106101060 • https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf	

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SEMESTER-IV

BCA-CC-243: Computer Networks

Total Hours: 30 **Credits: 2**

Course objectives	• Understand the fundamental concepts of Computer Networks and their applications. • The fundamental concepts of computer networks, network models and protocols. • Develop problem-solving skills related to network design, implementation and troubleshooting. • Implement network protocols and configure network devices.	
Course outcomes	**After successful completion of this course, students are expected to:** • Analyze data transmission techniques, error detection, and correction mechanisms. • Explain the working of different networking devices, routing algorithms, and network security concepts. • Configure and troubleshoot basic network setups using wired and wireless technologies. • Evaluate network performance and apply knowledge to design efficient and secure networks.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Computer Networks** • **Overview of Computer Networks:** Definition and Objectives, Applications and Examples Network Components and Architecture • **Network Models:** OSI Model: Layers and Functions, TCP/IP Model: Layers and Functions Comparison between OSI and TCP/IP Models • **Network Topologies**: Physical vs. Logical Topologies, Common Topologies: Star, Ring, Bus, Mesh, Hybrid, Advantages and Disadvantages of Each Topology • **Data Transmission**: Analog vs. Digital Signals, Transmission Modes: Simplex, Half-Duplex, Full-Duplex, Bandwidth and Latency • **Networking Devices:**Routers, Switches, Hubs, Bridges, Gateways,Functions and Configurations of Each Device.	**7**
Unit II	**Data Link Layer and Networking Protocols** • **Data Link Layer Fundamentals:** Functions of the Data Link Layer, Framing, Error Detection, and Error Correction, Flow Control Mechanisms. • **Ethernet:** Ethernet Standards and Frame Structure, MAC Addressing and ARP, Ethernet Switching: Basic Concepts and Methods • **Network Protocols:** Introduction to TCP/IP Protocol Suite, IP Addressing: IPv4 and IPv6 Subnetting and CIDR Notation • **Address Resolution Protocol (ARP):** ARP Operation and Table, ARP Spoofing and Security Considerations • **Virtual LANs (VLANs):** Concept of VLANs, VLAN Tagging and Configuration, Benefits and Use Cases	**8**

Unit III	**Network Layer and Transport Layer** • **Network Layer:** IP Routing: Static vs. Dynamic Routing,Routing Protocols: RIP, OSPF, BGP, Network Address Translation (NAT) • **Transport Layer:**TCP vs. UDP: Characteristics and Use Cases, TCP Handshake and Connection Management, Flow Control and Congestion Control in TCP • **Congestion Control Algorithms:** Techniques: Slow Start, Congestion Avoidance, Fast Retransmit, Fast Recovery, TCP Variants: TCP Reno, TCP Vegas. • **Quality of Service (QoS):** QoS Principles and Mechanisms, Differentiated Services (DiffServ) and Integrated Services (IntServ) • **Network Security Fundamentals:** Threats and Vulnerabilities, Basic Security Mechanisms: Firewalls, VPNs, Encryption.	**7**
Unit IV	**Application Layer and Emerging Technologies** • **Application Layer Protocols:** HTTP/HTTPS: Structure and Operation, FTP, SMTP, POP3, IMAP: Protocols and Uses, DNS: Domain Name System and Resolution • **Network Applications:** Web Browsing, Email Communication, File Transfer, Voice over IP (VoIP) and Streaming. • **Emergin Technologies:** Software-Defined Networking (SDN), Network Function Virtualization (NFV), Internet of Things (IoT) and Its Impact on Networking • **Network Management:** SNMP: Simple Network Management Protocol, Network Monitoring Tools and Techniques. • **Future Trends in Networking:** 5G and Beyond, Network Automation and Artificial Intelligence in Networking.	**8**
Study Resources	• Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012. • Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019. • Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023. • Mastering PC Hardware & Networking, Khanna Publishing House, 2024. • Cisco Networking Academy - Online Courses and Resources • NetworkLessons.com - Tutorials on Various Networking Topics	

S.Y.BCA

SEMESTER-IV

BCA-CC-244: Practical on Computer Networks

Total Hours: 60 **Credits: 2**

Course objectives	• Understand the fundamental concepts of Computer Networks and their applications. • The fundamental concepts of computer networks, network models and protocols. • Develop problem-solving skills related to network design, implementation and troubleshooting. • Implement network protocols and configure network devices.	
Course outcomes	**After successful completion of this course, students are expected to:** • Analyze data transmission techniques, error detection, and correction mechanisms. • Explain the working of different networking devices, routing algorithms, and network security concepts. • Configure and troubleshoot basic network setups using wired and wireless technologies. • Evaluate network performance and apply knowledge to design efficient and secure networks.	
	Content	**Hours**
1.	Configure Basic Network Settings: IP Address Configuration	4
2.	Configure Basic Network Settings: Subnet Mask and Gateway Settings	4
3.	Implement Network Protocols: Write a simple Python script to perform DNS resolution.	4
4.	Implement Network Protocols: Implement a basic HTTP client-server application.	4
5.	Network Simulation: Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies.	4
6.	Network Simulation: Configure routers and switches in a simulated environment.	4
7.	Performance Measurement: Measure network performance using tools like `ping`, `traceroute`, and `iperf`.	4
8.	Performance Measurement: Analyze network traffic using Wireshark.	4
9.	Implement VLANs: Configure VLANs on a switch and verify using simulation tools.	4
10.	Set Up a Simple Web Server: Deploy a basic web server and configure HTTP/HTTPS access.	4
11.	Network Security Lab: Implement basic firewall rules and VPN configurations.	4
12.	Network Security Lab: Perform vulnerability scanning and analyze results.	4

13.	Network Troubleshooting: Diagnose and resolve common network issues.	4
14.	Network Troubleshooting: Use troubleshooting commands to fix connectivity problems.	4
15.	Network Troubleshooting: Use troubleshooting techniques to fix connectivity problems.	4
Study Resources	• Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012. • Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019. • Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023. • Mastering PC Hardware & Networking, Khanna Publishing House, 2024. • Cisco Networking Academy - Online Courses and Resources • NetworkLessons.com - Tutorials on Various Networking Topics	

S.Y.BCA

SEMESTER-IV

BCA-CC-245: Artificial Intelligence

Total Hours: 30 **Credits: 2**

Course objectives	• Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents. • Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications. • Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning. Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets. • Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI	
Course outcomes	**After successful completion of this course, students are expected to:** • Apply Uninformed Search Algorithms and Implement Heuristic Search techniques • Analyze and Solve Constraint Satisfaction Problems • Develop Rule-Based Systems • Implement and Evaluate Optimization Techniques CO5: Apply and illustrate the NLP concepts	
Unit	**Content**	**Hours**
Unit I	**Introduction to Al** • What is AI? • Intelligent Agents: Agents and environment, the concept of Rationality, the nature of environment, the structure of Agents. • Knowledge-Based Agents: Introduction to Knowledge-Based Agents, the Wumpus World as an Example World. • Problem-solving: Problem-solving agents.	**7**
Unit II	**Advanced Search Techniques** • Uninformed Search: DFS, BFS, Iterative Deepening Search. • Informed Search: Best First Search, A* search, AO* search. • Constraints and Constraint Satisfaction Problems (CSPs), Backtracking search for CSP. • Evolutionary Search Techniques: Introduction to evolutionary algorithms, Genetic algorithms, Applications of evolutionary search in AI.	**8**
Unit III	**Logical Reasoning and Uncertainty** • Logic: Propositional logic, First-order predicate logic, Propositional versus first-order inference, Unification and lifting. • Inference: Forward chaining, Backward chaining, Resolution, Truth maintenance systems. • Handling Uncertainties: Non-monotonic reasoning, Probabilistic reasoning. • Introduction to Fuzzy set theory.	**7**

Unit IV	**Domains and Applications of AI** • Domains in AI: Introduction to Machine Learning, Computer Vision, Robotics, Natural Language Processing, Deep Neural Networks and their Applications. • Expert Systems: The architecture and role of expert systems include two case studies. • Legal and Ethical Issues: Concerns related to AI.	**8**
Study Resources	• M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook). • Nilsson Nils J, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4. • Dan W Patterson, Introduction to Artificial Intelligence & Expert Systems, PHI Learning 2010. • Rajiv Chopra, Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Khanna Book Publishing Company, 2024. • M.C. Trivedi, Introduction to AI and Machine Learning, Khanna Book Publishing Company, 2024. • Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall • Van Hirtum, A. & Kolski, C. (2020). Constraint Satisfaction Problems: Algorithms and Applications. Springer • Rajiv Chopra, Machine Learning and Machine Intelligence, Khanna Book Publishing Company, 2024.	

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SEMESTER-IV

BCA-CC-246: Practical on Artificial Intelligence

Total Hours: 60 **Credits: 2**

Batch Size: 12

Course objectives	• Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents. • Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications. • Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning. Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets. • Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI	
Course outcomes	**After successful completion of this course, students are expected to:** • Apply Uninformed Search Algorithms and Implement Heuristic Search techniques • Analyze and Solve Constraint Satisfaction Problems • Develop Rule-Based Systems • Implement and Evaluate Optimization Techniques CO5: Apply and illustrate the NLP concepts	
	Content	**Hours**
1.	Demonstrate basic problem-solving using Breadth-First Search on a simple grid.	4
2.	Implement Depth-First Search (DFS) on a small graph.	4
3.	Solve the Water Jug Problem using Breadth First Search (BFS).	4
4.	Implement a Hill Climbing search to find the peak in a numeric dataset.	4
5.	Apply the A* Search algorithm to find the shortest path in a 4x4 grid.	4
6.	Solve the 4 – Queens Problem as a CSP backtracking problem	4
7.	Apply optimization techniques to find the maximum value in a list.	4
8.	Represent and evaluate propositional logic expressions.	4
9.	Implement a basic rule-based expert system for weather classification.	4
10.	Implement a basic AI agent with simple decision	4
11.	Implement a basic Rule-Based Chatbot.	4
12.	Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content- Tokenizing, Filtering Stop Words, Stemming.	4

13.	Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content- Part of Speech tagging, Chunking.	4
14.	Using Python NLTK, perform the following Natural Language Processing (NLP) tasks for text content - Named Entity Recognition (NER)	4
15.	Perform Image classification for a given dataset using CNN. You may use Tensorflow/Keras.	4
Study Resources	• M.C. Trivedi, A Classical Approach to Artificial Intelligence, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook). • Nilsson Nils J, Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4. • Dan W Patterson, Introduction to Artificial Intelligence & Expert Systems, PHI Learning 2010. • Rajiv Chopra, Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Khanna Book Publishing Company, 2024. • M.C. Trivedi, Introduction to AI and Machine Learning, Khanna Book Publishing Company, 2024. • Russell, S. and Norvig, P., "Artificial Intelligence - A Modern Approach", 3rd edition, Prentice Hall • Van Hirtum, A. & Kolski, C. (2020). Constraint Satisfaction Problems: Algorithms and Applications. Springer • Rajiv Chopra, Machine Learning and Machine Intelligence, Khanna Book Publishing Company, 2024.	

Note: The lab experiments may be implemented in Python. Libraries like NLTK, Tensorflow and Keras may be used for Machine learning experiments.

S.Y.BCA

SEMESTER-IV

BCA-DSE-241A: Professional Elective–II

Data Science- Data Visualization

Total Hours: 30 **Credits: 2**

Course objectives	• Understand the fundamentals of data visualization and its importance. • Learn about visual perception and its impact on data interpretation. • Explore the ethical considerations and challenges in data visualization. • Study different types of visualizations and their appropriate uses. • Utilize Power BI to create and customize various types of visualizations.	
Course outcomes	**After successful completion of this course, students are expected to:** • Utilize various data visualization tools and libraries such as Matplotlib, Seaborn, and Tableau. • Apply different types of charts, graphs, and plots to represent and analyze datasets effectively. • Interpret insights from visualized data to support decision-making and storytelling. • Develop interactive and dynamic visualizations for real-world applications.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Data Visualization** • Definition and importance of data visualization-Role of data visualization in decision making- Types of data (numerical, categorical, temporal, geographical) • Data visualization process (data collection, exploration, analysis, visualization, interpretation)-Challenges and limitations of data visualization	**7**
Unit II	**Visualization tools and Data Storytelling** • Overview of Visualization Tools (e.g., Excel, Tableau, Power BI, Python)- Comparing and contrasting features and Use Cases among these tools. • Principles of Data Storytelling: Narrative and Context-Best Practices for Dashboard Layout and Interactivity	**8**
Unit III	**Designing Effective Visualizations** • Principles of Good Visualization Design - Understanding and Using Color in Visualizations –Importance of Data Modelling in Visualization.	**7**
Unit IV	**Exploratory Data Analysis (EDA) and Statistical Visualization** • Importance of EDA in data science • Summary statistics and distributions (mean, median, mode, variance, standard deviation) • Box plots, histograms, scatter plots, and density plots • Correlation matrices and heatmaps for feature relationships	**8**

	• Identifying outliers and missing data through visualization	
Study Resources	• "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018. • "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017. • "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018. • "Storytelling with Data: A Data Visualization Guide for Business Professionals" Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015. • 2. “The Visual Display of Quantitative Information” by Edward Tufte, Graphics Press USA; 2nd edition, 2001. • https://learn.microsoft.com/en-us/power-bi/ • https://www.storytellingwithdata.com/ • https://jpsm.umd.edu/sites/jpsm.umd.edu/files/syllabi/Syllabus_Introduction%20to%20 Data%20Visualization_Spring%202024.pdf	

S.Y.BCA

SEMESTER-IV

BCA-DSE-242 A : Professional Elective–I

Data Science- Practical on Data Visualization

Total Hours: 60 **Credits: 2**

Batch Size: 12

Course objectives	• Understand the fundamentals of data visualization and its importance. • Learn about visual perception and its impact on data interpretation. • Explore the ethical considerations and challenges in data visualization. • Study different types of visualizations and their appropriate uses. • Utilize Power BI to create and customize various types of visualizations.	
Course outcomes	**After successful completion of this course, students are expected to:** • Utilize various data visualization tools and libraries such as Matplotlib, Seaborn, and Tableau. • Apply different types of charts, graphs, and plots to represent and analyze datasets effectively. • Interpret insights from visualized data to support decision-making and storytelling. • Develop interactive and dynamic visualizations for real-world applications.	
	Content	**Hours**
	Introduction to Power BI Interface and Basics	
1.	Installation and interface overview	4
2.	Exploring the Power BI workspace: Ribbon, panes, and canvas.	4
3.	Importing data from Excel and CSV files.	4
4.	Introduction to multiple data sources	4
5.	Basic report creation: Adding visuals and saving a report.	4
	Data Transformation and Preparation	
6.	Using Power Query Editor	4
7.	Cleaning data: Removing duplicates, handling missing values.	4
8.	Transforming data: Splitting columns, changing data types, renaming columns.	4
9.	Merging and appending queries.	4
10.	Creating custom columns and calculated columns	4
	Data Modeling	
11.	Creating relationships between tables	4
12.	Identifying and resolving data inconsistencies	4

13.	Creating calculated columns and measures	4
	Creating Basic Visualizations	
14.	Creating various chart types (bar, column, line, pie, area, etc.,), Formatting and customizing visualizations	4
	Publishing and Sharing Reports	
15.	Publishing a report to Power BI Service, Sharing reports and dashboards with team members.	4
Study Resources	• "Data Visualization: A Practical Introduction" Kieran Healy, Princeton University Press, 2018. • "Analyzing Data with Power BI and Power Pivot for Excel", Alberto Ferrari and Marco Russo, Microsoft Press; 1st edition, 2017. • "Microsoft Power BI Complete Reference", Devin Knight, Brian Knight, Mitchell Pearson, and Manuel Quintana, Packt Publishing; 1st edition, 2018. • "Storytelling with Data: A Data Visualization Guide for Business Professionals" Cole Nussbaumer Knaflic, Wiley; 1st edition, 2015. • 2. “The Visual Display of Quantitative Information” by Edward Tufte, Graphics Press USA; 2nd edition, 2001. • https://learn.microsoft.com/en-us/power-bi/ • https://www.storytellingwithdata.com/ • https://jpsm.umd.edu/sites/jpsm.umd.edu/files/syllabi/Syllabus_Introduction%20to%20 Data%20Visualization_Spring%202024.pdf	

Note: Lab Programs for Data Visualization Using Power BI

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SEMESTER-IV

BCA-DSE-241B: Professional Elective–II

Artificial Intelligence & Machine Learning - Introduction to ML

Total Hours: 30 **Credits: 2**

Course objectives	• Understand the fundamental concepts, history, and types of Machine Learning. • Differentiate between Supervised, Unsupervised, and Reinforcement Learning techniques. • Apply various ML algorithms, including Regression, Classification, and Clustering. • Evaluate ML models using performance metrics such as Accuracy, Precision, Recall, and F1-score. • Implement feature engineering and hyper parameter tuning techniques to optimize ML models.	
Course outcomes	**After successful completion of this course, students are expected to:** • Define and explain machine learning concepts, types and basic metrics. • Implement and apply supervised learning techniques • Apply unsupervised learning methods • Develop and evaluate simple machine learning models • Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Machine Learning** • Introduction: Definition, History and Application of Machine Learning, • Types of Machine Learning: Supervised, Unsupervised, Semi-Supervised, and Reinforcement Learning. Labeled and Unlabelled Dataset. • Supervised Learning Tasks: Regression vs. Classification, • Learning Framework: Training, Validation and Testing of ML models. Performance • Evaluation Parameters: Confusion matrix, Accuracy, Precision, Recall, F1 Score, and AUC.	**7**
Unit II	**Supervised Learning and Unsupervised Learning** • Regression: Linear and non-linear Regression, Logistic Regression. • Classification: Naïve Bayes, K-Nearest Neighbors, Decision Trees. • Linear model: Introduction to Artificial Neural Networks, Perceptron Learning Algorithm, Single Layer Perceptron, Introduction to Support Vector Machine for linearly separable data. • Clustering: K-Means, Hierarchical Clustering, DBSCAN, Clustering Validation Measures. • ML Applications: Ethical Considerations in Machine Learning, Case study and Real-world Applications.	**8**

Unit III	**Feature Engineering and Data Preprocessing** • Introduction to Feature Engineering: Importance in ML models • Handling missing data: Mean/Median Imputation, KNN Imputation • Feature Scaling: Normalization and Standardization • Categorical Data Encoding: One-Hot Encoding, Label Encoding • Feature Selection Techniques: Filter, Wrapper, and Embedded Methods • Dimensionality Reduction: Principal Component Analysis (PCA), t-SNE	**7**
Unit IV	**Deep Learning and Advanced ML Applications** • Introduction to Deep Learning and Neural Networks • Convolutional Neural Networks (CNNs) for image recognition • Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) for sequential data • Transfer Learning and Pre-trained Models • ML Applications in Healthcare, Finance, and Autonomous Systems	**8**
Study Resources	• Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House. • Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House. • Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill. • Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780 • Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012. • Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167. • Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning. • Chollet, F. (2018). Deep Learning with Python. Manning Publications. • Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer. • Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press. • Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (1st ed.). O'Reilly Media.	

S.Y.BCA

SEMESTER-IV

BCA-DSE-242B : Professional Elective–II

Artificial Intelligence & Machine Learning – Practicals on Introduction to ML

Total Hours: 60 **Credits: 2**

Batch Size: 12

Course objectives	• Understand the fundamental concepts, history, and types of Machine Learning. • Differentiate between Supervised, Unsupervised, and Reinforcement Learning techniques. • Apply various ML algorithms, including Regression, Classification, and Clustering. • Evaluate ML models using performance metrics such as Accuracy, Precision, Recall, and F1-score. • Implement feature engineering and hyper parameter tuning techniques to optimize ML models.	
Course outcomes	**After successful completion of this course, students are expected to:** • Define and explain machine learning concepts, types and basic metrics. • Implement and apply supervised learning techniques • Apply unsupervised learning methods • Develop and evaluate simple machine learning models • Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.	
	Content	**Hours**
1.	Implement linear regression on a dataset and visualize the regression line.	4
2.	Implement logistic regression on a binary classification dataset and plot the decision boundary.	4
3.	Implement and evaluate the performance of Decision tree ID3/Cart classifier for any given dataset.	4
4.	Implement and evaluate the performance of the Naive Bayes Classifier on a given dataset.	4
5.	Build and evaluate a random forest classifier using a numerical dataset.	4
6.	Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary.	4
7.	Implement K-Means clustering on a point dataset and visualize and evaluate the clusters.	4
8.	Implement hierarchical clustering on a dataset and plot the dendrogram.	4
9.	Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.	4
10.	Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.	4
11.	Build a single layer perceptron model to classify AND, OR, and XOR problems (may use TensorFlow/Keras) and visualize their decision	4

	boundaries. Also evaluate its performance.	
12.	Demonstrate the concept of boosting using the AdaBoost algorithm.	4
13.	Implement a single-layer perceptron using NumPy.	4
14.	Implement a Convolutional Neural Network (CNN) using Keras/PyTorch.	4
15.	Train it on the CIFAR-10 dataset and evaluate its performance.	4
Study Resources	• Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House. • Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House. • Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill. • Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780 • Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012. • Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167. • Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning. • Chollet, F. (2018). Deep Learning with Python. Manning Publications. • Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer. • Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press. • Géron, A. (2017). Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems* (1st ed.). O'Reilly Media.	

Note: The lab experiments may be implemented in Python using relevant ML libraries, and datasets from Kaggle, public repositories, or generated datasets.

S.Y.BCA

SEMESTER-IV

BCA-SEC-241: Design Thinking and Innovation

Total Hours: 30 **Credits: 2**

Course objectives	• To introduce students to the principles of Design Thinking and its significance in fostering innovation. • To develop empathy and problem-solving skills through observation and customer-centric approaches. • To equip students with techniques for ideation, prototyping, and implementation of innovative solutions. • To enhance students' ability to iterate and refine designs based on user feedback for improved product experiences.	
Course outcomes	**After successful completion of this course, students are expected to** • Students will be able to understand and apply Design Thinking to solve real-world business challenges. • Students will develop empathy-driven problem-solving skills by observing and analysing customer needs. • Students will be able to generate creative solutions through brainstorming, prototyping, and iterative testing. • Students will evaluate user feedback and refine their designs to enhance customer experience and usability.	
Unit	**Content**	**Hours**
Unit I	**Basics of Design Thinking** • Understand the concept of innovation and its significance in business • Understanding creative thinking process and problem solving approaches • Know Design Thinking approach and its objective • Design Thinking and customer centricity – real world examples of customer challenges, use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product. • Discussion of a few global success stories like AirBnB, Apple, IDEO, Netflix etc. • Stages of Design Thinking Process – Empathize, Define, Ideate, • Prototype, Implement	**7**
Unit II	**Learning to Empathize and Define the Problem** • Importance of empathy in innovation process – how can students develop empathy using design tools • Observing and assimilating information • Individual differences & Uniqueness Group Discussion and Activities to	**8**

	encourage the understanding, acceptance and appreciation of individual differences.	
Unit III	**Ideate, Prototype and Implement** • Templates of ideation like brainstorming, systems thinking • Concept of brainstorming – how to reach consensus on wicked problems • Mapping customer experience for ideation • Know the methods of prototyping, purpose of rapid prototyping.	**7**
Unit IV	**Feedback, Re-Design & Re-Create** • Feedback loop, focus on User Experience, address ergonomic challenges, user focused design • Final concept testing, Final Presentation – Solving Problems through innovative design concepts & creative solution	**8**
Study Resources	• E Balaguruswamy, Developing Thinking Skills (The way to Success), C Khanna Book Publishing Company • Tim Brown C Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harvard Business Review • 8 steps to Innovation by R T Krishnan & V Dabholkar, Collins Publishing • Design Thinking by Nigel Cross, Bloomsbury	