''ज्ञान, विज्ञान आणि सुसंस्कार यांसाठी शिक्षण प्रसार'' - विवेकानंदमहर्षी डॉ. बापूजी साळुंखे
Shri Swami Vivekanand Shikshan Sanstha, Kolhapur.
VIVEKANAND COLLEGE, KOLHAPUR
(Empowered Autonomous)
Affiliated to Shivaji University
NAAC Reaccrediated "A" | College with Potential for excellence | ISO 9001 : 2015

DEPARTMENT OF BCA

BCA Part – II

Semester-III & IV SYLLABUS (w.e.f 2025-26)

VIVEKANAND COLLEGE, KOLHAPUR

(Empowered Autonomous)

Department of BCA (Bachelor of Computer Applications)

Departmental Teaching Evaluation Scheme

Three- Years UG Program

1. Title: Three Years UG degree in BCA (Bachelor of Computer Application)
2. Year of implementation: academic year 2025-26 onwards
3. Examination pattern: semester wise for Theory and Practical's
4. Structure of program:

Abrr. TH-Theory, PR-Practical, ESE- End Semester Examination, CIE-Continuous Internal Examination

Note: Minimum passing for 70 marks Theory paper = 28 marks
Minimum passing for 30 marks Internal evaluation = 12 marks
Minimum passing for 40 marks Theory paper = 16 marks
Minimum passing for 10 marks Internal evaluation = 04 marks
Minimum passing for 50 marks Practical = 20 marks
Separate passing for every head- ESE, CIE and Practical

BCA-I Semester-I & II

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-I										
1	DSC-I	DSC39MAT11	Mathematics Foundations to Computer Science - I	4	-	70	30	-	100	4
2	DSC-II	DSC39COM11	Computer Architecture	4	-	70	30	-	100	4
3	SEC-I	SEC39COM11	Problem Solving Techniques	4	-	70	30	-	100	4
4	AEC	AEC39ENG11	General English - I	2	-	40	10	-	50	2
5	IKS	IKS39GEC11	Indian Knowledge System^	2	-	40	10	-	50	2
6	CCC	CCC39CCC11	Yoga/Sports/NCC/NSS/ Disaster Management	2		40	10	-	50	2
7	DSCP-I	DSC39PRA19	DSC Computer Lab-1A		4			50	50	2
8	SECP-I	DSC39PRB19	DSC Computer Lab-1B		4			50	50	2
	Total (Semester-I)			**18**	**08**	**330**	**120**	**100**	**550**	**22**
Semester-II										
1	DSC-III	DSC39MAT21	Mathematics Foundations to Computer Science - II	4	-	70	30	-	100	4
2	DSC-IV	DSC39COM21	Data Structures	4	-	70	30	-	100	4
3	DSC-V	DSC39COM22	Operating Systems	4	-	70	30	-	100	4
4	SEC-II	SEC39COM21	Object Oriented Programming using Java	4	-	70	30	-	100	4
5	VEC-I	VEC39DEG11	Indian Constitution	2	-	40	10	-	50	2
6	DSCP-II	DSC39PRA29	DSC Computer Lab-2A		4			50	50	2
7	DSCP-III	DSC39PRB29	DSC Computer Lab-2B		4			50	50	2
	Total (Semester-II)			**18**	**08**	**320**	**130**	**100**	**550**	**22**
	Cumulative Total (1st Year)			**36**	**16**	**650**	**250**	**200**	**1100**	**44**

BCA-II Semester-III & IV

Sr. No.	Course Abbr.	Course code	Course Name	Teaching Scheme Hours/week		Examination Scheme and Marks				Course Credits
				TH	PR	ESE	CIE	PR	Marks	
Semester-III										
1	CC201		Descriptive Statistics	2	-	40	10	-	50	2
2	CC202		Data Base Management System	4	-	70	30	-	100	4
3	SEC201		Python Programming	2	-	40	10	-	50	2
4	CC203		Software Engineering	4	-	70	30	-	100	4
5	DSE201*		Feature Engineering	2	-	40	10	-	50	2
6	VAC201		Environmental Science	2	-	40	10	-	50	2
7			DSC Computer Lab-3A(CC201)	-	2	-	-	-	25	1
8			DSC Computer Lab-3B(CC202)	-	4	-	-	-	50	2
9			DSC Computer Lab-3C(SEC201)	-	4	-	-	-	50	2
10			DSC Computer Lab-3D(DSE201)	-	2	-	-	-	25	1
	Total (Semester-III)			**16**	**12**	**300**	**100**	**-**	**550**	**22**
Semester-IV										
1	CC204		Probability Distribution and Testing of Hypothesis	2	-	40	10	-	50	2
2	CC205		Computer Networks	4	-	70	30	-	100	4
3	CC206		Design and Analysis of Algorithm	4	-	70	30	-	100	4
4	CC207		Artificial Intelligence	4	-	70	30	-	100	4
5	DSE202*		Introduction to Machine Learning	2	-	40	10	-	50	2
6			DSC Computer Lab-4A(CC204)	-	2	-	-	-	25	1
7			DSC Computer Lab-4B(CC205)	-	4	-	-	-	50	2
8			DSC Computer Lab-4C(CC207)	-	4	-	-	-	50	2
9			DSC Computer Lab-4D(DSE202)	-	2	-	-	-	25	1
	Total (Semester-IV)			**16**	**12**	**290**	**110**	**-**	**550**	**22**
	Cumulative Total (2nd Year)			**32**	**24**	**590**	**210**	**-**	**1100**	**44**

SEMESTER –III

Course Code	Course Name: Descriptive Statistics	2L:0T:1P	Credits:3	Marks:40
Course Outcomes	**After the successful completion of the course the students are able to-** CO1. Learn basic concepts in statistics. CO2. Computation of various measures of central tendency and dispersion CO3. To compute correlation coefficient and its interpretation. CO4. To predict the data.			

Module	Description	Teaching Hrs
I	**1.1 Introduction of Statistics** 1.1.1 Meaning of Statistics, primary and secondary data 1.1.2 Qualitative and Quantitative data, Discrete and Continuous variable. 1.1.3 Frequency and Frequency Distribution, Class interval, frequency, class frequency, class mark, open end classes 1.1.4 Frequency Distribution, Discrete and continuous frequency distribution, Cumulative Frequencies. 1.1.5 Graphical Representation: i) Median ii) Mode iii) Frequency Polygon iv) Frequency Curve **1.2 Measures of Central Tendency (Averages)** 1.2.1 Concept of Central Tendency, Requirements of good average 1.2.2 Definition Arithmetic Mean, Properties of A.M. (without proof),combined mean, Median, Quartiles, Mode. Empirical relation between Mean, Median and Mode. 1.2.3 Merits and demerits of Mean, Median and Mode **1.3 Measures of Dispersion (Variability)** 1.3.1 Concept of Dispersion, Requirements of good measures of dispersion, Absolute and Relative measures of dispersion. 1.3.2 Definitions of Range, Quartile Deviation (Q.D.), Mean Deviation (M.D.), Standard Deviation (S.D.), and Variance, Combined Variance and their relative measures, Coefficient of Variation (C.V.) 1.3.3 Merits and Demerits of Range, Q.D., M.D., S.D. 1.3.4 Numerical Examples	**15**
II	**1.1 Correlation** 1.1.1 Bivariate Random variable (X, Y), Bivariate data, Definition of Correlation and Types of Correlation. 1.1.2 Methods of studying correlation: Scatter diagram, Karl Pearson's correlation coefficient (r), Spearman's rank correlation coefficient (R), computation of R (with and without tie). 1.1.3 Properties of correlation coefficient (r) (Statements Only): (i) $-1 \leq r \leq 1$, interpretation of value of r, (ii) Effect of change of origin and scale. **1.2 Regression** 1.2.1 Concept of regression. 1.2.2 Lines of regression, Fitting of lines of regression by the least square method (Without derivation). 1.2.3 Regression coefficients b_{xy} & b_{yx}, Properties of regression coefficients (Statements Only). 1.2.4 Numerical Examples	**15**

	Reference Books 1. Gupta, S.C. and Kapoor, V. K. (1983). Fundamentals of Mathematical Statistics, 8th Ed. Sultan Chand and Sons, New Delhi 2. Agarwal B. L. (2003). Programmed Statistics, 2nd ed., New Age International (P), New Delhi 3. Goon, A.M., Gupta M.K. and Dasgupta B: Fundamentals of Statistics Vol. I and Vol. II World Press, Calcutta. 4. Hogg R. V. and Criag A.T.: Introduction to Mathematical Statistics (Third edition), Macmillan Publishing, New York.	

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Course Code	Course Name: Database Management Systems	4L:0T:2P	Credits:6	Marks:70
Course Outcomes	**After the successful completion of the course the students are able to-** CO 1. Understand the basic probability concepts and random variables that have numerous applications in computer science. CO 2. Apply the concept of distribution functions in web data and traffic network modeling in computer science engineering. CO 3. Analyze statistics and its applications in simulation, data mining and reliability theory. CO 4. Determine the process constructing linear and non-linear curves through the method of least square and understand its usage in binary mixtures CO 5. Identify the concept of statistical quality control in computer science and mechanical engineering.			

Module	Description	Teaching Hrs
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	15
II	**Relational Algebra and Calculus**: Introduction to Relational algebra, **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 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	15
III	**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	15

	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	
IV	**NoSQL Databases and Big Data:** 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, MongoDB operators, Overview of Big Data Technologies: Hadoop, MongoDB, Cassandra. **Database Security and Advanced Topics:** Introduction to Database Security, Access Control, Discretionary Access Control, Introduction to Data Warehousing, OLAP, Data Mining	**15**
	Text Books 1. Raghu Ramakrishnan, Johannes Gehrke, ―Database Management Systems‖, third edition, McGraw – Hill, 2018 2. Benjamin Rosenzweig, Elena Rakhimov, ―Oracle PL/SQL by Example‖, fifth edition, Prentice Hall, 2015 3. Brad Dayley, ―NoSQL with MongoDB in 24 Hours‖, 1st edition, Sams Publishing, 2024 **Reference Books** 1. Korth, Silbertz, Sudarshan,‖ Database System Concepts‖, Seventh Edition, McGraw - Hill.(2019) 2. R.P. Mahapatra, Govind Verma, ―Database Management Systems‖, Khanna Publishing House, 2025. **Web Resources** 1. https://oracle-base.com/articles 2. https://forums.oracle.com/ords/apexds/domain/dev-community/category/sql_and_pl_sql	

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Course Code	Course Name: Python Programming	2L:0T:1P	Credits:3	Marks:40
Course Outcomes	**After the successful completion of the course the students are able to-** **CO1**: Develop problem-solving skills by writing Python programs to implement real-world solutions. **CO2**: Gain hands-on experience in working with various Python libraries and modules for advanced operations. **CO3**: Demonstrate effective use of Python for data analysis, file manipulation, and graphical representations.			
Module	**Description**			**Teaching Hrs**
I	**Introduction**: 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.			**10**
II	**Functions:** Built-In Functions, Function Definition and call; Scope an 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.			**10**
III	**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; Pi charts; Sine and cosine curves.			**10**
	Text Books: 1. Venkatesh, Nagaraju Y, Introduction to Python Programming, Khanna Publishing House, 2021. 2. Jeeva Jose, Introduction to Computing & Problem Solving With PYTHON, Khanna Publishing House, 2023. 3. Sheetal Taneja & Naveen kumar: Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications, Pearson, 2017. **Reference Books:** 1. Think Python, by Allen Downey, 2nd edition 2015, O'Reilly. https://drive.google.com/file/d/1p9Pul6d5UvnQrO9-Q-LE2_p4YvMk5cIg/view 2. An introduction to Python for absolute beginners, by Bob Dowling, Cambridge Univ. 3. Introduction to Computation and Programming using Python, by John Guttag, 2 nd edition, 2016, PHI India.			

	Web Resources: 1. https://www.learnpython.org/ 2. https://www.w3schools.com/python/default.asp	

Course Code	Course Name: Software Engineering	4L:0T:0P	Credits:4	Marks:70
Course Outcomes	**After the successful completion of the course the students are able to-** CO1:Understanding Software Engineering Principles CO2: Understand the principles of managing software projects, including time, cost, quality, and scope management. CO3: Foster critical thinking skills to assess and solve complex software engineering problems. CO4: Understand the importance of software maintenance and evolution, including bug fixes, enhancements, and re-engineering.			
Module	**Description**			**Teaching Hrs**
I	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**
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, RMMM plan. **Project planning**- Software pricing, Plan-driven development, Project scheduling, Agile planning, Estimation techniques.			**15**
III	**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. **Product metrics**: Software quality, metrics for analysis model, metrics for design model, metrics for source code, metrics for testing, metrics for maintenance.			**15**
IV	**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**
	Text Books 1. Software Engineering, N.S. Gill, Khanna Publishing House, 2023 (AICTE Recommended Textbook) 2. Software Engineering, Ian Somerville, 9th edition, Pearson			

	education. 3. Software Engineering A practitioner‘s Approach, 8th edition, Roger S Pressman, Bruce R. Maxim. McGraw Hill Education, 2015. **Reference Books** 1. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007 2. Software Engineering: Principles and Practice Hans van Vliet	

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Professional Elective -I

DSE201	Professional Elective -I **AIML**	**2L:0T:1P**	**3 Credits**

Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science / Artificial Intelligence and Machine Learning/ Full Stack Development**

Course Code	**Course Name: Feature Engineering**	**2L:0T:1P**	**Credits:3**	**Marks:40**
Course Outcomes	**After the successful completion of the course the students are able to-** CO1: 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). CO2: Apply basic feature preprocessing techniques such as handling missing data, data cleaning, and feature scaling and normalization. CO3: Implement feature engineering techniques for numerical data, including binning, discretization, polynomial and interaction features, and log transformation. CO4: Utilize categorical data techniques, such as one-hot encoding and label encoding, and understand feature selection methods, including filter and wrapper methods. CO5: Perform feature transformation using techniques like Principal Component Analysis (PCA) and understand its application in machine learning.			
Module	**Description**			**Teaching Hrs**
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.			**15**
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.			**15**
	Text Books 1. M.C. Trivedi, Data Science and Data Analytics Using Python Programming, Khanna Publishing House, 2024. 2. Zheng, Alice, & Casari, Amanda. (2018). Feature engineering for machine learning: Principles and techniques for data scientists. O'Reilly Media, Inc. 3. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN-13:			

Reference Books:

1. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed), John Wiley & Sons, ISBN-13: 978-8126511167.
2. N. Bhaskar, Vasundhara, Machine Learning, Khanna Publishing House, 2024.
3. M.C. Trivedi, Deep Learning and Neural Network_MC Trivedi, Khanna Publishing House, 2024.
4. Ng, Andrew. (2018). Machine learning yearning (Draft, MIT Licensed). GitHub. ISBN- 10: 199957950X, ISBN-13: 978-1999579500.
5. Han, Jiawei, Kamber, Micheline, & Pei, Jian. (2011). Data mining: Concepts and techniques (3rd ed.). Morgan Kaufmann Publishers. ISBN 978-0123814791.
6. Tan, Pang-Ning, Steinbach, Michael, Karpatne, Anuj, & Kumar, Vipin. (2021). Introduction to data mining (2nd ed.). Pearson. ISBN 978-9354491047.
7. 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.
8. Galli, Soledad. (2020). Python feature engineering cookbook: Over 70 recipes for creating, engineering, and transforming features to build machine learning
9. Nielsen, Aileen. (2019). Practical time series analysis: Prediction with statistics and machine learning. O'Reilly Media.
10. Rajiv Chopra, Deep Learning, Khanna Publishing House, 2024.
11. Jeeva Jose, Machine Learning, Khanna Publishing House, 2024.
12. Chollet, François. (2017). Deep learning with Python. Manning Publications. ISBN 9781617294433.

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Environment Science

VAC201	**Environment Science**	**0L:0T:4P**	**2 Credits**

Note: All the theoretical contents shall be delivered through the practical workshop mode only. No class room teaching is encouraged in this course.

B.C.A. Part-II
Semester-III Part-II
Lab Course Based on Descriptive Statistics
Theory: 00 Teaching Hours Credits-01

Course Outcomes: After the successful completion of the course the students are able to-

CO1: Classify, tabulate and represent the data graphically.

CO2: Compute and interpret various measures of central tendency.

CO3: Compute and interpret various measures of dispersion.

CO4: Compute and interpret various bivariate data.

Sr. No.	Title of the Experiment
1	Formation of Frequency Distribution
2	Graphical representation
3	Measures of Central Tendency I (Ungrouped data)
4	Measures of Central Tendency II (Grouped data)
5	Measures of Dispersion I (Ungrouped data)
6	Measures of Dispersion II (Grouped data)
7	Correlation I (Karl Pearson's correlation coefficient)
8	Correlation II (Spearman's rank correlation coefficient)
9	Regression (Ungrouped data)

B.C.A. Part-II
Semester-III Part-II
Lab Course Based on Database Management System
Theory:00 Teaching Hours Credits-02
Course Outcomes: After the successful completion of the course the students are able to-

CO1: Understand and apply the concepts of database design.
CO2: Develop SQL queries for database manipulation.
CO3: Implement and work with different types of database systems.
CO4: Collaborate effectively in teams to complete DBMS-related projects.

Sr No.	Content
1	Draw an ER Diagram of Registrar Office
2	Draw an ER Diagram of Hospital Management System
3	Reduce The ER diagram in question no 1 into tables
4	Reduce the ER diagram of question no 2 into tables
5	Consider the following Schema Supplier(SID, Sname, branch, city, phone) Part(PID, Pname, color, price) Supplies(SID, PID, qty, date_supplied) DDL Commands 1. Create the above tables 2. Add a new attribute state in supplier table 3. Remove attribute city from supplier table 4. Modify the data type of phone attribute 5. Change the name of attribute city to address 6. Change a table‘s name, supplier to sup 7. Use truncate to delete the contents of supplies table 8. Remove the part table from database DML Commands 1. Insert at least 10 records in tables supplier, part and supplies 2. Show the contents in tables supplier, part and supplies 3. Find the name and city of all suppliers 4. Find the name and phone no of all suppliers who stay in _Delhi‘ 5. Find all distinct branches of suppliers 6. Delete the record of the supplier whose SID is 204001 7. Delete all records of supplier table 8. Delete all records of suppliers whose city starts with capital A. 9. Find the supplier names which have _lk‘ in any position 10. Find the supplier name where _R‘ is in the second position 11. Find the name of supplier whose name starts with _V‘ and ends with _A‘ 12. Change the city of all suppliers to _BOMBAY‘ 13. Change the city of supplier _Vandana‘ to _Goa
6	Queries with Constraints 1. Create the supplier table with Primary Key Constraint 2. Create supplies table with Foreign key Constraint 3. Create a part table with UNIQUE Constraint 4. Create supplier Table with Check Constraints 5. Create Supplier table with Default Constraint

7	Queries on TCL 1. Create Savepoints 2. Rollback to SavePoints 3. Use Commit to save
8	Aggregate Functions: 1. Find the minimum, maximum, average and sum of costs of parts 2. Count the total number of parts present 3. Retrieve the average cost of all parts supplied by _Mike‘
9	Queries on GROUP BY, HAVING AND ORDER BY Clauses 1. Display total price of parts of each color 2. Find the branch and the number of suppliers in that branch for branches which have more than 2 suppliers 3. Find all parts sorted by pname in ascending order and cost in descending order Find the branch and the number of suppliers in that branch
10	Queries on Analytical, Hierarchical, Recursive nature. 1. Find out the 5th highest earning employee details. 2. Which department has the highest number of employees with a salary above $80,000, and what percentage of employees in that department have a salary above $80,000 3. Retrieve employee table details using the hierarchy query and display that hierarchy path starting from the top level indicating if it is a leaf and there exists a cycle. 4. What is the average salary for employees in the top 2 departments with the highest average salary, and what is the hierarchy of departments and sub-departments for these top 2 departments? 5. Use recursion to retrieve the employee table and display the result in breadth first and depth first order. 6. Write a recursive query to show the equivalent of level, connect_by_root and connect_by_path 7. Use recursion to retrieve the employee table and display the result in depth first order showing id, parent_id, level, root_id, path and leaf.
11	Queries on Operators 1. Find the pname, phoneno and cost of parts which have cost equal to or greater than 200 and less than or equal to 600. 2. Find the sname , SID and branch of suppliers who are in _local‘ branch or _global‘ branch 3. Find the pname, phoneno and cost of parts for which cost is between 200 and 600. 4. Find the pname and color of parts , which has the word _NET‘ anywhere in its pname. 5. Find the PID and pname of parts with pname either _NUT‘ or _BOLT‘ 6. List the suppliers who supplied parts on _1st may2000‘, _12 JAN 2021‘ ,‘17 dec 2000‘,’10 Jan 2021’ 7. Find all the distinct costs of parts
12	Join Operators 1. Perform Inner join on two tables 2. Perform Natural Join on two tables 3. Perform Left Outer Join on tables 4. Perform Right Outer join on tables 5. Perform Full Outer Join on tables
13	Set Theory Operators

	1. Show the use of UNION operator with union compatibility 2. Show the use of intersect operator with union compatibility 3. Show the use of minus operator with union compatibility 4. Find the cartesian product of two tables
14	Queries on Set Theory Operators 1. List all parts except _NUT‘ and _BOLT‘ in ascending order of costs 2. display all parts that have not been supplied so far 3. To display the supplier names who have supplied _green‘ part with cost 500 Rupees AND _red‘ part with cost 400 Rupees. 4. To display the supplier names who have supplied _green‘ part with cost 500 Rupees OR _red‘ part with cost 400 Rupees. 5. To Display the name of suppliers who have supplied all parts that are _red‘ in color.
15	PL/SQL Programs 1. Write a PL/SQL Code to add two numbers 2. Write a PL/SQL code for Fibonacci series 3. Write a PL/SQL Code for greatest of 3 numbers 4. Write a PL/SQL code for area and circumference of a circle
16	PL/SQL Programs on Cursors 1. Write a Program using CURSOR to display SID and city of 1st record of supplier 2. Write a program using cursors to display the SID and City of all suppliers and then print the count of suppliers.
17	PL/SQL Programs on Triggers, Procedures and Functions 1. Write a Program using TRIGGER on UPDATE 2. Write a command to See the effect of trigger 3. Write a Program using PROCEDURE to increase the cost by Rs.1000 for part whose PID is passed as an argument. 4. Write a procedure to update the city of an supplier whose SID and city are passed as arguments and the procedure returns the name of supplier whose city is updated. 5. Write a function to return the total number of suppliers 6. Write a function to return the PID of part, for which the part name is passed 7. Write a function to find the sum total of costs of all parts.
18	PL/SQL Programs on Implicit Cursors 1. Insert a record using %ROWTYPE 2. Write a code using %NOTFOUND, %FOUND, %ROWCOUNT 3. Write a code using %TYPE
19	MongoDB Queries 1. Create a collection and insert documents into it using insertOne() and insertMany() 2. Select all documents in collection 3. Find the count of all suppliers 4. Find all records that have city = _Delhi‘ 5. Retrieve all documents that have color equal to _red‘ or _green‘ 6. Retrieve all documents where part_name is _P1‘ or price is less than 200. 7. Update the record of _Geeta‘ ,set city = _Bombay‘ and phoneno = _11223344‘ 8. Delete all records where price is greater than 5000 9. Display only the name and city of the supplier 10. Sort all suppliers on city and display only the first two records.

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B.C.A. Part-II
Semester-III Part-II
Lab Course Based on Python Programming
Theory:00 Teaching Hours Credits-02

Course Outcomes:
CO1: Understand and apply the fundamental syntax of Python, including variables, data types, operators, conditionals, loops, and functions.
CO2: Implement basic programs to solve problems using fundamental programming constructs.
CO3: Understand and apply object-oriented programming principles in Python, such as classes, objects, inheritance, polymorphism, and encapsulation.
CO4: Develop algorithms and strategies for solving real-world problems efficiently using Python.

Sr No.	Content
1	Write a program to find whether a number is a prime number
2	Write a program to print m raise to power n, where m and n are read from the user.
3	Write a program having a parameterised function that returns True or False depending on whether the parameter passed is even or odd.
4	Write a program having a parameterised function that returns True or False depending on whether the parameter passed is even or odd.
5	Write a menu driven program to perform the following operations on strings using string built in functions. a. Find the frequency of a character in a string. b. Replace a character by another character in a string. c. Remove the first occurrence of a character from a string. d. Remove all occurrences of a character from a string.
6	Write a menu driven program to perform the following operations on strings using string built in functions. a. Find the frequency of a character in a string. b. Replace a character by another character in a string. c. Remove the first occurrence of a character from a string. d. Remove all occurrences of a character from a string.
7	Write a program that accepts two strings and returns the indices of all the occurrences of the second string in the first string as a list. If the second string is not present in the first string, then it should return -1
8	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.
9	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..
10	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..
11	Write a function that reads a file file1 and copies only alternative lines to another file file2. Alternative lines copied should be the odd numbered lines.
12	Write a program that reads a list of integers from the user and throws an exception if any numbers are duplicates.
13	Write a program that makes use of a function to display sine, cosine, polynomial and exponential curves.
14	Take as input in the months and profits made by a company ABC over a year. Represent this data using a line plot. Generated line plot must include X axis label name = Month Number and Y axis label name = Total profit.

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B.C.A. Part-I
Semester-III Part-II
Lab Course Based on Feature Engineering
Theory:00 Teaching Hours Credits-01

Course Outcomes-After the successful completion of the course the students are able to-

CO1: Demonstrate proficiency in handling and preprocessing missing data, including fillingmissing values and cleaning invalid data entries.
CO2: Apply feature scaling techniques, such as Min-Max normalization, and perform exploratory data analysis through data visualization methods like histograms and boxplots.
CO3: Implement feature engineering techniques, including binning, polynomial feature creation, and logarithmic transformations on numerical data.
CO4: Perform text data preprocessing tasks, such as tokenization, stemming, lemmatization,and apply TF-IDF and Bag-of-Words transformations.
CO5: Apply image and time series data augmentation and decomposition techniques to enhance and analyze image and time series data.

Sr No.	Content
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
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'.
3	Scale numerical features using Min-Max normalization for a dataset with columns like _Height', _Weight‘.
4	Perform exploratory data analysis and visualize data distributions using histograms and boxplots
5	Compute and visualize the correlation matrix of a dataset with 2 or more columns.
6	Bin numerical data into discrete intervals for a dataset with a column containing numerical values.
7	Create polynomial and interaction features from numerical data in a dataset with two columns.
8	Apply logarithmic transformation to skewed numerical features in a dataset with column 'Distance'.
9	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].
10	Preprocess text data (tokenization) for a dataset with a column 'Text'.
11	Preprocess text data (stemming) for a dataset with a column 'Text'.
12	Preprocess text data (lemmatization) for a dataset with a column 'Text'.
13	Convert text data into a Bag-of-Words representation for a dataset with a column 'Text'.
14	Apply TF-IDF transformation to text data for a column 'Text'.
15	Perform image augmentation (resizing, normalization, rotation, translation) for a set ofimages.
16	Perform image augmentation resizing for a set of images.
17	Perform image augmentation normalization for a set of images.
18	Perform image augmentation rotation for a set of images.
19	Perform image augmentation translation for a set of images.
20	Decompose a time series into trend, seasonal, and residual components for a dataset witha column 'TimeSeries'.
21	Perform Principal Component Analysis (PCA) on a dataset and visualize the first twoprincipal components.

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SEMESTER-IV

Course Code	Course Name: Probability Distribution and Testing of Hypothesis	2L:0T:1P	Credits:3	Marks:40
Course Outcomes	**After the successful completion of the course the students are able to-** CO1. Understand the basic concepts of probability, conditional probability and independence of events. CO2. Know applications of Binomial, Poisson and Normal Distribution. CO3. Understand large sample tests for mean. CO4. Understand small sample tests.			

Module	Description	Teaching Hrs
I	**1.1 Probability** 1.1.1 Concepts of experiments and random experiments, Sample Space, Discrete sample space (finite and countably infinite) 1.1.2 Events, Types of events: Elementary event, Compound event, Impossible events, Certain event 1.1.3 Algebra of events: Mutually exclusive events, Exhaustive events, Complement of an event, Union, Intersection of two events. 1.1.4 Classical definition of Probability, Addition and Multiplication laws of Probability (without proof), Conditional probability. 1.1.5 Random variable, types of random variable, Definition of Probability mass function (p.m.f.) and Probability density function (p.d.f.), cumulative distribution function (c.d.f.) and its Properties, Mean, Median, Mode and Variance of Random Variable 1.1.6 Numerical Examples. **1.2 Binomial Distribution** 1.2.1 Probability mass function, Mean and Variance (without proof) 1.2.2 Recurrence relation for successive probabilities. 1.2.3 Simple numerical problems to find probability and parameters. **1.3 Poisson Distribution** 1.3.1 Probability mass function, Mean and Variance (without proof) 1.3.2 Recurrence relation for successive probabilities. 1.3.3 Simple numerical problems to find probability and parameters. **1.4 Normal Distribution** 1.4.1 Probability density function, Mean and Variance (without proof) 1.4.2 Properties of Normal Curve, Standard normal distribution 1.4.3 Numerical problems to find probabilities for given area under standard normal curve.	**15**
II	**2.1 Hypothesis:** 2.1.1 Concept of Population and Sample, Parameter and Statistic. 2.1.2 Hypothesis, Null and alternative hypothesis, Simple and composite hypothesis, One and two tailed test, type I and type II errors, power of test. **2.2 Large Sample Tests for Means:** 2.2.1 Testing of population mean; H_0: $\mu = \mu_0$ 2.2.2 Testing equality of two population means; H_0: $\mu_1 = \mu_2$ **2.3 Small Sample Tests for Means:** 2.3.1 T Test: (i) Testing of population mean; H_0: $\mu=\mu_0$ (ii) Testing of equality of two population means; H_0: $\mu_1=\mu_2$ (iii) Paired t test. 2.3.2 Chi square test: (i) independence of attributes (ii) goodness of fit.	**15**

	Reference Books 1. Gupta S. C. & Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & sons, New Delhi. 2. Rohatgi V. K. and Saleh A. K. Md. E. (2002): An Introduction to probability and statistics. John Wiley & Sons (Asia). 3. Parimal Mukhopadhyaya: An Introduction to the Theory of Probability. World Scientific Publishing. 4. Agarwal B. L. (2003). Programmed Statistics, 2nd ed., New Age International (P), New Delhi	

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Course Code	Course Name: Computer Networks	4L:0T:2P	Credits:6	Marks:70
Course Outcomes	**After the successful completion of the course the students are able to-** CO1: Understand the fundamental concepts of Computer Networks and their applications. CO2: Develop problem-solving skills related to network design, implementation, and troubleshooting. CO3: Implement network protocols and configure network devices. CO4: Developing practical networking skills			
Module	**Description**			**Teaching Hrs**
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.			**15**
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 Consideration s**Virtual LANs (VLANs):** Concept of VLANs, VLAN Tagging and Configuration, Benefits and Use Cases			**15**
III	**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			**15**

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. **Emerging 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.	**15**
	Text Books: 1. Andrew S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education, 2011. 2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", 8th Edition, Pearson, 2021. **Reference Books:** 1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, McGraw-Hill Education, 2012. 2. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann, 2019. 3. Bhavneet Sidhu, An Integrated Approach to Computer Networks, Khanna Publishing House, 2023. 4. Mastering PC Hardware & Networking, Khanna Publishing House, 2024. **Web Resources**: 1. Cisco Networking Academy - Online Courses and Resources 2. NetworkLessons.com - Tutorials on Various Networking Topics	

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Course Code	Course Name: Design and Analysis of Algorithms	4L:0T:0P	Credits:4	Marks:70
Course Outcomes	**After the successful completion of the course the students are able to-** 1. Understanding Algorithmic Design Techniques 2. Data Structures and Algorithm Integration 3. Algorithm Implementation and Optimization 4. Greedy Algorithms and Dynamic Programming			
Module	**Description**			**Teaching Hrs**
I	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, Master's theorem.			**15**
II	**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. Lower bound for comparison-based sorting. **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.			**15**
III	**The Dynamic Programming Design Technique:** The general concept. Computation of Fibonacci series and Binomial coefficients, all pair shortest paths problem (Floyd-Warshall‘s 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.			**15**
IV	**Limitations of Algorithmic Power:** Backtracking Method: n-Queen problem; sum of subsets problem/ Hamiltonian circuit problem/vertex cover problem. Computational Intractability: Overview of non-deterministic algorithms, P, NP, NP-Complete and NP-hard problems.			15
	Text Books 1. Gajendra Sharma, Design and Analysis of Algorithms, Khanna Publishing House (AICTE Recommended Textbook) 2. Cormen Thomas H., Leiserson Charles E., Rivest Ronald L. and Stein Clifford, Introduction to Algorithms, PHI publication, 3rd Edition, 2009. 3. Horowitz Ellis, Sahni Sartaj and Rajasekaran Sanguthevar, Fundamentals of Computer Algorithms, University Press (I) Pvt. Ltd., 2012. 4. Levitin Anany, Introduction to Design and Analysis of			

	Algorithms, 3rd Edition, Pearson, 2012 **Reference Books** 1. Aho Alfred V., Hopcroft John E. & Ullman Jeffrey D., The Design & Analysis of Computer Algorithms, Addison Wesley Publications, Boston, 1983. 2. Kleinberg Jon & Tardos Eva, Algorithm Design, Pearson Education, 2006. **Web Resources** 1. https://nptel.ac.in/courses/106101060 2. https://www.cs.umd.edu/~mount/451/Lects/451lects.pdf	

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Course Code	Course Name: Artificial Intelligence	4L:0T:2P	Credits:6	Marks:70
Course Outcomes	**After the successful completion of the course the students are able to-** CO1: Understand the characteristics of rational agents, and the environment in which they operate, and gain insights about problem-solving agents. CO2: Gain insights about Uninformed and Heuristic search techniques and apply them to solve search applications. CO3: Appreciate the concepts of knowledge representation using Propositional logic and Predicate calculus and apply them for inference/reasoning. CO4: Obtain insights about Planning and handling uncertainty through probabilistic reasoning and fuzzy sets. CO5: Obtain a basic understanding of the AI domains and their applications and examine the legal and ethical issues of AI.			

Module	Description	Teaching Hrs
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.	**15**
II	**Advanced Search Techniques** Uninformed Search: DFS, BFS, Iterative Deepening Search. Informed Search: Best First Search, A* search, AO* search. Adversarial Search & Games: Two-player zero-sum games, Minimax Search, Alpha-Beta pruning. 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.	**15**
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. Introduction to Planning: Blocks World problem, Strips; Handling Uncertainties: Non-monotonic reasoning, Probabilistic reasoning, Introduction to Fuzzy set theory.	**15**
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.	15
	Text Books: 1. M.C. Trivedi, *A Classical Approach to Artificial Intelligence*, Khanna Book Publishing Company, 2024 (AICTE Recommended Textbook). 2. Nilsson Nils J, *Artificial Intelligence: A new Synthesis*, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4. 3. Dan W Patterson, *Introduction to Artificial Intelligence & Expert Systems*, PHI Learning 2010. 4. Rajiv Chopra, *Data Science with Artificial Intelligence, Machine Learning and Deep Learning*, Khanna Book Publishing	

	Company, 2024. **Reference Books:** 1. M.C. Trivedi, *Introduction to AI and Machine Learning*, Khanna Book Publishing Company, 2024. 2. Russell, S. and Norvig, P., ―Artificial Intelligence - A Modern Approach‖, 3rd edition, Prentice Hall 3. Van Hirtum, A. & Kolski, C. (2020). *Constraint Satisfaction Problems: Algorithms and Applications*. Springer 4. Rajiv Chopra, Machine Learning and Machine Intelligence, Khanna Book Publishing Company, 2024.	

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Professional Elective -II

DSE202	Professional Elective -I **(Data Science/ AIML/ Full Stack Development)**	2L:0T:1P	3 Credits

Refer to **Appendix–I** for Professional Electives and choose either one specialization from the basket of **Data Science /Artificial Intelligence and Machine Learning/ Full Stack Development.**

Course Code	Course Name: Introduction to Machine Learning	2L:0T:1P	Credits:3	Marks:40
Course Outcomes	**After the successful completion of the course the students are able to-** CO1: Define and explain machine learning concepts, types, and basic metrics. CO2: Implement and apply supervised learning techniques (e.g., KNN, Linear Regression, Logistic Regression). CO3: Apply unsupervised learning methods (e.g., K-Means, Hierarchical Clustering, Association Rules). CO4: Develop and evaluate simple machine learning models (e.g., Perceptron, single-layer neural networks). CO5: Analyze and apply appropriate machine learning algorithms depending on the problems with some real-world data.			
Module	**Description**			**Teaching Hrs**
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.			**15**
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.			**15**
	Text Books: 1. Rajiv Chopra (2024), Machine Learning and Machine Intelligence, Khanna Publishing House. 2. Jeeva Jose (2023), Introduction to Machine Learning, Khanna Publishing House. 3. Mitchell T. (1997). Machine Learning, First Edition, McGraw-Hill. 4. Kalita, J. K., Bhattacharyya, D. K., & Roy, S. (2023). Fundamentals of Data Science: Theory and Practice. Elsevier. ISBN9780323917780 **Reference Books:** 1. Flach, P. A. (2012). Machine Learning: The Art and Science of Algorithms that Make Sense of Data. Cambridge University Press. ISBN: 9781107422223, 2012. 2. Duda, R. O., Hart, P. E., Stork, D (2007). Pattern classification (2Ed),			

	John Wiley & Sons, ISBN-13: 978-8126511167. 3. Haykin S. (2009). Neural Networks and Learning Machines, Third Edition, PHI Learning. 4. Chollet, F. (2018). Deep Learning with Python. Manning Publications. 5. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer. 6. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press. 7. 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.	

B.C.A. Part-II
Semester-IV Part-II
Lab Course Based on Probability Distribution and Testing of Hypothesis
Theory: 00Teaching Hours Credits-01

Course Outcomes: After the successful completion of the course the students are able to-
CO1: Compute of various probabilities.
CO2: Understand the applications of Binomial, Poisson and Normal distributions.
CO3: Apply the large sample test for mean.
CO4: Apply the small sample tests.

Sr. No.	Title of the Experiment
1	Computation of probabilities and Conditional Probabilities.
2	Computation of Probabilities for Univariate Probability Distribution.
3	Fitting and Applications of Binomial Distribution.
4	Fitting and Applications of Poisson Distribution.
5	Applications of Normal Distribution.
6	Large sample tests for Testing population mean.
7	Large sample test for Testing equality of two population means.
8	Small sample tests for Testing of population mean and equality of two population means.
9	Paired t test.
10	Chi-square test: Test of independence of attributes, Test for goodness of fit.

B.C.A. Part-II
Semester-IV Part-II
Lab Course Based on Computer Network
Theory: 00Teaching Hours Credits-02

Course Outcomes: After the successful completion of the course the students are able to-

1. Understanding Network Fundamentals
2. Network Configuration and Troubleshooting
3. Implementing Networking Protocols
4. Subnetting and IP Addressing

Sr No	Content
1	Configure Basic Network Settings: a) IP Address Configuration b) Subnet Mask and Gateway Settings
2	Implement Network Protocols: a) Write a simple Python script to perform DNS resolution. b) Implement a basic HTTP client-server application.
3	Network Simulation: a) Use network simulation tools (e.g., Cisco Packet Tracer) to design and simulate network topologies. b) Configure routers and switches in a simulated environment.
4	Performance Measurement: a) Measure network performance using tools like `ping`, `traceroute`, and `iperf`. b) Analyze network traffic using Wireshark.
5	Implement VLANs: a) Configure VLANs on a switch and verify using simulation tools.
6	Set Up a Simple Web Server: a) Deploy a basic web server and configure HTTP/HTTPS access.
7	Network Security Lab: a) Implement basic firewall rules and VPN configurations. b) Perform vulnerability scanning and analyze results.
8	Network Troubleshooting: b) Diagnose and resolve common network issues. c) Use troubleshooting commands and techniques to fix connectivity problems.

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B.C.A. Part-II
Semester-IV Part-II
Lab Course Based on Artificial Intelligence
Theory: 00Teaching Hours Credits-02

Course outcomes: After the successful completion of the course the students are able to-

CO1: Apply Uninformed Search Algorithms and Implement Heuristic Search techniques CO2: Analyze and Solve Constraint Satisfaction Problems
CO3: Develop Rule-Based Systems
CO4: Implement and Evaluate Optimization Techniques CO5: Apply and illustrate the NLP concepts

Sr No.	Content
1	Demonstrate basic problem-solving using Breadth-First Search on a simple grid.
2	Implement Depth-First Search (DFS) on a small graph.
3	Solve the Water Jug Problem using Breadth First Search (BFS).
4	Implement a Hill Climbing search to find the peak in a numeric dataset.
5	Apply the A* Search algorithm to find the shortest path in a 4x4 grid.
6	Implement the Minimax search algorithm for 2-player games. You may use a game tree with 3 plies.
7	Solve the 4 – Queens Problem as a CSP backtracking problem.
8	Use constraint propagation to solve a Magic Square puzzle.
9	Apply optimization techniques to find the maximum value in a list.
10	Represent and evaluate propositional logic expressions
11	Implement a basic rule-based expert system for weather classification.
12	Implement a basic AI agent with simple decision-making rules.
13	Implement a basic Rule-Based Chatbot.
14	Using Python NLTK, perform the following Natural Language Processing (NLP) tasksfor text content. a) Tokenizing b) Filtering Stop Words c) Stemming d) Part of Speech tagging e) Chunking f) Named Entity Recognition (NER)
15	Perform Image classification for a given dataset using CNN. You may use Tensorflow /Keras.

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B.C.A. Part-II
Semester-IV Part-II
Lab Course Based on Introduction to Machine Learning Lab
Theory: 00 Teaching Hours Credits-01

Course Outcomes: After the successful completion of the course the students are able to-

CO1: Implement and evaluate supervised learning techniques, including K-Nearest Neighbors, linear regression, and logistic regression, and measure model performance using accuracy, precision, recall, and F1 score.

CO2: Apply and visualize clustering algorithms such as K-Means, hierarchical clustering, and DBSCAN on datasets. This practical application helps you understand their real- world use.

CO3: Perform dimensionality reduction using Principal Component Analysis (PCA) and interpret the results.

CO4: Develop and assess classification models using random forests, support vector machines, and neural networks.

CO5: Demonstrate ensemble learning concepts through bagging with random forests and boosting with the AdaBoost algorithm.

Sr No.	Content
1	Implement linear regression on a dataset and visualize the regression line.
2	Implement logistic regression on a binary classification dataset and plot the decision boundary.
3	Implement and evaluate the performance of Decision tree ID3/Cart classifier for any given dataset.
4	Implement and evaluate the performance of the Naive Bayes Classifier on a given dataset.
5	Build and evaluate a random forest classifier using a numerical dataset.
6	Implement a support vector machine for linearly separable classes and visualize the margins and decision boundary.
7	Implement K-Means clustering on a point dataset and visualize and evaluate the clusters.
8	Implement hierarchical clustering on a dataset and plot the dendrogram.
9	Implement DBSCAN clustering on a dataset and visualize and evaluate the clusters.
10	Perform Principal Components Analysis (PCA) and apply any one or more classifiers to show the performance variation with or without feature reduction.
11	Build a single layer perceptron model to classify AND, OR, and XOR problems (may use TensorFlow/Keras) and visualize their decision boundaries. Also evaluate its performance.
12	Demonstrate the concept of boosting using the AdaBoost algorithm.

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QUESTION PAPER PATTERN FOR ALL SEMESTERS

Duration: 3 Hours **Total Marks – 70**

Instructions: 1) Que.1 and Que.8 are compulsory.

2) Attempts any four Questions from Que. No.2 to Que. No. 7.

3) Figures to the right indicate marks.

Qu.1) Five MCQ / Short answer Questions / Match the Pairs	05
Qu.2) Broad answer question	14
Qu.3) Broad answer question	14
Qu.4) Broad answer question	14
Qu.5) Broad answer question	14
Qu.6) Broad answer question	14
Qu.7) Broad answer question	14
Qu.8) Write notes on (Any three out of five)	09

Note: Que.2 to Que.7 may contain sub-questions (A) & (B) carrying 7 marks each.

Question Paper Pattern

Duration: 2 Hours **Total Marks –40**

Instructions: 1) All Questions are compulsory.

2) Figures to the right indicate full marks.

Que. No	Type of question Marks	Marks
Q.1 A)	MCQ	**5**
B)	Fill in the Blanks/True or False	**3**
Q.2	Long answer question	**16**
Q.3	Short notes on (Any four out of six)	**16**

Internal Marks Distribution:

Total Marks-30

1. Ten Marks for Tests. (Two test of 10 Marks would be conducted and convert these marks to Ten marks.)
2. Ten Marks for designing apps or software or working model/ Field Work/online learning activity or Home Assignment etc.
3. Five Marks for Oral.
4. Five Marks for Department activity participation and Attendance.(75% to 80%- 02 marks, 81% to 85 %- 03 marks, 86% to 90%- 04, marks 91% to 100% - 5 mark)

Total Marks- 10

Test- 3 marks, Home Assignment-3 marks, Dept.Activities-02 marks, Oral-02 marks