SHIVAJI UNIVERSITY, KOLHAPUR - 416004,
MAHARASHTRA
PHONE:EPABX-2609000, www.unishivaji.ac.in, bos@unishivaji.ac.in
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/150 **Date: 26/05/2026.**

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.

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.

1.	B.Sc. Part II Medicinal Chemistry (Entire) (2.0)	6.	BCA Part III
2.	B.A./B.A.B.Ed Part III Geography (2.0)	7.	B.Sc. Part II Data Science
3.	B.Sc. Part II Artificial Intelligence	8.	B.Sc.-M.Sc. Part III AI & ML
4.	B.Sc.-M.Sc. Part IV Nano Science and Technology (1.0)	9.	MCA Part II (YCSRD)
5.	B.Sc.-M.Sc. Part III Nano Science and Technology (2.0)	10.	MCA Part II

This syllabus, nature of question and equivalence shall be implemented from the academic year 2026-2027 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website **www.unishivaji.ac.in>Syllabus>Syllabus as per NEP2020.**

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2026 & March/April 2027. 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

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

As per

National Education Policy (NEP-2020)

Syllabus for

B.Sc. Artificial Intelligence

(Under Faculty of Science and Technology)

PART-II SEMESTER III & IV

(Syllabus to be implemented from Academic Year 2026-27)

Multiple Entry and Multiple Exit Option (NEP-2020)
B.Sc. Artificial Intelligence Programme Structure
B.Sc. Part – II (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	Maximum Marks	Minimum Marks
1	**Subject I Major V** Advanced Python Programming	2	-	2	30	12	20	08
2	**Subject I Major VI** Database - II	2	-	2	30	12	20	08
3	**Subject I Major Practical III** : Practical Based on Subject I Major V & Subject I Major IV	-	4	2	30	12	20	08
4	**Subject II Minor V :** As per students choice and availability but must be continued with Minor V (with Statistics / Mathematics)	2	-	2	30	12	20	08
5	**Subject II Minor VI :** As per students choice and availability but must be continued with Minor VI(with Statistics / Mathematics)	2	-	2	30	12	20	08
6	**Subject II Minor Practical III :** Practical based on Minor V and Minor VI	-	4	2	30	12	20	08
7	**OE – III (T/P) :** As per students choice and can be opted from other than BSc. (ie.B.Com or BA) Basket	2	-	2	30	12	20	08
8	**VSC – I (T)(Major specific) :** Web Design using JavaScript	2	-	2	30	12	20	08
9	**SEC-I (T):** Java Programming - I	-	4	2	30	12	20	08
10	**AEC-I(English) :** Verbal Communication	-	4	2	30	12	20	08
11	**CC-I :** Basics of Yoga	2	-	2	30	12	20	08
	Total (A)			**22**	**330**	**-**	**220**	**-**

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)	Practical (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	**Subject I Major VII :** Data Structure using Python	2	-	2	30	12	20	08
2	**Subject I Major VIII** Basics of Artificia Intelligence	2	-	2	30	12	20	08
3	**Subject I Practical IV** Practical Based on Subject I Major VII	-	4	2	30	12	20	08
4	**Subject II Minor VII:** As per students choice and availability but must be continued with Minor VII(with Statistics / Mathematics)	2	-	2	30	12	20	08
5	**Subject II minor VIII:** As per students choice and availability but must be continued with Minor VIII(with Statistics / Mathematics)	2	-	2	30	12	20	08
6	**Subject II Minor Practical IV :** Practical Based on Subject Minor VII and VIII	-	4	2	30	12	20	08
7	**OE – IV (T/P) :** As per students choice and can be opted from other than BSc. (ie. B.Com or BA) Basket	2	-	2	30	12	20	08
8	**SEC-II(T/P) :** Java Programming - II	2	-	2	30	12	20	08
9	**AEC-II(English) :** Business Communication	-	4	2	30	12	20	08
10	**VEC – II (T) :** Environment Studies	-	4	2	30	12	20	08
11	**CEP-I (P) :** Field Work	2	-	2	30	12	20	08
	Total (B)			**22**	**330**	**-**	**220**	**-**
	Total (A+B)			**44**	**660**		**440**	

OE: Open Elective	**SEC: Skill Enhancement Course**
VSC: Vocational Skill Course	**AEC: Ability Enhancement Course**
CC: Co-Curricular Course	**CEP: Community Engagement Program**

Multiple Entry and Multiple Exit Option (NEP-2020)
B.Sc. Artificial Intelligence Part - II (Level-5.0)
With Statistics as Minor

SEMESTER-III (Duration- Six Month)								
Sr. No.	Course Code	Teaching Scheme			Examination Scheme			
		Theory and Practical			University Assessmen (UA)		Internal Assessment (IA)	
		Lectures (Per week	Practical (Per week)	Credit	Maximum Marks	Minimum Marks	Maximum Marks	Minimum Marks
1	**Subject II Minor V** : Statistical Inference	2	-	2	30	11	20	07
2	**Subject II Minor VI:** Stochastic Processes	2	-	2	30	11	20	07
3	**Subject II Practical III:** Practical Based on Subject Minor V Minor VI	-	4	2	30	11	20	07
SEMESTER-IV(Duration- Six Month)								
5	**Subject II Minor VII** : Multivariate Analysis	2	-	2	30	11	20	07
6	**Subject II Minor VIII:** Time Series Analysis	2	-	2	30	11	20	07
7	**Subject II Practical III:** Practical Based on Subject Minor VII and Minor VIII	-	4	2	30	11	20	07

Multiple Entry and Multiple Exit Option (NEP-2020)
B.Sc. Artificial Intelligence Part - II (Level-5.0)
With Mathematics as Minor

SEMESTER-III (Duration- Six Month)								
Sr. No.	Course Code	Teaching Scheme			Examination Scheme			
		Theory and Practical			University Assessmen (UA)		Internal Assessment (IA	
		Lectures (Per week	Hours (Per week	Credit	Maximu Marks	Minimum Mark	Maximum Marks	Minimum Marks
1	**Subject II Minor V** : Multivariable Calculus	2	-	2	30	11	20	07
2	**Subject II Minor VI:** Numerical Methods	2	-	2	30	11	20	07
3	**Subject II Practical III:** Practical Based on Subjec Minor V and Minor VI	-	4	2	30	11	20	07
SEMESTER-IV(Duration- Six Month)								
5	**Subject II Minor VII**: Computational Geometry	2	-	2	30	11	20	07
6	**Subject II Minor VIII**: Operational Research	2	-	2	30	11	20	07
7	**Subject II Practical III:** Practical Based on Subjec Minor VII and Minor VII	-	4	2	30	11	20	07

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III (Level- 5.0)
Title of course: Subject I Major V : Advanced Python Programming

Course Outcomes:

After completion of this course students will be able to:

1. Understand and apply advanced Python concepts including namespaces, modules, decorators, generators, iterators, and debugging techniques.
2. Design and implement object-oriented Python programs using inheritance, polymorphism, abstraction, encapsulation, special methods, and exception handling mechanisms.
3. Develop multithreaded applications using Python threading module with synchronization techniques such as Lock and Semaphore.
4. Build database-driven applications using Python DB-API by executing SQL queries and implementing basic CRUD operations.

Unit I **(15 Hours)**

Advanced Python Fundamentals: Namespaces and modules, virtual environments, advanced importing, decorators, generators and iterators, debugging techniques.

Object Oriented Programming in Python : Classes and objects, constructors and destructors, instance and class variables, inheritance, method overriding, polymorphism, abstraction, encapsulation, multiple inheritance, special (dunder) methods.

Exception Handling: Exceptions in object-oriented context, handling exceptions using try–except–finally, raising exceptions using raise, creating custom exception classes.

Unit II **(15 Hours)**

Multithreading and Concurrency in Python: Concept of Process vs Thread,Python threading module: creating and running threads,thread lifecycle, Extending the Thread class,Daemon threads, Thread synchronization using Lock and Semaphore.

Database Connectivity: Python DB-API concept, connecting Python with relational databases, executing SQL queries from Python, fetching results into objects/DataFrames, basic CRUD applications.

Reference Books:

1. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013
2. Luciano Ramalho, Fluent Python, O'Reilly Media, 2nd Edition, 2022
3. Dusty Phillips, Python 3 Object-Oriented Programming, Packt Publishing, 3rd Edition, 2018
4. Rick van Hattem, Mastering Python, Packt Publishing, 2nd Edition, 2016

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Title of course: Subject I Major VI : Database - II

Course Outcomes:

After completion of this course students will be able to:

1. Understand and apply PL/pgSQL block structure, variables, data types, and control statements.
2. Design and implement stored functions, procedures, and Common Table Expressions (CTEs) for database applications.
3. Create and manage database objects including views, cursors, triggers, and exception handling mechanisms.
4. Analyze and optimize database performance using indexing techniques and query optimization tools.

Unit I **(15 Hours)**

Introduction to PL/pgSQL: Overview, benefits and architecture, structure of PL/pgSQL blocks, anonymous blocks using DO statement.

Variables and Data Types: Scalar data types, RECORD type, %ROWTYPE and %TYPE attributes, variable declaration and assignment, output using RAISE NOTICE.

SQL Integration and Control Structures: Executing SELECT, INSERT, UPDATE and DELETE inside PL/pgSQL, transaction control, conditional statements, loops .

Functions and Procedures: Creating stored functions and procedures, IN and OUT parameters, returning tables from functions, calling functions from SQL.

Unit II **(15 Hours)**

Advanced Database Objects: Views and Materialized Views, constraints and rules.

Cursors and Exception Handling: Implicit and explicit cursors, cursor FOR loops, exception handling using EXCEPTION blocks.

Triggers: Introduction to triggers and their role in automation, creating triggers to respond to table events, BEFORE INSERT and AFTER INSERT triggers, dropping triggers, disabling triggers.

Indexing and Query Optimization: Concept of index and its role in query performance, CREATE INDEX and DROP INDEX, unique index, expression index, partial indexes, index-only scans.

[Note: PostgreSQL will be used as the primary database platform for delivering both theoretical concepts and practical exercises in this course.]

Reference Books:

1. Baji Shaik, Dinesh Kumar Chemuduru, Procedural Programming with PostgreSQL PL/pgSQL: Design Complex Database-centric Applications with PL/pgSQL, Apress, 1st Edition (2023)
2. Regina O. Obe, Leo S. Hsu, PostgreSQL: Up and Running, O'Reilly Media, 3rd Edition (2017)
3. Swati Saxena, Essential PostgreSQL: Your Guide to Database Design, Query Optimization, and Administration, BPB Publications, 1st Edition (2025)
4. Sayak Ghosh, Fundamentals of SQL, IP Innovative Publication, 1st Edition (2022)

B.Sc. Artificial Intelligence

Multiple Entry and Multiple Exit Option (NEP-2020)

PART II SEM III(Level- 5.0)

Title of course: Subject I Major Practical III :

Practical Based on Subject I Major V & Subject I Major IV

Course Outcomes:

After completion of this course students will be able to:

1. Develop advanced Python programs using modules, object-oriented programming concepts, special methods, and exception handling mechanisms.
2. Design and implement database-driven Python applications by integrating relational databases and performing CRUD operations.
3. Apply PL/pgSQL programming constructs including variables, control structures, and SQL integration to manipulate database records.
4. Create and manage stored functions and procedures using PL/pgSQL to build structured and reusable database applications.

Practical Based on Subject: Subject I Major V Advance Python Programming

1. Write a program to demonstrate namespaces and modules by creating and importing a user-defined module.
2. Write a program using generators and iterators to generate Fibonacci numbers.
3. Write a program to create a class and object, including constructor and destructor.
4. Write a program demonstrating instance variables and class variables.
5. Write a program to implement single inheritance and method overriding.
6. Write a program to implement encapsulation and multiple inheritance.
7. Write a program demonstrating special (dunder) methods such as __str__, __add__, and __len__.
8. Write a program to handle exceptions using try–except–finally and raise.
9. Write a program to create and use a custom exception class.
10. Write a program to connect Python with a relational database and perform CRUD operations (Create, Read, Update, Delete).

Practical Based on Subject : Subject I Major VI Database - II

1. Write a PL/pgSQL program to demonstrate variable declaration, assignment, and scalar data types.
2. Create a table Student(Student_ID, Name, Age, Dept_ID) and write a PL/pgSQL block to insert records using variables.
3. Write a PL/pgSQL program using %TYPE to fetch and display a student's name based on Student_ID.
4. Write a PL/pgSQL program using %ROWTYPE to retrieve and display complete student records.
5. Write a PL/pgSQL block using RECORD type to fetch values from a table.
6. Write a PL/pgSQL program to perform following operations inside PL/pgSQL.:
    a. a. INSERT
    b. b. UPDATE
    c. c. DELETE
    d. d. SELECT
7. Write PL/pgSQL programs using to classify students based on marks.:
    a. IF–ELSE statement
    b. CASE statement
8. Write PL/pgSQL programs using loops to display numbers or table records.:
9. Create a stored function that accepts Student_ID as input and returns student age.
10. Create a stored function returning a table to display students of a particular department.
11. Create a stored procedure with IN and OUT parameters to insert student data.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Course Title: Subject II Minor V: Statistical Inference (Minor)

Course Outcomes (COs)

After successful completion of this course, students will be able to:

1. Explain fundamental concepts of statistical inference including random variables, expectation, and sampling distributions.
2. Apply concepts of estimation and construct confidence intervals for population parameters.
3. Perform hypothesis testing using appropriate statistical tests for real-world data.
4. Interpret statistical results in the context of data analysis and artificial intelligence applications.

UNIT – I **(15 Hours)**

Jointly distributed random variables, independence, conditional distributions, expectation and variance, covariance and correlation, variance of sums, introduction to weak law of large numbers
Sampling distributions: random sample, parameter and statistic, sampling distribution of sample mean and proportion, standard error, introduction to t, chi-square and F distributions.

UNIT – II **(15 Hours)**

Parameter estimation: point estimation, properties of estimators (basic idea), maximum likelihood estimation (introductory), interval estimation of mean and proportion.
Hypothesis testing: basic concepts, level of significance, p-value, large and small sample tests (mean and proportion – basic), chi-square test for goodness of fit and independence.

Reference Books

1. Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, Cengage Learning, 2015.
2. Ronald E. Walpole et al., *Probability and Statistics for Engineers and Scientists*, Pearson, 2012.
3. William Mendenhall et al., *Introduction to Probability and Statistics*, Cengage Learning, 2013.
4. Sheldon M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists*, Academic Press, 2014.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Course Title: Subject II Minor VI : Stochastic Processes(Minor)

Course Outcomes (COs)

After successful completion of this course, students will be able to:

1. Explain fundamental concepts of stochastic processes and classify different types of processes.
2. Analyze discrete-time Markov chains and compute transition probabilities and steady-state distributions.
3. Apply Poisson and birth–death processes to model real-world systems.
4. Evaluate queueing models and interpret system performance measures.

UNIT – I: Foundations of Stochastic Processes and Markov Chains (15 Hours)

Basics: Definition and types of stochastic processes; discrete and continuous time processes; state space (finite and infinite).

Markov Chains: Markov property, transition probability matrix (TPM), Chapman–Kolmogorov equations (introductory), n-step transition probabilities.

State Analysis: Classification of states – accessible, communicating, recurrent, and transient states.

UNIT – II: Poisson Processes, Queuing, and AI Applications (15 Hours)

Poisson Process: Definition, properties (including memoryless property), real-world applications.

Continuous Systems: Introduction to birth–death processes and continuous-time Markov chains.

Queueing Theory: M/M/1 queue – characteristics, average queue length, waiting time.

Reference Books

1. Sheldon M. Ross, *Introduction to Probability Models*, Academic Press, 2014.
2. J. Medhi, *Stochastic Processes*, New Age International, 2010.
3. Allen B. Downey, *Think Stats / Think Bayes*, O'Reilly Media, 2013.
4. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006. *(for AI applications)*
5. S. Karlin and H.M. Taylor, *A First Course in Stochastic Processes*, Academic Press, 2012. *(Advanced Reference)*

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)

Course Title : Subject II Practical III :
Mathematics Practical based on Minor V and VI (Minor)

Practical Experiments (Minor V).

1. Compute mean, variance, covariance, and correlation for a dataset.
2. Simulate random variables and verify properties of expectation.
3. Demonstrate Central Limit Theorem using simulation.
4. Draw random samples and compute sampling distributions.
5. Calculate standard error for sample mean and proportion.
6. Construct confidence intervals for mean and proportion.
7. Perform Maximum Likelihood Estimation (basic examples).
8. Test equality of two means using appropriate statistical tests.
9. Perform chi-square goodness-of-fit test.
10. Conduct chi-square test for independence using contingency tables.

Practical Experiments (Minor VI)

11. Simulate discrete-time stochastic processes using random number generation.
12. Implement and visualize Markov chains using transition probability matrices.
13. Compute n-step transition probabilities for a given Markov chain.
14. Determine steady-state (stationary) distribution numerically.
15. Simulate Poisson process and verify its properties.
16. Generate inter-arrival times using exponential distribution.
17. Model and simulate birth–death processes.
18. Implement basic M/M/1 queue simulation and compute average waiting time.
19. Analyze queue performance (queue length, utilization).

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Course Title: Subject II: Minor V : Multivariable Calculus(Minor)

Course Outcomes (COs)

After successful completion of this course, students will be able to:

1. Explain functions of several variables and analyze their graphical representation using level curves and surfaces.
2. Apply partial derivatives, gradients, and directional derivatives to solve multivariable problems.
3. Analyze differentiability and apply chain rule and Euler's theorem in solving problems.
4. Solve optimization problems using extrema conditions and Lagrange multipliers.

UNIT – I: Functions of Several Variables & Differentiation (15 Hours)

Introduction: Functions of n variables, domain, range, level curves and surfaces, visualization of multivariable functions.

Limits and Continuity: Definitions and properties, evaluation of limits along different paths, continuity of functions of several variables.

Partial Differentiation: First-order and higher-order partial derivatives, partial differential coefficients.

Differentiability: Gradient vector, directional derivatives, total differential.

UNIT – II: Optimization & Multiple Integration (15 Hours)

Extrema: Local and absolute extrema, critical points, Hessian matrix and second derivative test.

Constrained Optimization: Method of Lagrange multipliers (single constraint) and applications.

Double Integrals: Evaluation in Cartesian and polar coordinates, change of order of integration.

Change of Variables: Jacobian determinant and its applications.

Reference Books

1. James Stewart, Calculus: Early Transcendentals, Cengage Learning, 2015.
2. H. Anton, I. Bivens and S. Davis, Calculus, Wiley, 2016.
3. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley, 2011.
4. K.A. Stroud, Engineering Mathematics, Palgrave Macmillan, 2013.
5. Gilbert Strang, Calculus and Linear Algebra (Applied Perspective), Wellesley-Cambridge Press, 2016.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Course Title : Subject II Minor VI : Numerical Methods (Minor)

Course Outcomes: After completion of this course, student should be able to

1. Understand how to find the roots of transcendental equations.
2. Understand learn numerical solution of differential equations
3. Understand how to find the roots of transcendental equations.
4. Understand how to interpolate the given set of values.

Unit I: Solution of Non-linear Equations & Interpolation **(15 Hours)**

1.1 Introduction to Non-linear Equations
1.2 Bisection Method: Algorithm, graphical representation and examples
1.3 Regula–Falsi Method: Algorithm, graphical representation and examples
1.4 Newton-Raphson Method: Algorithm, graphical representation and examples
1.5 Interpolation: Introduction, equally spaced data, unequally spaced data
1.6 Finite Differences and Operators: Forward Difference (Δ), Backward Difference (∇), Shift Operator (E)
1.7 Elementary Results of Δ, ∇ and E
1.8 Fundamental Theorem of Difference Calculus with proof
1.9 Newton-Gregory Forward Interpolation Formula with proof and examples
1.10 Newton-Gregory Backward Interpolation Formula with proof and examples
1.11 Lagrange's Interpolation Formula with proof and examples

Unit II: Numerical Integration **(15 Hours)**

2.1 Introduction to Numerical Integration
2.2 General Quadrature Formula with proof
2.3 Trapezoidal Rule with proof and examples
2.4 Simpson's 1/3 Rule with proof and examples
2.5 Simpson's 3/8 Rule with proof and examples
2.6 Weddle's Rule with proof and examples

Recommended Book:

1. IntroductoryMethodsofNumericalAnalysis,S.S.Sastry,3rd edition, Prentice Hall of India, 1999.
2. Finite differences and Numerical Analysis, sH.C. Saxena,S. Chand and Company.

REFERENCE BOOKS:

1. NumericalAnalysis,Balguruswamy.
2. CalculusofFiniteDifferencesandNumericalAnalysis,P.P.Gupta,G.S.MalikandS. Gupta,Krishna Prakashan Media (P) Ltd.
3. Computer oriented Numerical methods, A.B.AutiTech-maxpublications.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)

Minor Practical- III
Mathematics Practical based on Minor V and VI (Minor)

List of Practical:

Practical Number	Title of the practical
1	Visualization of multivariable functions.
2	Limits and Continuity
3	First-order and higher-order partial derivatives,
4	Gradient vector, directional derivatives, total differential.
5	Method of Lagrange multipliers
6	Bisection method
7	Newton Forward and Backward interpolation, Lagrange's interpolation
8	Trapezoidal,Simpson's1⁄3andSimpson's3⁄8rule
9	Weddle's rule
10	Regula-Falsi Method and Newton Raphson method
11	Computer Program for 1. Plot functions of two variables using Python (surface and contour plots). 2. Visualize level curves and surfaces of multivariable functions. 3. Compute partial derivatives using symbolic tools (e.g., SymPy). 4. Calculate gradient vectors and directional derivatives. 5. Verify chain rule computationally for multivariable functions.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Title of course: VSC – I (T) : Web Design using JavaScript

Course Outcomes:

After completion of this course students will be able to:

1. Understand different HTML tags.
2. Learn how to design and develop a Web page using HTML and CSS
3. Design and develop a web site using text, images, links, lists and tables.
4. 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. lisabeth Robson, Eric Freeman - Head First HTML and CSS - O'Reilly Media, 2nd Edition, 2012
2. Julie C. Meloni, Jennifer Kyrnin - HTML, CSS, and JavaScript All in One, Pearson (Sams Publishing), 1st Edition, 2015
3. Andy Harris - HTML5 and CSS3 All-in-One For Dummies - John Wiley & Sons, 3rd Edition, 2014

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Title of course: SEC-I (T): Java Programming - I

Course Outcomes:

After completion of this course students will be able to:

1. Understand Java fundamentals including JVM architecture, data types, control structures, arrays, and predefined classes.
2. Design object-oriented programs using classes, constructors, inheritance, polymorphism, abstraction, and interfaces.
3. Apply encapsulation, packages, access modifiers, and exception handling to develop robust Java applications.
4. Develop structured Java programs using user-defined exceptions, interfaces, and core OOP principles.

Unit I **(15 Hours)**

Introduction to Java: Introduction to Java, History and Features of Java, C++ vs Java, JDK vs JRE vs JVM, Java Virtual Machine (JVM – basic architecture), Compilation and Execution Process, First Java Program, Accepting Input (Command Line Arguments, Scanner).

Programming Basics: Variables in Java, Java Data Types, Type Casting, Java Operators, Control Flow Statements, Loops, break and continue statements, Java Arrays (1D and 2D).

Predefined Classes: Object Class (equals(), toString(), hashCode(), getClass()), String Class, StringBuilder Class, Wrapper Classes.

Unit II **(15 Hours)**

Object Oriented Programming in Java: Classes and Objects, Constructors, Methods and Types of Methods, Static keyword (variables, methods, blocks).

Inheritance and Polymorphism: Inheritance using extends, Types of Inheritance, Superclass and Subclass, super keyword, Method Overriding, Use of final keyword related to method and class.

Abstraction and Interfaces: Abstract class and abstract methods, Defining and Implementing Interfaces, Runtime polymorphism using Interface.

Encapsulation and Packages: Encapsulation (getters and setters), Packages, Access Modifiers (public, private, protected, default).

Exception Handling: Exception Handling Concepts, Checked and Unchecked Exceptions, try–catch–finally, throw and throws, User-defined Exceptions.

Reference Books:

1. Herbert Schildt - Java: The Complete Reference, McGraw-Hill Education, 11th Edition, 2019
2. Paul Deitel, Harvey Deitel - Java How to Program, Pearson Education, 10th Edition, 2015
3. Cay S. Horstmann - Core Java Volume I – Fundamentals, Prentice Hall, 11th Edition, 2018
4. E. Balagurusamy - Programming with Java, McGraw-Hill Education (India), 6th Edition, 2019

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Title of course: AEC- I: Verbal Communication

Course Outcomes:

After completion of this course students will be able to:

1. Demonstrate Proficiency in Grammar and Sentence Structures.
2. Demonstrate effective oral communication for various purposes including introductions, apologies, and expressing agreement or disagreement.
3. Participate in structured conversational activities like monologues, dialogues, role plays, and situational conversations.
4. 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
3. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraHillPublishingCompanyLimited,2001.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM III(Level- 5.0)
Title of course: CC-I: Basics of Yoga

Course Outcomes:

After completion of this course students will be able to:

1. To understand the importance of Yoga and understand various Asans.
2. Classify and differentiate various types of yoga including Jnana, Bhakti, Karma, Hatha, and Raja Yoga.
3. Analyze the role of yoga in character building, mental discipline, and stress management through techniques like Nishkama Karma and meditation.
4. 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. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Title of course: Subject I Major VII : Basics of Artificial Intelligence

Course Outcomes:

After completion of this course students will be able to:

1. Explain fundamental concepts of Artificial Intelligence, intelligent agents, and ethical aspects of AI.
2. Apply problem-solving techniques including state space search, uninformed and informed search, and game playing strategies.
3. Represent knowledge using propositional and predicate logic and perform inference using resolution, unification, and forward/backward reasoning.
4. Analyze learning paradigms in AI including supervised and unsupervised learning, regression, classification, bias–variance trade-off, and model evaluation techniques.
5. Demonstrate understanding of uncertainty handling using probabilistic reasoning and Bayesian networks.

UNIT-I **(15 Hours)**

Fundamentals of Artificial Intelligence: Definitions, Introduction, key concepts, Evolution, Terminology, Approaches and Goals. Ethical aspects of Artificial Intelligence. Relation between Artificial Intelligence, Machine Learning and Deep Learning. Intelligent Agents: Structure, Types and interaction with the environment.

Problem Solving : State space search; production systems, search space control, Uninformed and Informed

Search: depth first search, breadth-first search. Heuristic Search: Best First Search, Hill Climbing. Game Playing: Minimax, alpha-beta pruning.

Knowledge Reasoning : Introduction to Knowledge representation, Building a Knowledge Base: propositional logic, first order logic and inferencing. Uncertain Knowledge and Reasoning, Probabilities, Bayesian Networks.

UNIT-II **(15 Hours)**

Learning in Artificial Intelligence : Definition, process, types - unsupervised and supervised learning. Regression, Classification, Bias-Variance trade-off, Overfitting-Underfitting, loss function, cross-validation

Applications of Artificial Intelligence : Healthcare: Diagnosis, treatment, and medical imaging; Finance: Fraud detection, algorithmic trading, and risk assessment, Education: Personalized learning and intelligent tutoring systems.

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. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Title of course: Subject I Major VIII: Data Structure using Python

Course Outcomes:

After completion of this course students will be able to:

1. Understand fundamental concepts of data structures and algorithm analysis.
2. Implement linear and non-linear data structures using Python.
3. Apply searching and sorting techniques.
4. Analyze performance of algorithms using basic complexity measures.
5. Solve computational problems using appropriate data structures.

UNIT - I **(15 Hours)**

Introduction to Data Structures and Algorithm Analysis: Definition of Data Structures, Abstract Data Types, Linear and Non-Linear Data Structures, Applications of Data Structures.
Algorithm Analysis: Time and Space Complexity, Asymptotic notations.
Stacks: Concept of Stack, Implementation using List and Linked List, Applications of Stack.
Queues: Concept of Queue, Implementation using List and Linked List, Circular Queue, Priority Queue, Applications of Queue.
Linked Lists: Definition, Comparison with Arrays, Representation, Types of Linked lists, Traversing, Inserting, Deleting and Searching in Singly Linked List, Doubly Linked List. Applications of Linked Lists

UNIT - II **(15 Hours)**

Searching Algorithms: Linear Search, Binary Search.
Sorting Algorithms: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort.
Trees : Tree Terminology, Binary Trees, Tree Traversals (Inorder, Preorder, Postorder).
Binary Search Trees: Introduction, Insertion, Deletion, Searching.

Reference Books:

1. Michael T. Goodrich, Roberto Tamassia and Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley Publications, 2013.
2. Bradley N. Miller and David L. Ranum, Problem Solving with Algorithms and Data Structures Using Python, Franklin, Beedle & Associates, 2011.
3. Rance D. Necaise, Data Structures Using Python, Wiley Publications, 2016.
4. Magnus Lie Hetland, Python Algorithms: Mastering Basic Algorithms in the Python Language, Apress, 2010.
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms (3rd Edition), MIT Press, 2009.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Title of course: Subject I Practical IV : Practical Based on Subject I Major VII

Course Outcomes:

After completion of this course students will be able to:

1. Explain fundamental concepts of data structures and analyze algorithm efficiency using basic time complexity measures.
2. Implement searching and sorting algorithms in Python and compare their performance.
3. Design and implement linear data structures such as linked lists, stacks, and queues using Python.
4. Construct and traverse tree-based data structures including Binary Trees, Binary Search Trees.

List of Practical:

1. Write a Python program to implement Linear Search.
2. Write a Python program to implement Binary Search.
3. Write a Python program to implement Bubble Sort.
4. Write a Python program to implement Selection Sort.
5. Write a Python program to implement Insertion Sort.
6. Write a Python program to implement Merge Sort.
7. Write a Python program to implement Quick Sort.
8. Write a Python program to analyze time complexity of sorting algorithms using simple input sizes.
9. Write a Python program to implement Singly Linked List with insertion and deletion.
10. Write a Python program to implement Doubly Linked List.
11. Write a Python program to implement Circular Linked List.
12. Write a Python program to implement Stack using List.
13. Write a Python program to implement Stack using Linked List.
14. Write a Python program to implement Queue using List.
15. Write a Python program to implement Queue using Linked List.
16. Write a Python program to implement Circular Queue.
17. Write a Python program to implement Priority Queue.
18. Write a Python program to create a Binary Tree and perform tree traversals (Inorder, Preorder, Postorder).
19. Write a Python program to implement Binary Search Tree with insertion and search.
20. Write a Python program to implement deletion in Binary Search Tree.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Course Title : Subject II Miner VII : Multivariate Analysis

Course Outcomes (COs)

After successful completion of this course, students will be able to:

1. Explain concepts of multivariate data and compute multivariate descriptive statistics.
2. Analyze relationships among multiple variables using covariance, correlation, and partial correlation.
3. Apply dimensionality reduction techniques such as Principal Component Analysis and Factor Analysis.
4. Perform clustering and classification using multivariate techniques.

UNIT – I **(15 Hours)**

Introduction to multivariate data, multivariate descriptive statistics, covariance and correlation matrices, partial correlation. Multivariate normal distribution, introduction to multivariate analysis of variance. Principal Component Analysis (PCA): concept, computation and interpretation.

UNIT – II **(15 Hours)**

Cluster Analysis: hierarchical and non-hierarchical methods - concept and applications.

Discriminant Analysis: concept and basic classification. Multidimensional Scaling (MDS): concept and applications. Predictive analytics: Introduction and applications in AI and Data Science.

Reference Books

1. Gareth James et al., *An Introduction to Statistical Learning*, Springer, 2013.
2. Brian S. Everitt and Torsten Hothorn, *An Introduction to Applied Multivariate Analysis with R*, Springer, 2011.
3. Richard A. Johnson and Dean W. Wichern, *Applied Multivariate Statistical Analysis*, Pearson, 2014.
4. Trevor Hastie et al., *The Elements of Statistical Learning*, Springer, 2009.

B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Course Title : Subject II Miner VIII : Time Series Analysis

Course Outcomes (COs)

After successful completion of this course, students will be able to:

1. Explain fundamental concepts of time series and identify its components and patterns.
2. Analyze time-dependent data using ACF and PACF and determine stationarity.
3. Apply time series models such as AR, MA, and ARIMA for forecasting.
4. Implement smoothing techniques and seasonal models for real-world data.

UNIT – I: Time Series Foundations & Linear Models (15 Hours)

Introduction to time series: definition, importance, and components (trend, seasonal, cyclical, irregular variations).

Time series patterns: additive and multiplicative models.

Statistical tools: descriptive statistics for time-dependent data, autocorrelation and partial autocorrelation, interpretation of ACF and PACF plots.

Introduction to stochastic models: concept of stationarity, basic concepts of autoregressive (AR), moving average (MA).

UNIT – II: Smoothing, Seasonal Models, and Applications (15 Hours)

Smoothing techniques: simple moving averages, exponential smoothing (single, double/Holt's, triple/Holt-Winters).

Performance metrics: mean absolute error (MAE), mean squared error (MSE), introduction to AIC and BIC.

Applications in AI and Data Science: predictive analytics using time series, applications in finance, energy demand forecasting.

Reference Books

1. Hyndman and Athanasopoulos, *Forecasting: Principles and Practice*, OTexts, 2021.
2. Douglas C. Montgomery et al., *Introduction to Time Series Analysis and Forecasting*, Wiley, 2015.
3. Robert H. Shumway and David S. Stoffer, *Time Series Analysis and Its Applications*, Springer, 2017.
4. Gareth James et al., *An Introduction to Statistical Learning*, Springer, 2013.

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B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)

Course Title: Statistics Practical based on Minor VII and VIII

Practical Experiments(Minor VII)

1. Compute covariance and correlation matrices for multivariate datasets.
2. Calculate and interpret partial correlations.
3. Perform exploratory data analysis on multivariate datasets.
4. Implement Principal Component Analysis (PCA) and interpret components.
5. Reduce dimensionality using PCA and visualize results.
6. Apply hierarchical clustering and visualize dendrograms.
7. Apply k-means clustering and evaluate cluster quality.
8. Perform discriminant analysis for classification problems.
9. Apply Multidimensional Scaling (MDS) for visualization of data.
10. Compare clustering vs classification methods on a dataset.

Practical Experiments(Minor VIII)

11. Plot and visualize time series data and identify its components.
12. Decompose time series into trend, seasonal, and residual components.
13. Identify additive and multiplicative models using visualization.
14. Compute and plot ACF and PACF for a dataset.
15. Test stationarity of a time series (visual/ADF concept).
16. Fit AR and MA models to time series data.
17. Apply moving average smoothing techniques.
18. Apply exponential smoothing (single, double, Holt-Winters).
19. Evaluate forecasting models using MAE and MSE.

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B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Course Title : Subject II Miner VII : Computational Geometry

Course Outcomes(COs):

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

1. Understand how to represent point, lines, transformations and matrices.
2. Understand how to various types of transformations.
3. Solve multiple transformation and projection on three dimensional.
4. Understand the concept curve, its properties and B-spline curve.

UNIT - 1 Two dimensional transformations (15 Hours)

1.1 Introduction
1.2 Representation of Point
1.3 Basic2DTransformation:Scaling,Shearing,Rotation, Reflection
1.4 Combined Transformation
1.5 Transformation of points, straight lines
1.6 Midpoint Transformation
1.7 Slope of transformed line
1.8 Transformation of parallel lines and intersecting lines
1.9 Homogeneous coordinates and Homogeneous matrix
1.10 Rotation about an arbitrary point.
1.11 Reflection through an arbitrary line.
1.12 Solid body transformation
1.13 Point at infinity.

UNIT - 2 Three dimensional transformations (15 Hours)

3.1 Introduction.
3.2 Three dimensional-Scaling, Shearing, Rotation, Reflection, Translation.
3.3 Multiple transformations.
3.4 Rotation about-an axis parallel to coordinate axes, an arbitrary axis in space.
3.5 Reflection through-planes parallel to coordinate planes
3.6 Reflection through arbitrary plane(only algorithm).
3.7 Plane Curves
    3.7.1 Introduction.
    3.7.2 Curve representation
    3.7.3 Parametric representation of a circle and generation of circle.
    3.7.4 Parametric representation of an ellipse and generation of ellipse.
    3.7.5 Parametric representation of a parabola and generation of parabolic Segment

Recommended Book:

1. Mathematicalelementsforcomputergraphics,F.DavidandJ.AlanAdams(McGrawHill International Edition)

Reference Books:

1. Computer graphics,Schaumseries.
2. ComputerGraphicshandbook,GeometryandMathematics,M.E.Mortenson,IndustrialPressInc.

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B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Course Title : Subject II Miner VIII : Operational Research

Course Outcomes (COs):

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

1. learn about characteristics, scope of operation Research.
2. Understand the Assignment problem.
3. UnderstandtheTransportationproblemInitialSolutionandOptimization.
4. To know the fundamentals of game theory.

Unit I: Introduction to Operation Research and Transportation Problem (15 Hours)

1.1 Basics of Operation Research
1.2 Different definitions of Operation Research
1.3 Characteristics, scope, limitations of Operation Research
1.4 Basics of Transportation Problem
1.5 Basic Definitions
1.6 Initial Solution
    1.6.1 North-West Corner Method and examples
    1.6.2 Matrix Minima Method and examples
    1.6.3 Vogel's Approximation Method and examples
1.7 MODI Method and examples
1.8 Maximization in Transportation Problem and examples
1.9 Unbalanced Transportation Problem and examples

Unit II: Assignment Problem and Theory of Games (15 Hours)

2.1 Introduction to Assignment Problem
2.2 Hungarian Method and examples
2.3 Maximization in Assignment Problems and examples
2.4 Unbalanced Assignment Problem and examples
2.5 Assignment Problems with restrictions and examples
2.6 Basic definitions of Game Theory
2.7 Saddle Point and examples
2.8 Algebraic Method for 2×2 size game and examples
2.9 Arithmetic Method for 2×2 size game and examples
2.10 Principle of Dominance, Dominance Method and examples
2.11 Sub-game Method for 2×n and m×2 size game and examples
2.12 Graphical Method for 2×n and m×2 size game and examples

RecommendedBook:

1. OperationsResearch,S. D. Sharma

REFERENCE BOOKS:

1. PrinciplesofOperationsResearch,H.M.Wagner,PrenticeHallofIndia.
2. OperationsResearch,GuptaandHira.
3. OperationsResearch,JKSharma(secondedition)

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B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)

Course Title: Mathematics Practical based on Minor VII and VIII

List of Practical:

Practica Numbe	Title of the practical
1	PlaneLinear transformation – I Scaling,Shearing,ReflectionCombinedtransformation matrix
2	PlaneLinear transformation – II Rotationaboutorigin,Rotationaboutarbitrarypoint,Reflectionthrougharbitraryline
3	Spacelineartransformation–I Scaling,ShearingandRotationaboutCoordinateaxis,ReflectionthroughCoordinate planes
4	Spacelineartransformation–II TranslationMultipletransformations,RotationaboutalineparalleltoCoordinateaxis, Rotation through planes which are parallel to Coordinate planes
5	PlaneCurves – I Generationofpointsoncircleandellipse(Examples only)
6	PlaneCurves_ II Generationofpointsonparabolicsegment(Examples only)
7	Initialsolutionoftransportationproblem – I North–WestCornermethod,Matrixminima method
8	Initialsolutionoftransportationproblem–II Vogel's approximation method
9	Maximizationoftransportationproblem,Unbalancedtransportationproblem
10	AssignmentProblem-Minimizationtypeand Maximization in assignment problem,
11	Graphicalmethodfor□×□&□×□sizegame
12	ComputerProgram: 1) Tocheckgiventransformationissolidbodytransformation ornot. 2) TodeterminevalueofgameusingArithmeticMethod 3) TodeterminevalueofgameusingAlgebraicMethod

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B.Sc. Artificial Intelligence

Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
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. 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

Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Title of course: SEC-II (T): Java Programming - II

Course Outcomes:

After completion of this course students will be able to:

1. Understand and apply Java Collections Framework concepts and multithreading mechanisms for concurrent programming.
2. Design database applications using JDBC architecture, statements, ResultSet, and CRUD operations.
3. Develop web applications using Servlets for request handling, session tracking, and database connectivity.
4. Build dynamic web pages using JSP concepts including lifecycle, implicit objects, directives, actions, and Expression Language.

Unit I **(15 Hours)**

Collections Framework : Introduction to Collection framework, Generics in Collections, List (ArrayList, LinkedList), Set (HashSet, TreeSet), Map (HashMap, TreeMap), Comparable vs Comparator, Iterator, ListIterator, Enumeration, enhanced for-loop.

Multithreading : Concept of Process and Thread, Life cycle of thread, Creating threads using Thread class and Runnable interface, Thread priorities, Running multiple threads, Synchronization.

Unit II **(15 Hours)**

Database Programming using JDBC : JDBC architecture and design, Types of JDBC drivers, DriverManager and Connection, Statement and PreparedStatement, Executing SQL statements, CRUD operations, ResultSet.

Servlets : Introduction to Servlet, Servlet lifecycle, Handling GET and POST requests, Handling data from HTML to Servlet, Database connectivity in Servlet, Session tracking (Cookies, HttpSession, URL rewriting, hidden form fields).

JSP : Introduction to JSP, JSP lifecycle, Implicit objects, JSP directives.

Reference Books:

1. Herbert Schildt - Java: The Complete Reference, McGraw-Hill Education, 11th Edition, 2019
2. Cay S. Horstmann - Core Java Volume I – Fundamentals, Pearson Education, 11th Edition, 2018
3. Bryan Basham, Kathy Sierra, Bert Bates - Head First Servlets and JSP, O'Reilly Media, 2nd Edition, 2008
4. Kogent Learning Solutions - Java 2 Enterprise Edition, Pearson Education (India), 1st Edition, 2014

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Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Title of course: VEC-II: Environmental Studies

Course Outcomes:
After completion of this 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 varioustypes and sourcesof 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

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B.Sc. Artificial Intelligence
Multiple Entry and Multiple Exit Option (NEP-2020)
PART II SEM IV(Level- 5.0)
Title of course : CEP-I(P): Field work

Course Outcomes:
After completion of this course students will be able to:

5. Understand the structure and values of rural society, including joint family systems, caste and gender relations, and rural cultural practices.
6. Examine rural livelihoods through agriculture, land ownership, water management, animal husbandry, and non-farm enterprises, including the role of rural entrepreneurs and markets.
7. Analyze traditional and modern rural institutions such as self-help groups, panchayati raj institutions, local governance bodies, and their roles in decentralized planning.
8. Explore the significance of natural and public rural resources like ponds, fisheries, and community-based resource management systems.
9. Evaluate national rural development programs such as NRLM, MGNREGA, and the role of civil society and local administration in empowering rural communities.
10. 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