Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA
PHONE : EPABX – 2609000, BOS Section – 0231-2609094, 2609487
Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

SU/BOS/Sci & Tech/ 499 **Date: 18 /08/2025**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur

The Head/ Director/ Co-ordinator
All Concerned Department (Science)
Shivaji University, Kolhapur

Subject: Regarding revised syllabi of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0)

Ref: No. SU/BOS/Science/271 & 274 Date: 03/05/2025 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabi, nature of question paper of B.Sc. Part-II (Sem.III & IV) degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

B.Sc. Part-II (Sem. III & IV) as per NEP-2020 (2.0)			
1.	B.Sc.Part II Biochemistry	5.	Computer Science (Entire)
2.	Animation (Entire)	6.	Computer Science (Optional)
3.	B.Sc. - M.Sc. AI&ML)	7.	Information Technology (Entire)
4.	BCA		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk (Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dr. S. M. Kubal
Dy. Registrar

Encl. : As above.

Copy to: For Information and necessary action.

1	I/c Dean, Faculty of Science & Technology	7	Appointment Section A & B
2	Director, Board of Examinations & Evaluation	8	Affiliation Section (T.1) (T.2)
3	The Chairpersan, Respective Board of Studies	9	P.G.Admission Section,
4	B.Sc. Exam Section	10	Computer Centre / IT Cell
5	Eligibility Section	11	Internal Quality Assorance Cell (IQAC)
6	P.G Seminar Section		

SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
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शिवाजी विद्यापीठ, कोल्हापूर -४१६००४,महाराष्ट्र
दूरध्वनी-ईपीएबीएक्स -२६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९४
०२३१—२६०९४८७

Estd. 1962
"A++" Accredited by
NAAC (2021)
With CGPA 3.52

Ref.No.SU/BOS/Science/ 274 **Date: 03/05/2025.**

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur

The Head/Co-ordinator/Director
All Concerned Department (Science)
Shivaji University, Kolhapur.

Subject: Regarding revised syllabi of degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of degree programme under the Faculty of Science and Technology as per NEP-2020 (2.0).

1.	B.C.A. Part II
2.	B.Sc.-M.Sc. Part III Nano Science and Technology
3.	B.A./B.A.B.Ed Part II Geography
4.	B.Sc.-M.Sc. Part II Artificial Intelligence & Machine Learning

This syllabus, nature of question and equivalence shall be implemented from the academic year 2025-2026 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020 (Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2025 & March/April 2026. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Dy Registrar
Dr. S. M. Kubal

Encl: As above
for Information and necessary action

Copy to:

1	Dean, Faculty of Science & Technology	6	Appointment Section A & B
2	Director, Board of Examinations and Evaluation	7	I.T.Cell /Computer Centre
3	Chairman, Respective Board of Studies	8	Eligibility Section
4	B.A.,OE-II & B.Sc.-M.Sc. Exam Section	9	Affiliation Section (T.1) (T.2)
5	Internal Quality Assurance Cell (IQAC Cell)	10	P.G. Seminar Section

SHIVAJI UNIVERSITY, KOLHAPUR

NAAC A++ Grade with CGPA 3.52

Multiple Entry and Multiple Exit Option (NEP-2020)

Syllabus for
B.Sc- M.Sc. (AI-ML)

Five year Integrated Programme

(Under Faculty of Science and Technology)

PART- II SEMESTER- III & IV

(Syllabus to be implemented from Academic year 2025-26)

Multiple Entry and Multiple Exit Option (NEP-2020)B.Sc-M.Sc(AI-ML)
Program Structure
B.Sc-M.Sc (AI-ML) (Level-5.0)

SEMESTER-III (Duration- Six Month)										
Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam minutes	Maximum Marks	Minimum Marks	Exam minutes
1	Subject I Major V: Data Structure	2	-	2	40	14	90	10	04	20
2	Subject I Major VI: Database Management System	2	-	2	40	14	90	10	04	20
3	Subject I Practical III : Practical Based on Subject I Major V & Major VI	-	4	2	40	14	90	10	04	-
4	Subject II Minor V: Exploratory Data Analysis	2	-	2	40	14	90	10	04	20
5	Subject II Minor VI: Advanced Python Programming	2	-	2	40	14	90	10	04	20
6	Subject II Practical III : Practical Based on Subject II Minor VI	-	4	2	40	14	90	10	04	-
7	OE – III (T) : Discrete Mathematics-I	2	-	2	40	14	90	10	04	20
8	VSC – I (T): Major specific Web Design using JavaScript	2	-	2	40	14	90	10	04	20
9	SEC-I (T): Core Java Programming	2	-	2	40	14	90	10	04	20
10	AEC-I: Verbal Communication	2	-	2	40	14	--	10	04	20
11	CC-I: Basics of Yoga	2	-	2	40	14	90	10	04	20
	Total (A)			22	440			110		

Multiple Entry and Multiple Exit Option (NEP-2020)B.Sc-M.Sc(AI-ML)
Program Structure
B.Sc-M.Sc (AI-ML) (Level-5.0)

SEMESTER-IV (Duration- Six Month)										
Sr. No.	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam minutes	Maximum Marks	Minimum Marks	Exam minutes
1	Subject I Major VII: Advanced Data Structures	2	-	2	40	14	90	10	04	20
2	Subject I Major VIII: Relational database Management System	2	-	2	40	14	90	10	04	20
3	Subject I Practical IV: Practical Based on Subject I Major VII & Major VIII	-	4	2	40	14	90	10	04	-
4	Subject II Minor VII: Feature Engineering	2	-	2	40	14	90	10	04	20
5	Subject II minor VIII: Basics of Artificial Intelligence	2	-	2	40	14	90	10	04	20
6	Subject II Practical IV: Practical Based on Subject II Minor VII	-	4	2	40	14	90	10	04	-
7	OE – III (T): Discrete Mathematics - II	2	-	2	40	14	90	10	04	20
8	SEC-II (T): Advanced Java Programming	2	-	2	40	14	90	10	04	20
9	AEC-II: Business Communication	2	-	2	40	14	90	10	04	20
10	VEC-II: Environmental Studies	2	-	2	40	14	--	10	04	20
11	CEP-I (P): Field work	-	4	2	10	4	--	40	14	90
	Total (A)			22	440			110		

• Student contact hours per week : **24** Hours (Min.)	Total Marks for B.Sc-MSc(AI-ML)-I: **1100**
• Theoryand Practical Lectures : **60** Minutes Each	• Total Credits for B.Sc- MSc(AI-ML)-II (Semester III & IV) : 44
	• Practical Examination is **Semester wise before theory Examination**. • Subject I Practical III • Subject II Practical III • SEC-I (T/P) Practical • *Duration of Practical Examination as per respective BOS guidelines • Separate passing is mandatoryfor Theory, Internal and PracticalExamination
• **Requirement for Entry at Level 5.0:** Must have completed Level 4.5	
• **Exit Option at Level 5.0:** Students can exit after Level 5.0 with under **Diploma course in AI-ML** if he/she completes the courses equivalent to minimum of **44** credits	

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: Subject I Major V: Data Structure

Course Outcomes:

After completion of this course students will be able to;

1. Understand concept of time complexity, space complexity.
2. Understand concept of linear data structure linked list, stack, queue.
3. Explore concepts of searching and sorting algorithm.
4. Demonstrate operations such as traversing, inserting, and deleting in linear and multidimensional arrays including sparse matrices.
5. Implement various searching techniques like linear and binary search to retrieve data efficiently.
6. Construct and manipulate linear data structures like linked lists, stacks, and queues and apply expression conversions (infix, prefix, postfix).

UNIT I (15 Hours)

Definition of data structure, data structure operations. Algorithms : Complexity, Time Complexity of Algorithms, Types of time complexity, Space complexity, Asymptotic Notations for Complexity of Algorithms, Sub algorithms, Variables, data. Linear data structures and non linear data structures, Arrays, Traversing linear arrays, Inserting and Deleting, Multidimensional arrays: Representation of Two-Dimensional arrays in memory, Pointers: Pointers arrays, Matrices, Sparse Matrices.

UNIT II (15 Hours)

Linear search, Binary search, Sorting, Bubble sort, Selection sort, insertion sort, Quick sort, Radix sort, Merge sort, Concept of link list, singly linked list, singly circular, doubly link list, stack queue using array, Infix expression, postfix expression ,prefix expression.

Reference Books:

1. Robert Kruse, C.L Tondo and Bruce Leung, “Data Structure and Programming in C”, Pearson Education.

2. Yedidyah Langsam, Moshe J. Augenstein, and Aaron M. Tenenbaum, “Data Structure using C and C++”, Pearson Education 2nd Edition.

3. “C” Programming in an Open Source Paradigm: A Hands on Approach by K.S.Oza, S.R.Patil and R.K.Kamat

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: Subject I Major VI: Database Management System

Course Outcomes:

After completion of this course students will be able to:

1. Analyze Data Models and Database Schema.
2. Differentiate between schema and instances, data models.
3. Apply Tuple and Domain Relational Calculus for query formulation.
4. Illustrate the use of database languages (DDL, DML) and interfaces, and describe the role of a Database Administrator (DBA).
5. Explain relational data model concepts and enforce various integrity constraints such as entity, referential, key, and domain constraints.
6. Demonstrate SQL operations including data definition, manipulation, joins, subqueries, views, aggregate functions, set operations, and cursors.

UNIT I **(15 Hours)**

An overview of database management system, Database System Vs File System, Database system concepts and architecture, data models, schema and instances, data independence and database language and interfaces, Data definitions language, DML, Overall Database Structure, role of a DBA, Data Modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, Specialization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationships of higher degree.

UNIT II **(15 Hours)**

Relational data model concepts, integrity constraints: entity integrity, referential integrity, Keys constraints, and Domain constraints. Relational Algebra: Relational algebra, relational calculus, tuple and domain calculus. Introduction to SQL: Characteristics of SQL, Advantages of SQL, SQL data types and literals, Types of SQL commands, SQL operators and their procedure, Tables, views and indexes, Queries and sub queries, Aggregate functions, Insert, update and delete operations, Joins, Unions, Intersection, Minus, Cursors in SQL.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Reference Books:

1. Database Management System A C Shah & A R Patel, MacMillan Publication
2. Introduction to Database System C. J. Date (7th edition) Low Price Edition
3. Database system concepts Henry F. Korth (3rd edition) TMH Publications

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: Subject I Practical III:

Practical Based on Subject I Major V & Major VI

Course Outcomes:

After completion of this course students will be able to:

1. Implement Linear and Non-Linear Data Structures
2. Apply DML, cursors, aggregate functions for analytical queries.
3. Construct complex SQL queries using joins, subqueries, aggregate functions, and set operations.
4. Demonstrate the use of views, indexes, and cursors for efficient data access and manipulation.
5. Perform array operations including traversal, insertion, deletion, and manipulation of multidimensional and sparse matrices.
6. Implement stack and queue operations using arrays and evaluate expressions in infix, prefix, and postfix forms.

There will be around 20 programs (10 programs on each subject) based on Major V & Major VI.

Practical Based on Subject I Major V: Data Structure

1. Write a program to read n number of values in an array and display them in reverse order.
2. Write a program to find the maximum and minimum elements in an array.
3. Write a program to search particular element in an array.
4. Write a program to read and display elements of two dimensional array.
5. Write a program for the addition, subtraction and multiplication of two matrices.
6. Write a program to implement linear search.
7. Write a program to implement binary search.
8. Write a program to implement bubble sort.
9. Write a program to implement quick sort.
10. Write a program to implement singly linked list.
11. Write a program to perform insert and delete operations on singly linked list.
12. Write a program to implement doubly linked list.
13. Write a program to implement bubble sort.
14. Write a program to perform PUSH and POP operations on stack using array.
15. Write a program to perform ENQUEUE and DEQUEUE operations on queue using array.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Practical Based on Subject I Major VI: Database Management System

List of Programs based on Database Management System:

1. Write SQL queries to create the following relational tables with appropriate constraints:

   Student (Student_ID, Name, Age, Dept_ID)

   Department (Dept_ID, Dept_Name, HOD)

   Course (Course_ID, Course_Name, Dept_ID)

   Enrollment (Enroll_ID, Student_ID, Course_ID, Marks)

2. Write SQL INSERT statements to add at least 5 records into each table.
   a. Write an SQL query to display all students and their details from the Student table.
   b. Write SQL queries to:

   Set Student_ID as the Primary Key in the Student table.

   Set Dept_ID as a Foreign Key in the Student table referring to Department.

3. Write SQL queries to:

   Retrieve all students from the 'Computer Science' department.

   Find the names of students aged above 20.

4. Write an SQL query to:

   Update the Department name to 'IT' where Dept_ID = 102.

   Increase the marks of all students by 5 where Course_ID = 'C101'.

5. Write SQL queries to:

   Delete students who have not enrolled in any course.

   Remove a specific course from the Course table using Course_ID.

6. Write SQL queries to:

   Find the total number of students in each department.

   Get the average marks obtained by students in Course_ID = 'C102'.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

7. Write SQL queries to:

   Retrieve students with marks greater than 75.

   Find the departments having more than 3 students enrolled.

8. Write SQL queries using different types of JOINs:

   INNER JOIN: Show students along with their enrolled courses.

   LEFT JOIN: Display all students and their department names (even if some students are not assigned to any department).

9. Write SQL queries to:

   Find the student(s) with the highest marks in any course.

   Retrieve students who have enrolled in more than one course.

10. Create a SQL VIEW to display student details along with their enrolled courses and department names.

11. Create an INDEX on the Student table for the Name column to optimize search queries.

12. Write SQL queries to:

    Display the total number of students in each department, sorted in descending order.

    Retrieve students grouped by department, showing the average age of students in each department.

13. Write an SQL stored procedure with a cursor to fetch and display all students' names one by one.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: Subject II Minor V: Exploratory Data Analysis

Course Outcomes:

The course will enable students to:

1. To outline an overview of exploratory data analysis.
2. To implement data visualization using Matplotlib.
3. To perform univariate data exploration and analysis.
4. Apply various data transformation techniques such as merging, reshaping, pivoting, and standard transformations using Python.
5. Manipulate and analyze structured data using Pandas, including indexing, selection, missing value handling, and dataset combination.
6. Analyze single-variable distributions and relationships between two variables using numerical summaries and graphical tools.

UNIT I (15 Hours)

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data –Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques. Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operation.

UNIT II (15 Hours)

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread- Scaling and Standardizing – Inequality, Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables -Handling Several Batches - Scatterplots and Resistant Lines.Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

Reference Books:

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017
3. Claus O. Wilke, “Fundamentals of Data Visualization”, O’reilly publications, 2019

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: Subject II Minor VI: Advanced Python Programming

Course Outcomes:

After completion of this course students will be able to:

1. To learn how to design object-oriented programs with Python classes.
2. To learn about reading, writing and implementing other operation on files in Python.
3. To design GUI Programs and implement database interaction using Python.
4. To know about use of handling exceptions for writing robust python programs.
5. Implement abstract classes, interfaces, and advanced OOP concepts like duck typing and inner classes.
6. Establish connections between Python and SQL databases to perform basic CRUD operations and manage transactions.

UNIT I (15 Hours)

OOPs in python: Features of Object Oriented Programming system (oops)- classes and objects, encapsulation, abstraction, inheritance, polymorphism, constructors and destructors Classes and objects: Creating a class, the self-variable, types of variables, namespaces, types of methods, instance methods, class methods, static methods, passing members of one class to another class, inner classes Inheritance and polymorphism: Inheritance in python, types of inheritance- single inheritance, multilevel inheritance, hierarchical inheritance, multiple inheritance, constructors in inheritance, overriding ,polymorphism, duck typing, operator overloading, method overloading, method overriding, Abstract classes and interfaces**.**

UNIT II (15 Hours)

Python SQL Database Access, introduction, installation, DB connection, Creating DB table, INSERT, DELETE, READ,UPDATE operations, COMMIT and ROLLBACK operations, Handling errors Exceptions in python: Errors in a python program, compile & run-time errors, logical error, exceptions-exception handling, types of exceptions, the except block, the assert statement, user-defined exceptions, logging the exceptions.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Reference Books:

1. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul ries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
2. Python for Informatics: Exploring Information, Charles Severance 3. Learning Python, Fourth Edition, Mark Lutz, O'Reilly publication
3. Advanced Python Programming, Dr. Gabriele Lanaro, Quan Nguyen, SakisKasampalis, Packt Publishing, 2019

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: Subject II Practical III:

Practical Based on Subject Minor VI

Course Outcomes:

After completion of this course students will be able to:

1. Understand Object-Oriented Programming (OOP) Principles in Python.
2. Apply Inheritance and Polymorphism.
3. Develop programs using abstract classes, interfaces, and inner classes for modular and reusable code.
4. Handle runtime and user-defined exceptions in Python using try-except blocks, assertions, and logging mechanisms.
5. Execute commit and rollback operations to manage transactions and maintain database integrity.
6. Debug and log Python applications by handling different types of errors and exceptions with custom error message.

There will be following programs based on Advanced Python Programming:

1. Write a Python program to create a person class. Include attributes like name, country and date of birth. Implement a method to determine the person's age.
2. Write a Python program to create a class representing a bank. Include methods for managing customer accounts and transactions.(Use inheritance)
3. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.
4. Write a Python program in python to elaborate single inheritance.
5. Write a Python program in python to elaborate multiple inheritance.
6. Write a Python program in python to elaborate single inheritance.
7. Write a Python program in python to elaborate multilevel inheritance.
8. Write a Python program in python to elaborate hierarchical inheritance.
9. Write a Python program in python to elaborate multilevel inheritance.
10. Write a Python program in python to elaborate function overloading.
11. Write a Python program in python to elaborate operator overloading.
12. Write a Python program in python to elaborate abstract class.
13. Write a program to alter table in MYSQL in python.
14. Write a program in python to insert a record in SQL Server

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: OE – III (T): Discrete Mathematics-I

Course Outcomes:

The course will enable students to:

1. Basic knowledge of set theory, functions and relations concepts, matrix needed for designing and solving problems.
2. Construct simple mathematical proofs and possess the ability to verify them.
3. Apply concepts of graph connectivity and solve shortest path problems in various types of graphs.
4. Explain set cardinality and different types of functions including injective, surjective, bijective, inverse, and composite functions.
5. Use basic counting principles such as the product rule, sum rule, and inclusion-exclusion principle to solve combinatorial problems.
6. Apply advanced counting techniques like permutations and combinations with/without repetitions, and the pigeonhole principle.

UNIT I **(15 Hours)**

Recurrence Relations & Graphs:

Recurrence Relations: Introduction, Formation. Linear Recurrence Relations with constant coefficients. Homogeneous Solutions.Particular Solutions.Total Solutions. Graphs: Graphs and Graphs models, Graph terminology and special types of graphs, Representing graphs and Graph isomorphism, Connectivity, shortest path problems.

UNIT II **(15 Hours)**

Counting Principles

Cardinality of Set: Cardinality of a finite set. Types of mapping, Injective, Surjective Bijective functions, Inverse function, Composition of functions Basics of Counting: The Product Rule, The Sum Rule, The Inclusion- Exclusion Principle. The Pigeonhole Principle: Statement, the Generalized Pigeonhole Principle, Its Applications. Generalized Permutations and Combinations: Permutation and Combination with Repetitions, Permutations with Indistinguishable Objects.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Reference Books:

1. Text book Elements of Discrete Mathematics, by C. L. Liu, Tata McGraw Hill,
2. Discrete Mathematics and its applications, by Kenneth Rosen, Tata McGraw Hill, Seventh Edition.
3. Discrete Mathematical Structures by Kolman, Busby, Ross.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: VSC – I (T): Majorspecific Web Design using JavaScript

Course Outcomes:

1. Understand different HTML tags.
2. Learn how to design and develop a Web page using HTML and CSS
3. Learn how to link pages so that they create a Web site.
4. Design and develop a web site using text, images, links, lists and tables.
5. Write and execute basic JavaScript programs using variables, data types, conditional statements, loops, and functions.
6. Develop simple object-oriented JavaScript programs using arrays, objects, and properties.

UNIT-I (15 Hours)

Introduction to web design principles, overview of web development technologies and tools, understanding the role of HTML, CSS, and JavaScript, HTML basics, HTML elements, Attributes, heading, paragraphs, Styles, Formatting, Quotations, colors, links, images, table, list tags, Iframe, File paths, HTML layouts, Introduction to CSS syntax and selectors, applying styles to HTML elements, managing layouts using CSS

UNIT-II (15 Hours)

Overview of JavaScript and its role in web development, setting up the development environment, Writing and executing JavaScript code, Declaring and assigning variables, working with numbers, strings, booleans, and arrays, Type coercion and type conversion, Conditional statements, Switch statements, Loops, Break and continue statements, Element Access in Java scripts, Event and event handling, dialog boxes, Defining and invoking functions, working with arrays, Introduction to objects and properties, Object-oriented programming concepts

Reference Books:

1. Head First HTML and CSS by Elizabeth Robson and Eric Freeman
2. HTML, CSS, and JavaScript All in One by Meloni and Kyrin's
3. HTML5 and CSS3 All-in-One For Dummies – by Andy Harris

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III

Title of course: SEC-I (T): Core Java Programming

Course Outcomes:

The course will enable students to:

1. Understand the working of java virtual machine.
2. Implement Object oriented concepts using java.
3. Implement control structures, operators of java.
4. Apply object-oriented programming concepts such as classes, objects, constructors, and method overloading in Java.
5. Demonstrate inheritance, polymorphism, interfaces, and abstract classes to build modular Java applications.
6. Develop exception-handling mechanisms using try-catch blocks, throw, throws, and finally clauses.

UNIT I (15 HOURS)

Java Language Basics History and features of Java, Java Virtual Machine (JVM), JDK tool, Structure of java program, compilation and execution of java program, Java keywords, Data types, Java variables- declaration and assigning values to variables(using assignment statement and Scanner class object), scope of variables Type casting Implicit and Explicit casting, Operators of java, Control structures of java –Branching statements and switch statement , Iterative statements- for loop, do-while, while loop, jumping statements-break and continue statement.

UNIT II (15 HOURS)

Introducing classes and objects Introduction : Classes, Objects and methods, Defining a class, field declaration, method declaration, Accessing class members, access specifiers in java, Static variables and methods .Method overloading, Constructor- types of constructor, constructor overloading. Use of this keyword, Garbage collection-finalize (), wrapper classes, Array, types of array: one dimensional , multi dimensional array.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III
Title of course: SEC-I (T): Core Java Programming

Reference Books:

1. Java How to Program, Sixth Edition, H.M.Dietel and P.J.Dietel, Pearson Education/PHI.
2. Herbert Schildt, The Complete Reference Java 2.0, Fifth edition
3. Debasish Jana, Java and Object-Oriented programming Paradigm, PHI
4. Java and Object Oriented Programming Paradigm, PHI (2007)

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III
Title of course: AEC- I: Verbal Communication

Course Outcomes:

The course will enable students to:

1. Demonstrate Proficiency in Grammar and Sentence Structures.
2. Enhance Vocabulary for Effective Communication.
3. Participate Effectively in Group Discussions and Interviews.
4. Demonstrate effective oral communication for various purposes including introductions, apologies, and expressing agreement or disagreement.
5. Participate in structured conversational activities like monologues, dialogues, role plays, and situational conversations.
6. Develop group discussion and interview skills by practicing initiation, continuation, and conclusion techniques.

UNIT I **(15 Hours)**

Basic Language Skills: Grammar: Sentence Structures/Patterns, Subject - Verb agreement, Tenses. Vocabulary : Synonyms and Antonyms, Homonyms, One-word substitutes, Idioms, Suffixes and prefixes Collocations. Speaking for Different Purpose: Meeting and Greeting People, introducing your Self Introducing People to One another, Apologies and Responses, Agreeing and Disagreeing, General Speaking Strategies. Conversational Activities – Monologues, Introducing yourself, Introducing others, One-minute impromptu speeches, Scaffolded storytelling, Conversational Activities – Dialogues. Role plays on everyday interactions, Information Gap Activities, Picture descriptions and feedback, Situational conversations.

UNIT II **(15 Hours)**

Group Discussion, Interview and Interviewing Skills, Initiating a Group Discussion, Continuing a Group Discussion, Concluding Group Discussion, Preparing for an Interview, Facing an Interview, Interviewing Techniques. Conversational Activities - Pronunciation, Stress & Rhythm, Intonation, Neutralization of accent, Word stress, Rhythm & Pauses, Tonal variations/inflections Presentation Skills: Kinds of Presentation, Structuring Content, Visual Aids, the Language of Presentations, Making a Presentation.

Reference Books:

1. Barret Grant. Perfect English Grammar: The Indispensable Guide to Excellent Writing and Speaking. Fall River Press, 2016
2. Monippally, Matthukutty, M. Business Communication Strategies. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2001 Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraHillPublishingCompanyLimited,2001.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM III
Title of course: CC-I: Basics of Yoga

Course Outcomes:

The course will enable students to;

1. To understand the importance of Yoga.
2. To understand various Asans.
3. Explain the methods and benefits of asanas, pranayama, sukshma vyayama, and concentration practices.
4. Classify and differentiate various types of yoga including Jnana, Bhakti, Karma, Hatha, and Raja Yoga.
5. Analyze the role of yoga in character building, mental discipline, and stress management through techniques like Nishkama Karma and meditation.
6. Explore the therapeutic values of yoga, yogic literature, and the lives and contributions of yogis like Swami Vivekananda and Sri Aurobindo.

UNIT I **(15 Hours)**

Yoga Definition, Objectives of yoga Education Difference between Yoga Asana, and physical exercises, Importance of Yoga in daily life, Methods and benefits of Asanas, Pranayama and Concentration, Knowledge of five yama with more emphasis on 'Asteya', Knowledge of five Niyama with emphasis on 'Santosh', Knowledge of Aahar-Vihar, Methods and benefits of Sukshma, Vyayama, Asanas and prayers. Types of Yoga: Jnana Yoga, Bhakti Yoga, Karma Yoga, Hatha Yoga,Raja Yoga.

UNIT II **(15 Hours)**

Role of yoga in character building, Therapeutic values of yoga, Introduction of yoga literature, Life history of Arvindo, Vivekanand and other yogis, Knowledge of Bandha, Mudra and Chakras, Methods and benefits of Asans, Pranayama and Concentration Effects of Asanas and Pranayama on physiology of human body, Concept of Nishkama Karma Yoga, Role of Yoga practices in eveloping concentration, will power and discipline, Techniques of stress management, Methods and benefits of Asanas, Pranayama and concentration

Reference Books:

1. Light on Yoga by B.K.S. Iyengar
2. The Yamas & Niyamas: Exploring Yoga's Ethical Practice by Deborah Adele

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: Subject I Major VII: Advanced Data Structures

Course Outcomes:

After completion of this course students will be able to:

1. Apply non- linear data structures to solve real-world problems efficiently and effectively.
2. Understand the fundamental concepts of non linear data structures such as trees and graphs.
3. Understand the concept of BFS and DFS.
4. Implement operations such as searching, insertion, and deletion in Binary Search Trees (BST).
5. Apply tree traversal techniques including pre-order, in-order, post-order and traversal using stacks.
6. Describe graph terminology, types of graphs (directed, multigraphs), and their sequential and linked representations.

UNIT I (15 Hours)

Introduction of non linear data structure, tree data structure, Binary Search trees, Searching and Inserting in Binary Search trees, Deleting in a Binary search tree. Traversing Binary Tree: Preorder, In-order, Post-ordered traversal, Traversal algorithms using stacks, Headed nodes: Threads, AVL trees, m-trees and B-Trees

UNIT II (15 Hours)

Graphs-. Introduction, Graph theory terminology: Graph and multi graphs. Directed Graphs, Sequential representation of graphs: Adjacent matrix, Path matrix, Linked representations of a Graph, Operations on Graphs: Searching in a Graph, Inserting in a graph, traversing a graph: Breadth- First search, Depth Final search, Spanning tree.

Reference Books:

1. Alfred V Aho, John E Hopcroft and Jeffery D Ullman, “Data Structures and Algorithms”, Pearson Education.

2. Samiran Chattopadhyay, Debabrata Ghosh Dastidar and Matagini Chattopadhyay, “ Data Structures through C Language”, BPB Publication.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: Subject I Major VIII: Relational Database Management System

Course Outcomes:

The course will enable students to:

1. Understand Functional Dependencies and Normalization Concepts.
2. Demonstrate Concurrency Control Techniques.
3. Implement Recovery Techniques for Transaction Failures.
4. Analyze inclusion dependencies and perform lossless join decomposition to ensure effective database design.
5. Explain transaction management concepts including serializability, conflict and view serializability, and recoverability.
6. Describe transaction failure recovery methods including log-based recovery, checkpoints, and deadlock handling.

UNIT I (15 Hours)

Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, and Higher Normal forms, inclusion dependencies, lossless join decompositions, Transaction system, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling.

UNIT II (15 Hours)

Concurrency Control Techniques: Concurrency control, locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation based protocol, multiple granularity, Multi-version schemes, Recovery with concurrent transaction. Transaction Processing in Distributed system, data fragmentation. Replication and allocation techniques for distributed system, overview of concurrency control and recovery in distrusted database.

Reference Books:

1. C.J Date, S. Swamynathan, “An Introduction to Database System”, Pearson Edition
2. Korth, Silbertz, Sudarshan, “Database Concepts”, McGraw Hill
3. Elmasri, Navathe, “Fundamentals of Database Systems”, Addision Wesley
4. Desai, “An introduction to Database Systems”, Asian Students Edition

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: Subject I Practical IV:

Practical Based on Subject I Major VII & Major VIII

Course Outcomes:

After completion of this course students will be able to:

1. Implement advanced data structures such as trees, heaps, and graphs.
2. Implement normalization techniques to optimize database structure.
3. Demonstrate lossless join decomposition and dependency preservation through practical examples using SQL.
4. Implement log-based transaction recovery using SQL scripts to demonstrate commit, rollback, and checkpoint operations.
5. Construct and manipulate advanced tree structures like AVL trees, m-ary trees, and B-trees for efficient data organization.
6. Develop programs to represent graphs using adjacency matrices, path matrices, and linked representations.

There will be around 10 programs each based on Subject I Major VII & Major VIII.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: Subject II Minor VII: Feature Engineering

Course Outcomes:

The course will enable students to:

1. Learn multiple techniques for missing data imputation.
2. Extract useful features from dates and time variables.
3. Transform categorical variables into numbers while capturing meaningful information.
4. Apply techniques to handle missing data, categorical variables, and skewed distributions using appropriate transformations.
5. Perform normalization, scaling, and discretization (binning) of numeric features to adapt to model requirements.
6. Utilize dimensionality reduction techniques like PCA to simplify datasets while retaining essential information.

UNIT I **(15 Hours)**

Importance of Feature Engineering in Data Science, Dealing with Complex Relationships, Handling Missing Data, Normalization and Scaling, Categorical Variable Encoding, Reducing Dimensionality, Creating Informative Interaction Terms, Improving Model Interpretability, Domain-Specific Knowledge Integration, Adapting to Model Requirements, Date Time Features, Text Data, Encoding Categorical Variables, Creating Interaction Terms, Polynomial Features, Handling Missing Data, Aggregations, Scaling Numeric Features, Binning or Discretization, Domain-Specific Features, Feature Crosses.

UNIT II **(15 Hours)**

Logarithmic Transformation, Handling Non-Linearity, Dealing with Missing Data, Normalization and Scaling, Encoding Categorical Variables, Creation of Interaction Terms, Dimensionality Reduction, Handling Skewed Distributions, Temporal and Spatial Aggregation, Feature Engineering in Machine Learning, Iterative Process, Validation and Evaluation, Best Feature Engineering in Data Science Tools, Imputation of Missing Values, Handling Categorical Variables, Binning or Discretization, Feature Scaling, Principal Component Analysis.

Reference books:

1. Feature Engineering for Machine Learning by Alice Zheng, Amanda Casari, 2018, O'Reilly Media, Inc.
2. Feature Engineering Bookcamp, Sinan Ozdemir, 2022.
3. Python Feature Engineering Cookbook by Soledad Galli .
4. Bad Data Handbook: Cleaning Up The Data So You Can Get Back To Work by Q. Ethan McCallum.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: Subject II Minor VIII: Basics of Artificial Intelligence

Course Outcomes:

The course will enable students to:

1. Learn Artificial Intelligence and describe its future scope.
2. Implement problem-solving methods and various search strategies.
3. Analyze reasoning systems with default and incomplete information.
4. Demonstrate knowledge representation using propositional and predicate logic, syntax, semantics, and inference rules.
5. Apply uninformed and informed search strategies including heuristic search, hill climbing, A*, and AO* algorithms.
6. Explain constraint satisfaction problems and explore solution strategies for constraint-based reasoning.

UNIT-I **(15 Hours)**

Introduction of AI and Problem Solving: Artificial Intelligence, AI Problems, AI Techniques, Defining the Problem as a State Space Search, uninformed search and informed search, heuristic search, hill climbing, Best first search, A* algorithm, AO* algorithm, constraint satisfaction, Game playing: Minmax search procedure, refining Minmax, Alpha – Beta pruning.

UNIT-II **(15 Hours)**

Knowledge Representation: Introduction, Propositional Logic, Syntax and Semantics, Interpretations, Properties, Predicate logic, WFF, Free and Bound Variables, Normal Forms, Inference Techniques, Resolution, Unification, Modes Pones, Frames, Frame Representation Language, Semantic Net, Forward and Backward Reasoning.

Reference Books:

1) Artificial Intelligence, 2nd Edition, Rich and Knight.
2) Machine Learning, Tom M Mitchell.
3) Artificial Intelligence: A New Synthesis, Nils J. Nilsson.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: Subject II Practical IV:

Practical Based on Subject II Minor VII

Course Outcomes:

After completion of this course students will be able to;

1. Apply appropriate methods to handle missing data using imputation techniques to improve dataset completeness.
2. Perform normalization and scaling of numerical features using standard techniques to prepare data for machine learning models.
3. Implement encoding methods for categorical variables such as label encoding, one-hot encoding, and ordinal encoding.
4. Engineer interaction terms and apply dimensionality reduction methods like Principal Component Analysis (PCA).
5. Extract features from date-time and text data using domain-specific transformation techniques.
6. Design, implement, and evaluate end-to-end feature engineering pipelines using tools such as Scikit-learn and Pandas

There will be around 15 programs each based on Subject II Minor VII.

1. Load a dataset and handle missing values using mean, median, mode, and forward/backward fill.
2. Apply normalization (Min-Max) and standardization (Z-score) on numeric features.
3. Encode categorical variables using one-hot encoding and label encoding.
4. Create interaction terms and polynomial features using PolynomialFeatures in Scikit-learn.
5. Apply logarithmic transformation to correct skewed numeric data.
6. Perform dimensionality reduction using PCA and visualize the principal components.
7. Extract date-time features (year, month, day, weekday, hour) from a datetime column.
8. Handle text data by applying tokenization, stop-word removal, and TF-IDF vectorization.
9. Discretize continuous features using equal-width and equal-frequency binning methods.
10. Apply aggregation (mean, sum, count) on grouped data using group-by operations.
11. Handle skewed distributions using Box-Cox or Yeo-Johnson transformation.
12. Scale numeric features using RobustScaler and MaxAbsScaler.
13. Perform feature crossing by combining multiple categorical variables.
14. Create and integrate domain-specific features into a dataset (e.g., BMI in a health dataset).
15. Build a complete feature engineering pipeline using Scikit-learn's Pipeline and ColumnTransformer.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: OE-III (T): Discrete Mathematics -II

Course Outcomes:

After completion of this course students will be able to;
1. Understand the fundamental concepts of discrete mathematics, including logic.
2. Understand functions, and counting principles.
3. Explain the foundational principles of Boolean algebra and its applications in representing logical statements.
4. Apply propositional logic and equivalences to build and validate arguments using rules of inference.
5. Analyze predicate logic with quantifiers and apply logical equivalences involving universal and existential quantifiers in mathematical reasoning.
6. Apply Warshall's algorithm to compute transitive closure of relations and analyze their applications in computer science.

UNIT I **(15 Hours)**

Lattices and Boolean Algebra: Relations, types of relations, equivalence relations, Partial ordering relations Digraphs of relations, matrix representation and composition of relations.Transitive closure and Warshall's Algorithm Poset, Hasse diagram. Lattices, Complemented lattice, Bounded lattice and Distributive lattice. Boolean Functions : Introduction, Boolean variable, Boolean Function of degree n, Boolean identities, Definition of Boolean Algebra. Representation of Boolean Functions : Minterm, Maxterm Disjunctive normal form,Conjunctive normal Form.

UNIT II **(15 Hours)**

LOGIC: Revision: Propositional Logic, Propositional Equivalences. Rules of Inference : Argument in propositional Logic, Validity Argument(Direct and Indirect methods) Rules of Inference for Propositional Logic, Building Arguments. Predicates and Quantifiers : Predicate, n-Place Predicate or ,n-ary Predicate, Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains, Logical Equivalences involving Quantifiers.

Reference Books:

1. Discrete mathematics by S. R. Patil and others, NIRALI Prakashan.
2. Discrete mathematics by Bhopatkar, Nimbkar, Joglekar, VISION Publication.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: SEC-II (T): Advanced Java Programming

Course Outcomes:

The course will enable students to:

1. Develop programs using the concepts of inheritance, interfaces and packages.
2. Understand the multithreading concepts.
3. Handle exceptions while executing programs.
4. Understand the JDBC connectivity.
5. Implement abstract classes and methods to build reusable and modular Java applications.
6. Apply exception handling techniques to manage run-time errors effectively using try, catch, and custom exceptions.

UNIT I **(15 Hours)**

Inheritance, packages and interfaces Inheritance- definition, syntax, types of inheritance, Method overriding, use of super keyword, difference between method overloading and overriding , Abstract class and method, use of final keyword, Interface- defining and implementing interface, implementation of multiple inheritance using interface, difference between abstract class and interface. Packages- Java API package, Defining and accessing user defined package

UNIT II **(15 Hours)**

Exception Handling and Multithreading Concept of exception, difference between error and exception, Types of exceptions-checked and unchecked, Exception handling using try and catch block, Multiple catch block, finally block, throws keyword, User defined exception, Concept of multithreading in java, Difference between process and thread Creating thread by extending Thread class and by implementing Runnable interface Life cycle of thread, Thread class methods- start(), run(),yield(), suspend(), resume(), sleep(), wait(), notify(), stop() Thread synchronization. Introduction to JDBC: Architecture, JDBC Drivers, JDBC Connectivity, Inserting, Retrieving, deleting, updating data in database.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Reference Books:

1. Programming in Java, S. Malhotra, S. Chudhary, 2nd edition, Oxford Univ. Press.

2. Java Programming and Object-oriented Application Development, R. A. Johnson, Cengage Learning.

3. Java How to Program, Sixth Edition, H.M.Dietel and P.J.Dietel, Pearson Education/PHI.

4. Introduction to Java programming, By Y.DanielLiang,Pearson Publication.

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: AEC-II: Business Communication

Course Outcomes:

After completion of this course students will be able to:

1. To provide an overview of Prerequisites to Business Communication.
2. To put in use the basic mechanics of Grammar.
3. To underline the nuances of Business communication.
4. Analyze the communication process and its components (sender, message, medium, receiver, feedback) to enhance clarity and effectiveness.
5. Recognize various barriers to communication and apply strategies to overcome them in different contexts.
6. Differentiate and apply levels and flows of communication (intrapersonal, interpersonal, organizational, mass media) within a business environment.

UNIT I **(15 Hours)**

Need and Importance of effective communication skills, Basic ways of communication (Listening, Speaking, Reading, Writing), Forms/methods of Communication (verbal-oral and written; nonverbal- Body language, facial expressions, eye contact, gestures, postures, paralinguistic features, signs, symbols, signals etc.), Communication cycle/process (sender, receiver, message, medium/channel, feedback, encoding and decoding) (Thinking, getting ideas, determining intent, selecting notes, and media, encoding, transmitting messages, decoding, receiving, perceiving, and interpreting, giving feedback, etc.), Barriers to communication (physical, mechanical, psychological, socio-cultural, linguistic, inter-personal, organizational, etc.) and techniques to overcome them.

UNIT II **(15 Hours)**

Levels of communication: importance and nature (extra-personal, intrapersonal, interpersonal, transpersonal, organizational, mass and media communication, Communication in business context (channel/flow of communication in business context: formal, informal, vertical, horizontal/lateral, crosswise, grapewine, etc.), Written Communication, the process of formal written communication, designing a message, deciding purpose, analyzing audience, organizing, selecting, arranging ideas, and preparing outlines, enveloping a message – writing, evaluating, revising, and editing. Reading and analysis of Business articles, short reports, success stories and case lets. Seven Cs of Business Writing - Completeness, Conciseness, Consideration, Concreteness, Clarity, Courtesy, Correctness.

Reference Books:

1. Communication Skills by Meenakshi Raman and Sangeeta Sharma
2. Communication Skills by Kumar and Lata
3. Business Communication by Raman and Sing
4. A Complete Course in Communication Skills by Dr. Ravi S. Sharma

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: VEC-II: Environmental Studies

Course Outcomes:

Upon completion of the course, students will be able to:

1. Explain the scope, objectives, and multidisciplinary nature of environmental science with a focus on sustainable development.
2. Analyze the structure and functions of ecosystems and recognize their significance for conservation efforts.
3. Evaluate the importance and challenges of managing natural resources to promote sustainable living.
4. Understand the concepts of biodiversity, its importance, threats, and conservation strategies, especially in the context of the Western Ghats.
5. Identify various types and sources of environmental pollution and assess appropriate mitigation and control measures.
6. Develop awareness and responsibility towards environmental issues and the role of individuals and society in achieving sustainability.

- To be taken from Environmental Science BoS

B.Sc.-M.Sc. Artificial Intelligence & Machine Learning (AI & ML)
Multiple Entry and Multiple Exit Option
(NEP-2020)
PART II SEM IV

Title of course: CEP-I: Field work

Course Outcomes:

Upon completion of the course, students will be able to:

1: Understand the structure and values of rural society, including joint family systems, caste and gender relations, and rural cultural practices.

2: Examine rural livelihoods through agriculture, land ownership, water management, animal husbandry, and non-farm enterprises, including the role of rural entrepreneurs and markets.

3: Analyze traditional and modern rural institutions such as self-help groups, panchayati raj institutions, local governance bodies, and their roles in decentralized planning.

4: Explore the significance of natural and public rural resources like ponds, fisheries, and community-based resource management systems.

5: Evaluate national rural development programs such as NRLM, MGNREGA, and the role of civil society and local administration in empowering rural communities.

6: Assess the impact of current flagship national schemes like Swachh Bharat, Skill India, Ayushman Bharat, Digital India, and ATMANIRBHAR Bharat on rural transformation.

Field work as per NEP 2.0 (CEP, CC), University circular enclosed

SHIVAJI UNIVERSITY, KOLHAPUR
416 004, MAHARASHTRA
PHONE : EPABX – 2609000, BOS Section – 0231-2609094, 2609487
Web : www.unishivaji.ac.in Email: bos@unishivaji.ac.in
शिवाजी विद्यापीठ, कोल्हापूर, ४१६ ००४, महाराष्ट्र
दूरध्वनी - इपीबीएक्स - २०६०९०००, अभ्यासमंडळे विभाग : ०२३१- २६०९०९४, २६०९४८७
वेबसाईट : www.unishivaji.ac.in ईमेल : bos@unishivaji.ac.in

Estd. 1962
"A++" Accredited by NAAC (2021)
With CGPA 3.52

संदर्भ क्र. : शिवाजी वि./अ.म./400 दिनांक : 15/07/2024

प्रति,

1. मा. प्राचार्य/संचालक,
सर्व संलग्नित महाविद्यालये/मान्यताप्राप्त संस्था,
शिवाजी विद्यापीठ, कोल्हापूर

2. मा. अधिविभाग प्रमुख,
सर्व अधिविभाग,
शिवाजी विद्यापीठ, कोल्हापूर

विषय : राष्ट्रीय शैक्षणिक धोरण, 2020 (NEP 2.0) नुसार CEP, CC अभ्यासक्रमाबाबत.

महोदय/महोदया,

उपरोक्त संदर्भिय विषयास अनुसरुन आपणास आदेशान्वये कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० (NEP 2.0) नुसार शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्यात आलेल्या सर्व पदवी कोर्सला लागू असणा–या **Community Engagement Programme (CEP), Co-Curricular Courses (CC)** अभ्यासक्रम/त्याची नियमावली सोबत पाठवित आहे.

सदर **Community Engagement Programme (CEP), Co-Curricular Courses (CC)** अभ्यासक्रमाच्या प्रती जोडल्या आहेत. तसेच विद्यापीठाच्या www.unishivaji.ac.in,NEP-2020@suk (Online Syllabus) या संकेतस्थळावर ठेवण्यात आल्या आहेत.

सदर अभ्यासक्रम/त्याची नियमावलीची सर्व संबंधित विद्यार्थी व शिक्षकांच्या निदर्शनास आणून द्यावेत ही विनंती.

कळावे,

आपला विश्वासू,

(डॉ. एस. एम. कुबल)
उपकुलसचिव

सोबत : अभ्यासक्रमाची प्रत.

प्रत : माहितीसाठी व पुढील योग्यत्या कार्यवाहीसाठी.

अधिष्ठाता, सर्व विद्याशाखा	पात्रता विभागास
अध्यक्ष, सर्व अभ्यास व अस्थायी मंडळे	पी.जी. सेमिनार विभागास
संचालक, परीक्षा व मुल्यमापन मंडळ कार्यालयास	पी.जी. प्रवेश विभागास
परिक्षक नियुक्ती ए व बी विभागास	संलग्नता टी. १ व टी २ विभागास
दूरस्थ व ऑनलाईन शिक्षण विभागास	नॅक विभागास
संगणक केंद्र/आय. टी. सेल विभागास	सर्व ऑन परीक्षा विभागास

SHIVAJI UNIVERSITY, KOLHAPUR

Established: 1962

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New Syllabus For

Community Engagement Programme (CEP)

All Bachelor Degree Programme

STRUCTURE AND SYLLABUS IN ACCORDANCE WITH

NATIONAL EDUCATION POLICY - 2020

HAVING CHOICE BASED CREDIT SYSTEM

WITH MULTIPLE ENTRY AND MULTIPLE EXIT OPTIONS

(TO BE IMPLEMENTED FROM ACADEMIC YEAR 2024-25 ONWARDS)

Community Engagement Programme (CEP):

1. INTRODUCTION:

New generation of students are increasingly unaware of local rural and peri-urban realities surrounding their HEIs, as rapid urbanization has been occurring in India. A large percentage of Indian population continues to live and work in rural and peri-urban areas of the country. While various schemes and programs of community service have been undertaken by HEIs, there is no singular provision of a well- designed community engagement course that provides opportunities for immersion in rural realities. Such a course will enable students to learn about challenges faced by vulnerable households and develop an understanding of local wisdom and lifestyle in a respectful manner

2. OBJECTIVES:

- To promote a respect for rural culture, lifestyle, and wisdom amongstudents.
- To learnabout the present status of agricultural and development initiatives.
- Identify and address the root causes of distress and povertyamong vulnerable households.
- Improve learning outcomes by applying classroom knowledge to real-world situations.

To achieve the objectives of the socio-economic development of New India, HEIs can play an important role through active community engagement. This approach will also contribute to improve the quality of both teaching and research in HEIs in India. India is a signatory to the global commitment for achieving Sustainable Development Goals (SDGs) by 2030. Achieving these 17 SDG goals requires generating locally appropriate solutions. Community engagement should not be limited to a few social science disciplines alone. It should be practiced across all disciplines and faculties of HEIs. These can take the forms of enumerations, surveys, awareness camps and campaigns, training, learning manuals/films, maps, study reports, public hearings, policy briefs, cleanliness and hygiene teachings, legal aid clinics, etc. For example, students of chemistry can conduct water and soil testing in local areas and share the results with the local community. Students of science and engineering can undertake research in partnership with the community on solid and liquid waste disposal Therefore, students are being encouraged to foster social responsibility and community engagement in their teaching and research.

3. LEARNING OUTCOMES:

After completing this course, students will be able to

- Gain an understanding of rural life, Indian culture, and social realities.
- Develop empathyand bonds of mutualitywith the local community.
- Appreciate the significant contributions of local communities to Indian society and economy.
- Learn to Value local knowledge and wisdom.
- Identify opportunities to contribute to the community's socioeconomic improvement.

7. **Credits:** Two credit Course; Students are expected to complete 60 hours of participation

7. COURSE STRUCTURE:

Sr.	Module Title	Module Content	Teaching/Learning/Methodology
1	Appreciation of Rural Society	Rural lifestyle, rural society, joint family, caste and gender relations, rural values with respect to community, rural culture nature and public resources, ponds and fisheries, elaboration of soul of India lies in villages' rural infrastructure,	Classroom discussionsField visit Individual /Group conference Report/journal submission & VIVA
2	Understanding rural and local economy and livelihood	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihood and artisan's rural entrepreneurs, rural markets, migrant labour, social innovation projects	Classroom discussionsField visit Individual /Group conference Report/journal submission & VIVA
3	Rural and local Institution	Traditional rural and community organization, self-help groups, decentralized planning, panchayat raj institutions Gram panchayat, Nagarpalika and Municipalities, local Civil Society, Local administration, National rural, Livelihood Mission [NRLM], Mahatma Gandhi National Rural Employment. Guarantee [MGNREGA].	Classroom discussionsField visit Individual /Group conference Report/journal submission & VIVA
4	Rural and National development programmers	History of rural development and current National Programms in India: Sarva shiksha Abhiyan, Beti Bachao-Beti Padhao, Ayushman Bharat, eShram Swachh Bharat, PM Awas yojana, Skill India, Digital India, Start-Up India, Stand-Up India, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), Jal Jeevan Mission, Mission Antyodaya, ATMANIRBHAR Bharat, etc..	Classroom discussionsField visit Individual /Group conference Report/journal submission & VIVA

Note: Faculty can make addition in the list of activities as per domain content:

Recommended field-based activities (Tentative):

- Participate in Gram Sabha meetings, and study community participation;
- Visit to Swachh Bharat Mission project sites, conduct analysis and initiate problem solvingmeasures;
- Interaction with Self Help Groups (SHGs) women members, and study their functions and challenges; planning for their skill-building and livelihood activities;
- Visit Mahatma Gandhi National. Rural Employment Guarantee Act 2005 (MGNREGS) project sites, interact with beneficiaries and interview functionaries at the work site;
- surveys on Mission Antyodaya to support under Gram Panchayat Development Plan
- Visit Rural Schools/mid-day meal centres, study academic and infrastructural resources, digital divide and gaps;
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries;
- Visit to local Nagarpalika office and review schemes for urban informal workers and migrants;
- Attend Parent Teacher Association meetings, and interview school drop outs;
- Visit local Anganwadi and observe the services being provided;
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries;
- Organize awareness programmes, health camps, Disability camps and cleanliness camps;
- Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys and building solar powered village;
- Understanding of people's impacts of climate change, building up community's disaster preparedness;
    - Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers, promotion of traditional species of crops and plants and awareness against stubble burning;
    - Formation of committees for common property resource management, village pond maintenance and fishing;
    - Identifying the small business ideas (handloom, handicaraft, khadi, food products, etc.) for ruralareas to make the people self-reliant.
    - Interactive with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization;

- Financial Literacy Awareness Programme
- Digital Literacy Awareness Programme
- Education Loan Awareness Programme
- Entrepreneurship Awareness Programme
- Awareness Programmes on Government Schemes
- Products Market Awareness
- Services Market Awareness
- Consumer Awareness Programme
- Accounting Awareness Programme for Farmers
- Accounting Awareness Programme for Street Vendors etc.

8. IMPORTANT RULES AND REGULATIONS FOR CEP:

Concurrent Fieldwork:

Students must conduct comprehensive studies on various challenges that they face in their chosen field. Every work relevant to the subject matter should be compiled and documented.

Students should keep separate fieldwork diary or maintain journal in order to record their fieldwork experiences i.e. reading, e- contents, tasks, planning and work hours have to be recorded in the diary. Detailed work records report on students' fieldwork experiences and activities to be submitted and should be presented. The fieldwork conference is part of the timetable and is mandatory. Faculty should hold a fieldwork conference FOREIGHTNIGHTLY for all students.

In addition to the principal curriculum, the students engage in a variety of community development- related activities. They are encouraged to plan and carry out programs, processions, and events for social causes. These activities seek to enhance students' personal and professional skills as well as foster self- development. "Rural Camp" should be embedded in the curriculum for first-year students to be held in the backward and neglected areas of District's

Concurrent Fieldwork is the core curriculum activity in the CEP course. Hence, 100% attendance of the students is mandatory in case of absence on any student, supplementary fieldwork must be arranged and accomplished with the approval of the faculty supervisor.

9. EVALUATION/ASSESSMENT SCHEME:

Students should keep a Field Diary / journal to record, content, readings and field visit planning. The assessment pattern is internal and external i.e. 40+10.

Internal continuous Assessment: Participation in concurrent field visits 40%; individual/group field project conference, report/journal submission 40%.

External Assessment: Presentation of field project findings (VIVA) should be assigned 20%.