West Bengal Council of Higher Secondary Education
Vidyasagar Bhavan
9/2, Block DJ, Sector-II, Salt Lake, Kolkata – 91

No : L/PR/143/2025 **Date : 10/03/2025**

NOTIFICATION

The Council has introduced several new subjects in the H.S Curriculum from the academic year 2025-26.

Syllabi of all these subjects namely, Artificial Intelligence and Data Science [AIDS], Business Mathematics and Basic Statistics [BMBS], Basic Mathematics for Social Sciences [BMSS], Environmental Science [EVSC] and Fisheries and Aquaculture [FSAQ] are being enclosed with this Notification.

In our earlier Notification in this regard [Memo No. L/PR/065/25 dated 17/02/2025], the Council has already mentioned eligibility criteria for the teachers and schools who can apply for introduction of these subjects and the revised set structure with the new subjects.

All are requested to check our Notification Section and Download Center on a regular basis for the latest uploads.

PRESIDENT
WBCHSE

WEST BENGAL COUNCIL OF HIGHER SECONDARY EDUCATION

SYLLABUS FOR CLASS XI AND XII

SUBJECT : ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Course Objectives :

The objectives of this course are:

- To impart knowledge about basic computer fundamentals and programming environments required for implementing Artificial Intelligence (AI) systems.
- To enable the students to understand the history of AI and the basic principles of modern AI.
- To enable students to learn the informed and uninformed search methods, and a simple evolutionary algorithm for solving problems.
- To enable students to understand the fundamentals of knowledge representation, building of simple knowledge-based systems, and to apply knowledge representation and reasoning
- To enable the students to understand important machine learning(ML) algorithms used for improving various components of an AI agent
- To enable the students to understand the uses of AI and ML in various applications.
- To enable the student to understand ethics in AI
- To gain practical experience in developing various AI and ML models

Course outcomes:

Upon successful completion of this course, the student shall be able to:

- Demonstrate an understanding of the history of AI and its foundations.
- Apply basic principles of AI in problem-solving that require perception, knowledge representation , inference, and learning.
- Demonstrate awareness and a fundamental understanding of various applications of AI and Machine Learning techniques in real-world problem solving.
- Demonstrate proficiency in developing various real-world AI and ML applications using the latest programming languages and software tools.
- Demonstrate an ability to share in discussions of AI and ML, its current scope and limitations, and its impact on society.

CLASS – XI : SEMESTER – I

SUBJECT: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (AIDS)-THEORY

FULL MARKS: 35 **CONTACT HOURS: 60 Hours**

UNIT NO.	SUB UNIT	TOPICS	CONTACT HOURS	MARKS
Unit-1 **Computer Fundamentals (16)**	1A	History of computer, generation of computers, classification of computers, block diagram of a basic Computer system-a visual representation of its fundamental components (CPU unit, input unit, output unit, memory unit input) and their functions, various input and output devices, Basic computer architecture, Storage Devices -primary and secondary storage devices	**5**	**3**
	1B	Bit, Byte and Word, Number System (Base, Binary, Decimal, Octal, Hexadecimal), Conversion of number systems, Boolean logic, Logic Gates, canonical form, combinational circuit design(with simple examples), ASCII code. **Basic computer architecture**-data flow between CPU, Memory and I/O device, Interconnection of computer units via system buses, Registers- various important registers within CPU, Control unit-how it instructs ALU and registers, and I/O devices, Simple examples showing how ALU works. Basic instruction format, basic steps of instruction cycle and their brief description.	**10**	**5**
	1C	Concept of Algorithm and Flowchart(with simple examples), Basics of Computer Programming (three levels: high level language, assembly language, machine language, definition and block diagrams), Overview of Compiler and Interpreter (definition and mention name of major compiled (e.g., C, C++) and interpreted languages (e.g., Python), Overview of procedural and object oriented programming (key features and just the basic differences, mention names of some popular procedural (e.g., BASIC, FORTRAN, C) and object oriented programming languages (e.g., C++, Java, Python).	**8**	**5**

	1D	Overview of Software (system software and application software with examples (mention names only), Definition of Operating System and functions (mention names of some popular operating systems like Windows, Linux, Android, etc). Networking of machines (overview of LAN, MAN, WAN, Internet, Wifi etc), types of computer (workstation, desktop, Smartphone, embedded system, etc.),	**5**	**3**
Unit -2 **Introduction to Python Programming (14)**	2a	Basics of Python programming (with a simple 'hello world' program, process of writing a program, running it, and print statement), Concept of class and object, Data-types (integer, float, string), Notion of a variable, Operators (assignment, logical, arithmetic etc.), accepting input from console, conditional statements (If else and Nested If else), Collections (List, Tuple, Sets and Dictionary), Loops (For Loop, While Loop & Nested Loops), Iterator, String and fundamental string operations (compare, concatenation, sub-string etc.), Function, Recursion.	10	5
	2B	Overview of linear and non-linear data structure (definition, schematic view and difference), array (1D, 2D and its relation with matrix, basic operations: access elements using index, insert, delete, search), stack-concept of LIFO, basic stack operations and their implementations using basic python code (use user-defined functions for stack operations), queue-concept of FIFO, basic queue operations and their implementations using basic python code(use user-defined functions for queue operations), use of List methods in python for basic operations on array, stack and queue, overview of NumPy library and basic array operations (arrange(), shape(), ndim(), dtype() etc.), binary tree (definition and schematic view only) .	10	6
	2C	**Time complexity -** Big-oh and Big-omega notation only**,** Linear search and binary search algorithm, sorting algorithm (bubble sort only)	4	3
Unit- 3 Introduction to Linear Algebra and Vector Algebra	3	Basic matrix operations like matrix addition, subtraction, multiplication, transpose of matrix, identity matrix. Distance function, Euclidean norm, distance between two points in 2D and 3D and extension of idea to *n* dimensions. A brief introduction to vectors, unit vector, normal vector, Euclidean space, real n-dimensional space, dot product of vectors	8	5

NB : Additional 10 hours for Remedial and/or Tutorial classes

CLASS – XI : SEMESTER – II

SUBJECT: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (AIDS)-THEORY

FULL MARKS: 35 **CONTACT HOURS: 60 Hours**

UNIT NO.	SUB UNIT	TOPICS	CONTACT HOURS	MARKS
Unit -4 Statistics and Probability (6)	**4**	Basic statistics - measures of dispersion, range, quartile deviation, mean deviation-for simple series and for frequency distribution, standard deviation- for simple series and for frequency distribution, variance, Standard deviation of composite group, median and mode, Pearson Correlation Coefficient, distance functions- Euclidean distance. Probability theory- random experiment, event, mutually exclusive event, impossible and certain event, complementary event, equally likely events, sample space- discrete and continuous, mathematical definition of probability, probability distribution, combining events- Event complement and union, Joint probabilities and the law of total probability, Conditional probabilities, Conditional and joint probability tables, independence, and Bayes' Rule. Random variables and discrete distributions- The geometric distribution, The Bernoulli distribution, The binomial distribution, Continuous random variables- probability density functions, normal or Gaussian distribution	**12**	**6**
Unit -5 Introduction to AI & DS (6)	**5A**	Definitions of AI, Four main approaches to AI (Acting Humanly, Thinking Humanly, Acting Rationally, Thinking Rationally), History of AI, various real world applications of AI. Relation among AI, Machine Learning and Deep Learning.	**5**	**3**

	5B	Definition of data science. Difference between Data Science and Artificial Intelligence. Data Science life cycle. Difference between quantitative and qualitative data.	**5**	**3**
Unit -6 Intelligent Agent (5)	**6**	**Intelligent Agents**- definition of an agent, definition of intelligent agent, A block diagram depicting agent's interaction with the environment through sensors and actuators, agent terminology-Performance measure, Behavior/action of an agent, Percept, Percept sequence, Agent function (Illustrating these terms using vacuum cleaner agent example), examples of some AI agents (robots, software agent(softbot), Autonomous spacecraft, Internet book shopping agent, etc.), rational agent, autonomous agent, Agent's environment, Structure of an AI Agent(Architecture + Agent programs), types of agents (block diagram and short description only) - simple reflex agent, model based reflex agent(state based), goal based agent, utility based agent, learning agent.	**10**	**5**

Unit -7 Solving Problem by Searching (12)	**7**	**State Space Search** Why search is important to an intelligent agent, modeling the search as state space search for a goal-based agent, State space search-what is an state, atomic representation vs factored representation of states, Formal representation of state space, Formulating search problem as state space search, formulating 8-puzzle problem and tic-tac-toe as state space search problems. **Uninformed search** a) Breadth first search b) Depth first search **Informed search** a) Heuristic search strategy with tic tac toe example b) Greedy best-first search c) A* search - basic idea only**(without proof)** **Search in complex environments** a) Local beam search b) Hill climbing (*only basic idea with a small example*) c) Simulated Annealing (*No algorithm, Only basic idea*) d) Evolutionary algorithms and search(*basic idea with a small example*)- Purpose of evolutionary algorithms, an example of applying an evolutionary algorithm to a simple search problem and illustrating the terminology such as Initial Population, Fitness Function, Selection, Crossover, Mutation.	**18**	**12**

Unit -8 Knowledge Representation and Propositional Logic (8)		The main components of a Knowledge-based agent(basic idea only, no technical details): Knowledge base, Steps performed by a Knowledge-based agent to take an action, Difference between problem solving agent and Knowledge-based agent. knowledge presentation language- Logic-based Representation. **Propositional logic** propositional logic, logic as expressions, truth table, conjunction, disjunction, syllogism, tautology, De Morgan's theorem. Use of logic to derive conclusions with practical examples, Statements as logical propositions, Atomic and compound propositions, Negation, conjunction and disjunction as NOT, AND and OR, Implication and Biconditional statements, Truth table as a way of proving propositions, Commutativity and Associativity and Distributive rules, De Morgan's theorem, Practical examples to infer meanings from statements. Basic concept of Inference (With Simple examples), Answer Extraction system (With Simple examples)	**10**	**6**

NB : Additional 10 hours for Remedial and/or Tutorial classes

CLASS: XI

SUBJECT: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE(AIDS)-PRACTICAL

FULL MARKS: 30 **CONTACT HOURS: 60 HOURS**

SL NO	TOPICS	CONTACT HOURS	MARKS
1. Computer Fundamentals [No marks]			
1	Visit to Computer Lab and familiarization with computers and peripherals and different networking devices (e.g., modem, switch, router). Opening of the CPU box/cabinet and identification of different parts (e.g., Motherboard, CPU/Processor, RAM, Hard Disk, power supply).	6	0
2. Introduction to Python Programming [20 Marks]			

2a	Introduction to installation and running of python codes with hello world and simple accessing user inputs from console examples. Menu driven arithmetic calculator Simple logical and mathematical programs (e.g., printing patterns, Conversion of binary to decimal and vice versa, Computing GCD of two numbers, Finding prime numbers, Generating Fibonacci sequence, Computing factorial –iterative and recursive etc.) Finding max, min, avg, sum, length of a list. Use of basic string methods like upper(), lower(), count(), find(), join(), replace(), split() etc. Calculating Euclidean distance between two vectors using a python program without using any library. Consider a table of data about *n* persons with two attributes-age and income and find Pearson correlation coefficient using a python program. Do not use any ready -to-use library function that directly accepts the data table and produces the output.	16	8
2b	Use of Python List methods for Stack and Queue implementation, for examples, append() and pop() Use of NumPy array methods: arrange(), shape(), ndim(), size(), add(), subtract(), multiply(), divide(), mat() etc. Use of NumPy matrix multiplication methods: dot(), matmul(), multiply() etc.	6	7
2c	Linear search and binary search in an array Bubble sort in an array	4	5
3. Foundation for AI [3 Marks]			

3	Generation of random numbers in python following a Gaussian distribution and filling up random arrays Introduction to matplotlib to plot arrays as histograms Computation of mean, median and mode(for simple series and for frequency distribution) Plotting Gaussian distribution with a given mean and standard deviation	10	5
4. Solving Problem by Searching (basic principles and example based understanding) [12 Marks]			
4	Implementing 8-puzzle problem using DFS and BFS Use of class to denote state of a problem, example board state of tic tac toe Expansion of possible states from a given state with all possible moves Score function of each state and selection of highest score or least cost at each level, i.e. making game tree Implement Simulated Annealing using Python	18	5

NB : Additional 10 hours for Remedial and/or Tutorial classes

CLASS – XII : SEMESTER – III

SUBJECT: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (AIDS)-THEORY

FULL MARKS: 35 **CONTACT HOURS: 60 Hours**

UNIT NO.	SUB UNIT	TOPICS	CONTACT HOURS	MARKS
Unit -1 First order predicate logic (4)	**1**	Predicate, Quantifier, Universal Quantifier and Existential quantifier with simple examples, Simple concept of Unification (without details of MGU), Well-formed formula, translating English sentences to predicate logic(with simple examples), conversion to clause form (With Simple examples), Basic concept of Inference (With Simple examples), resolution in first order logic (With Simple examples)	8	4
Unit -2 Uncertainty Management (2)	2	Handling Uncertain Knowledge , Uncertainty and Rational decision, Probabilistic Reasoning, Bayes Rule, Conditional probability , Probabilistic inference using Bayes rule	4	2
Unit -3 Data Visualization (10)	3	Need for data visualization. Key Data Visualization Techniques (with suitable examples): Line plots, Bar plots, Histograms, Box plots, Scatter plots, Bubble plot, Treemaps, Heatmaps, Word clouds, Geospatial maps. Visualizing two-dimensional data with pair-wise scatter plots. Key Techniques in 3D Data Visualization: 3D Scatter Plots, 3D Surface Plots, contour plots. A brief introduction to data visualization platforms -Tableu and Google Chart	**16**	**10**

Unit-4 Introduction to Machine Learning (5)	5A	Definition of machine learning, Difference between traditional programming and Machine Learning, Applications of machine learning Types of Machine Learning (Supervised, Unsupervised, Semi-supervised and reinforcement learning), Linear Regression with one variable(feature), Hypothesis representation, Concept of hypothesis space, Concept of training examples, Concept of cost/loss function , Squared Error cost function, Normal method for finding the values of the parameters for the Linear Regression model with one variable , Gradient descent algorithm for minimizing Squared Error cost function to find the values of the parameters for the Linear Regression model with one variable, Effect of learning rate, Importance of feature scaling (min-max normalization. Define feature or attribute with Some examples, Types of features(continuous, categorical), Representation of training examples with multiple features, Regression with multiple variables (features) and its hypothesis representation, Formula for finding the values of the parameters for the Linear Regression model with multiple features (Mention formula only, no mathematical derivation for multivariate regression), Polynomial Regression(basic concept only).	10	5

Unit -5 Supervised Learning (14)	5A	Difference between regression and classification, Examples of some real world classification problems, Linear classification and threshold classifier, Concept of mis classification error, accuracy. Concept of input space and linear separator, Drawback of threshold classifier, Logistic regression model (without derivation), Use of logistic function in defining hypothesis function for logistic regression model, Probabilistic interpretation of the logistic regression model's output, Use of logistic regression model in binary classification task, Multi-class classification using One *vs.* all strategy.	14	10
	5B	Measuring performance of machine learning algorithms: confusion matrix, true positive, true negative, false positive, false negative, error, accuracy, precision, recall, F-measure, sensitivity and specificity, K-fold cross validation	8	4

NB : Additional 10 hours for Remedial and/or Tutorial classes

CLASS – XII : SEMESTER – IY

SUBJECT: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (AIDS)-THEORY

FULL MARKS: 35 **CONTACT HOURS: 60 Hours**

UNIT NO.	SUB UNIT	TOPICS	CONTACT HOURS	MARKS
Unit -6 Supervised Learning (10)	**6**	**Probabilistic classifier:** Basics of Bayesian Learning, Conditional independence, Naive Bayes classifier. Applications of Naive Bayes Classifier to sentiment classification task, add-one smoothing. **Instance based learning or lazy learning:** K-nearest neighbor classifier, curse of dimensionality	**20**	**10**
Unit -7 Unsupervised Learning (5)	**7**	What is unsupervised learning? Difference between supervised and unsupervised learning, What is clustering? Difference between clustering and classification, Why do we use clustering in an unsupervised learning technique? , Some examples of real world application of clustering, K-means clustering algorithm and its drawback. Simple use cases	**12**	**5**

Unit -8 Artificial Neural Network (17)	**8**	Biological motivation for Artificial Neural Networks(ANN), A simple mathematical model of a neuron (McCulloch and Pitts(1943)), Concept of activation function: threshold function and Sigmoid function, Perceptron as a linear classifier, perceptron training rule, Implementation of basic Boolean functions of two inputs using threshold perceptron, Equation of a linear separator in the input space, Representational power of perceptrons, Training unthresholded perceptron using Delta rule(with derivation) , What is the need for hidden layers ? - XOR example. Why do we need non-linearity in ANN?, Network structures: feed forward networks and recurrent networks **(basic concept only).** Training multiplayer feed-forward neural networks using Back propagation algorithm **(Concepts only and no derivation),** Generalization, overfitting, and stopping criterion, overcoming the overfitting problem using a set of validation data. An Illustrative example of an ANN architecture for handwritten digit recognition **(Only input representation, output representation and a block diagram of the network),** Need for automatic feature learning, difference between the conventional feed-forward neural networks and CNN, role of convolution layer and fully connected layer in CNN, function of pooling layer in CNN. An example of 2D convolution, a block diagram illustrating CNN applied to handwritten digit recognition task	**26**	**17**

Unit -9 Ethics in Large Language Models (LLM)	**9**	Brief introduction to ethics in Large Language Models(LLM), for example, GPT, ChatGPT.	**2**	**3**

NB : Additional 10 hours for Remedial and/or Tutorial classes

CLASS: XII

SUBJECT: ARTIFICIAL INTELLIGENCE AND DATA SCIENCE (AIDS)-PRACTICAL

FULL MARKS: 30 **CONTACT HOURS: 60 HOURS**

SL NO	TOPICS	CONTACT HOURS	MARKS
1. Data Visualization Techniques [Marks 5]			
1	Introduction to plotly library in python and plotting different types of plot using the library refer this *(https://plotly.com/python/plotly-express/)* 1D Histogram of four attributes of the IRIS dataset, 2D Histogram(considering the IRIS dataset, plot 2D histogram of petal length and width), Box Plots (Considering the IRIS dataset, show the Box plots of attributes for IRIS attributes and species) , Plot the Pie chart, showing the distribution of IRIS flowers (use IRIS dataset), Scatter Plots for each pair of attributes of the IRIS dataset, Heatmap, Word clouds, Geospatial maps.	8	5
2. Introduction to Machine Learning [6 Marks]			

2a	Introduction to python libraries like scipy and statsmodel to various basic codes Revisit matrix operations using scipy (basic matrix operations of addition, subtraction, multiplication, transpose), Using Scipy for advanced matrix operations - inverse. Write a python program to find the values of the parameters for the regression model with multiple features (using only formula for normal method).	6	3
2b	Generation of random (x, y) pairs where y = f(x) + d (d varies from -r to +r , a random value), f being a linear function, Linear regression or line fitting of the data, Optimizing the function using gradient descent, Plotting the steps using matplotlib	6	3
3. Supervised Learning [10 Marks]			
3a	● Building linear regression-based threshold classifier and testing the model on Diabetes Data set downloadable from UCI Machine Learning Repository ● Building Logistic regression model for binary classification of Diabetes Data. Vary learning rate and verify the impact of learning rate on classification performance. ● Introduction to the IRIS dataset, building a logistic regression for multi-class classification and testing the model on the IRIS dataset downloadable from UCI Machine Learning Repository ● Building K-nearest neighbor classifier and testing on the IRIS dataset downloadable from UCI Machine Learning Repository (Use Scikit-learn open source data analysis library for implementing the models)	18	7
3b	Building a naive Bayes classifier for sentiment analysis (Use Scikit-learn open source data analysis library)	6	3

4. Unsupervised Learning [3 Marks]			
4a	Using Scikit-learn library to use the K-means algorithm for clustering IRIS data and its visualization	6	3
5. Artificial Neural Network [6 marks]			
5a	● Using MLP from Scikit learn library, develop a handwritten digit recognition model using MLP and MNIST dataset ● Using CNN from keras library, develop a handwritten digit recognition model using CNN and MNIST dataset ● Compare the performance of the MLP based model and the CNN based model for the handwritten digit recognition task	10	6

NB : Additional 10 hours for Remedial and/or Tutorial classes

SUBJECT: ARTIFICIAL INTELLIGENCE and DATA SCIENCE (AIDS)

Class XI TOTAL Theory MARKS: 70

- **Class XI SEMESTER 1 TOPICS: [MCQ] MARKS: 35 [1 MARK PER QUESTION]**

Unit	Topic	Marks allotted
1	Computer Fundamentals	16X1=16
2	Introduction to Python Programming	14X1=14
3	Introduction to Linear Algebra & Vector Algebra	5X1=5

- **Class XI SEMESTER 2 TOPICS: [Short Answer Questions , Descriptive Questions] MARKS: 35**

Unit	SHORT ANSWER TYPE QUESTIONS (2 marks)	DESCRIPTIVE TYPE QUESTIONS (3/4/5 marks)	TOTAL
4 : Statistics & Probability		2X3=6	6
5: Introduction to AI and DS	3X2=6		6
6: Intelligent Agents	1x2=2	1X3=3	05
7: Solving Problem by Searching	1X2=2	5x2=10	12
8. Knowledge Representation and Propositional Logic		3x2=6	6
TOTAL	10	25	35

Class XII TOTAL Theory MARKS: 70

- **Class XII SEMESTER 1 TOPICS: [MCQ] MARKS: 35 [1 MARK PER QUESTION]**

Unit	Topic	Marks allotted
1	First order predicate logic	4X1=4
2	Uncertainty Management	2X1=2
3	Data Visualization	10X1=10
4	Introduction to Machine Learning	5x1=5
5	Supervised learning	14x1=14

- **Class XII SEMESTER 2 TOPICS: [Short Answer Questions , Descriptive Questions] MARKS: 35**

Unit	SHORT ANSWER TYPE QUESTIONS (2 marks)	DESCRIPTIVE TYPE QUESTIONS (3/4/5 marks)	TOTAL
6. Supervised Learning	1X2=2	1x5=5 1x3=3	10
7. Unsupervised Learning	1x2=2	1x3=3	5
8. Artificial Neural Network	3X2=6	1X5=5 2x3=6	17
9. Ethics in AI	-	1X3=3	03
TOTAL	10	25	35

WEST BENGAL COUNCIL OF HIGHER SECONDARY EDUCATION
SYLLABUS FOR CLASS XI AND XII
SUBJECT: BUSINESS MATHEMATICS AND BASIC STATISTICS (BMBS)

Course Objectives

The Mathematics curriculum for commerce students has been designed in response to the field's expansion and the changing demands of society. In order to address the evolving demands of specific discipline, the current syllabus has been created. More focus has been placed on the application of certain principles, drawing inspiration for the issues from real-world scenarios and other academic disciplines.

The following are the main goals of teaching mathematics to senior school students opting for commerce:

- To develop general interest in Mathematics as a discipline
- To gain a good measure of insight and knowledge to application oriented problems (daily life problems)
- To experience the fashion of demonstrating an outcome or resolving an issue
- To use the gained information to solve practical life oriented mathematical and statistical problems
- To be able to solve practical problems by forming and solving mathematical and statistical structures associated therewith
- To develop the power of solving problems logically step by step
- To develop a sense of appreciation and respect for notable mathematicians and their contributions to mathematics
- To cultivate an optimistic outlook in order to evaluate and perform coherently

Course Outcomes

At the end of the course, the students are expected to develop the power of critical thinking to solve various problems.
The following are the major course outcomes. A student is expected:

- To be able to develop problem solving skills and apply mathematical concepts to real life situations
- To be able to develop a mindset to collaborate with peers to solve mathematical problems
- To be able to understand the graphical representation of curves and to be able to make predictions and draw conclusions based on statistical data
- To be able to communicate mathematical ideas and solutions both verbally and in written form
- To be able to present mathematical arguments and justifications
- To be able to perform up to (at least) satisfactory level in formal evaluation
- To be able to understand the relevance of mathematics in real-world applications
- To be able to compete in the several Entrance Examinations successfully

CLASS - XI

SEMESTER – I

SUBJECT: BUSINESS MATHEMATICS AND BASIC STATISTICS (BMBS)

FULL MARKS: 40 **CONTACT HOURS: 100 Hours**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	ALGEBRA	45	18
	1. Theory of Quadratic Equations: General form of quadratic equation $p(x) = 0$ [where $p(x) = ax^2+bx + c, (a \neq 0)$ is a polynomial in x of degree 2; $a, b, c \in \mathbb{R}$.]; Zeros of a polynomial $p(x)$, also known as the roots of the polynomial equation $p(x) = 0$; To find the solutions/roots of quadratic equations with rational coefficients by factorization, the method of perfect squares and by Sridharacharya's method(statement only), For a given real number, to check whether that is a root of a given quadratic equation? Cardinality of the set of real solutions for a of quadratic equation	20	8
	2. Compound Interest: Compound interest compounding yearly, half yearly, quarterly, monthly (for a span of 3 years, at the most)	12	5
	3. Taxes Sales tax, Value Added Tax (VAT), Goods and Services Tax (GST, including SGST and CGST), Comparison among them	13	5

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-II	**Statistics**	**25**	**10**
	1. Evaluation of Arithmetic mean (discrete data) **2. Evaluation of Arithmetic mean (grouped data)** **3. Evaluation of mode for discrete data** **4. Evaluation of median for discrete data** **5. Evaluation of mean of y from that of x, where $y = ax + b$, $where\ a, b\ are\ real\ constants$**	**5** **5** **5** **5** **5**	**2** **2** **2** **2** **2**
UNIT-III	**Theory of Sets**	**15**	**6**
	Definition of set, Representation of sets: Roster form; Set-builder form, Some types of sets: empty set, singleton sets, universal set, finite sets. Cartesian product of two finite sets (idea of ordered pair). Cardinality of finite sets and cardinality of Cartesian product of two finite sets **Set relation: Subset, Superset (Example: $\mathbb{N} \subseteq \mathbb{W}$), Proper subset (Example: $\mathbb{N} \subset \mathbb{W}$), Special Thinking: A$\subset B \Rightarrow$A$\subseteq B$ but converse is not necessarily true (example only),**	**15**	**6**
UNIT-IV	**Trigonometry**	**15**	**6**
	1. Trigonometric ratios; Trigonometric ratios of $0^o, 30^o, 45^o, 60^o, 90^o$; Trigonometric identities ($sin^2x + cos^2x = 1$) and other identities from trigonometric ratios; Complementary angles and supplementary angles and the values of $\sin x, \cos x, \tan x$ for $x = 120^o, 135^o, 150^o, 180^o$	**15**	**6**

SEMESTER – II

SUBJECT: BUSINESS MATHEMATICS AND BASIC STATISTICS (BMBS)

FULL MARKS: 40 **CONTACT HOURS: 80 HOURS**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	ALGEBRA	24	12
	1. Arithmetic Progression and Geometric Progression: Idea through examples, idea of first term and common difference (for arithmetic progression) and common ratio (for geometric progression), formula for general term for above mentioned types of progressions and related problems such as – to find the value of a term or finding the position of a term for a particular value assigned to that particular term, Some Important Series, Formulae for sum of the first *n* terms of Arithmetic Progression and Geometric Progression and related problems, Verification of the following formulae for a given positive integer: $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$, $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$, $\sum_{i=1}^{n} i^3 = (\frac{n(n+1)}{2})^2$	12	6
	2. Permutations and Combinations Factorial of any natural number, $0! = 1$ (axiom), $n_{P_r} = \frac{n!}{(n-r)!}$ ($0 \le r \le n$)($r, n \in \mathbb{W}$); $n_{C_r} = \frac{n!}{r!(n-r)!}$ ($0 \le r \le n$) ($r, n \in \mathbb{W}$), Meaning of n_{P_r} and n_{C_r} ,Evaluation of n_{P_r} and n_{C_r} ,simple problems related on these for $n \le 8$	12	6

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-II	**Theory of Sets**	**20**	**10**
	Important Theorem (statement only): Null set is considered as a subset of any set. Power set of a finite set and its cardinality (verification with sets with cardinality ≤ 4), **Set operations: Union, Intersection, Difference, Symmetric Difference, and Complement of a set in the universal set. Knowledge of disjoint sets. Venn Diagram,** **Some Important Properties/Axioms (excluding proofs): Commutative property for Union and Intersection of sets, Distributive property of Union over Intersection and Intersection over Union for sets. Verification of the above with Venn diagram and for finite sets (with cardinality ≤ 6),** **De Morgan's Laws (excluding proof) and verification with sets (with cardinality ≤ 6),** **Inclusion and Exclusion theorem of set theory (Cardinality theorem) for two sets and three sets; Simple problems including word problems using this theorem; Cartesian product of two sets, Ordered pair; Cardinality of Cartesian product of two finite sets** **Functions: Pictorial representation of a function, understanding the function as a set of ordered pair, understand the domain, co-domain and range of a function guided by the diagram, Concept of one-to-one function and many-to-one function, surjectivity and bijectivity of functions through pictorial presentations**	**20**	**10**
UNIT-III	**Limits and Derivatives**	**24**	**12**
	1. Limits: **Concept of limits (questions should not be set on this),** **Formal representation of a limit of a function like $\lim_{x\to a} f(x)$, limit over addition, subtraction, product and division of two functions. Basic difference between Right hand limit and Left hand limit,**	**24**	**12**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	Limit formulae: $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$ and $\lim_{x\to 0}\frac{(1+x)^n-1}{x}=n$, $n\in\mathbb{Q}(the\ set\ of\ rational\ numbers)$ (different representation of the same formula), $\lim_{x\to 0}\frac{e^x-1}{x}=1$, $\lim_{x\to 0}\frac{\log_e(1+x)}{x}=1$; Simple problems using these formulae, Derivative as a rate of measure (First principle to calculate derivative is excluded); Differentiation formulae: $\frac{dc}{dx}=0, c\ is\ a\ constant$ $\frac{dx^n}{dx}=nx^{n-1}, n\in Q, \frac{de^x}{dx}=e^x, \frac{d\log_e x}{dx}=\frac{1}{x}, \frac{da^x}{dx}=a^x\log_e a\ (a>0)$; Chain rule; Simple problems using these formulae Application of derivatives: Maxima and Minima: Cost functions, demand functions, marginal cost etc.		
UNIT-IV	Theory of Probability	12	6
	Important terminology: random experiment, sample space, events, simple event, compound event, mutually exclusive events, collectively exhaustive events, equally likely events (regarding the number of sample points), classical definition of probability and related problems	12	6

[Note: 20 Hours reserved for Remedial classes, Tutorials and Home Assignments.]

Course: Project for Class XI

Full Marks: 20

Projects should be conducted regularly throughout the year. A project notebook is to be prepared by each and every student where all the below mentioned activities should be recorded. There should be a project assessment once a year (once in Class XI and once in Class XII) where the student will be asked to do one of the activities and write it in his/her script provided for the purpose. The student should carry his/her project notebook during the assessment. A viva should also be conducted during the assessment to test the knowledge of the student regarding the project activity.

List of Projects for Class XI

Sl. No.	Topics	Activities
1	Sequence and Series	To illustrate that the arithmetic mean of two different positive numbers is always greater than the geometric mean (by proper diagram and by proper calculation)
2	Theory of Sets	To show that the total number of subsets of a given set with *'n'* number of elements is 2^n (by inductive method of learning and by using the notion of combination)
3	Theorem of Inclusion and Exclusion	Verification through Venn Diagram
4	Limits and Derivatives-I	Evaluating $\lim_{x\to c}\frac{x^2-c^2}{x-c}$, $\lim_{x\to c}\frac{x^3-c^3}{x-c}$,$\lim_{x\to c}\frac{x^4-c^4}{x-c}$, and inductive learning of the generalized formula $\lim_{x\to c}\frac{x^n-c^n}{x-c}$ for positive integer *n*
5	Limits and Derivatives-II	Evaluating $\lim_{x\to c}\frac{x^2-c^2}{x-c}$, $\lim_{x\to c}\frac{x^3-c^3}{x-c}$,$\lim_{x\to c}\frac{x^4-c^4}{x-c}$, and inductive learning of the generalized formula $\lim_{x\to c}\frac{x^n-c^n}{x-c}$ and inductive learning the general formula for negative integer *n*
6	Permutations and Combinations	To find out the number of permutations and combinations from a set of 3 different objects taking 2 at a time. 1. Using formulae and 2. Verify the results thus obtained by real activities
7	Theory of probability	To write the sample space, when a coin is tossed three times. Finding out the probability of the events " zero head";"one head"; "two heads" and "three heads" and two find the sum of probabilities of these events and verify that the sum is 1

Marks Division for the Project Assessment

Sl. No.	Item	Marks
1	Project Notebook	10
2	Doing and writing a project during the project assessment	5
3	Viva	5
	Total	**20**

CLASS - XII

SEMESTER – III

SUBJECT: BUSINESS MATHEMATICS AND BASIC STATISTICS (BMBS)

FULL MARKS: 40 **CONTACT HOURS: 100 Hours**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	Algebra	35	14
	1. Banking (special emphasis on Fixed deposit and Recurring deposit calculation) 2. Shares and Dividends 3. Laws of Indices 4. Logarithm	10 7 8 10	4 3 3 4
UNIT-II	Geometry	15	6
	Geometry of two dimensions: Cartesian co-ordinate system. Formula for distance between two points, Section formula, Formula for finding co-ordinates of centroid of a triangle with given vertices	15	6
UNIT-III	Statistics	40	16
	1. Graphical representation of statistical data: Line graph, Bar diagram (including multiple bars), Pie diagram, Histogram, Frequency Polygon, Ogives, Comparison of statistical data from graphical presentation 2. Measurement of dispersion (for discrete set of data and continuous set of data): Mean deviation about arithmetic mean and median, Variance, Standard Deviation, Coefficient	15 15	6 6

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	of Variance 3. Index Numbers Price Index Numbers: Simple Aggregate Method ($\frac{\sum p_n}{\sum p_0} \times 100$), Weighted Aggregate Method ($\frac{\sum p_n w}{\sum p_0 w} \times 100$), Cost of Living Index ($\frac{\sum IW}{\sum W}$)	10	4
UNIT-IV	Logical Reasoning	10	4
	1. Number series coding and decoding and odd man out 2. Direction Tests 3. Seating Arrangements 4. Blood relations	3 2 2 3	1 1 1 1

SEMESTER – IV

SUBJECT: BUSINESS MATHEMATICS AND BASIC STATISTICS (BMBS)

FULL MARKS: 40 **CONTACT HOURS: 80 HOURS**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	Algebra	24	12
	1. Theory of Matrices (order up to 2×2) Idea of rows and columns of a matrix, idea of equal matrices, null matrix, square matrix, diagonal matrix, scalar matrix, identity matrix, Algebra of matrices: addition, subtraction, multiplication by a scalar and multiplication of two matrices	6	3
	2. Determinants: Determinant of a square matrix of order 2×2, solving linear equations in two variables using Cramer's rule (number of independent equations=number of variables)	8	4
	3. Different types of financial loans: EMI calculation for different situations arises in real life	6	3
	4. Calculation of billing discount and average billing date	4	2
UNIT-II	CALCULUS	28	14
	1. Integration Integration as an operation just opposite to the operation differentiation Simple problems using formulae: $\int x^n\,dx = \frac{x^{n+1}}{n+1} + C\ (n \neq -1), \int \frac{1}{x}dx = \ln\lvert x\rvert + C,$	16	8

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	$\int e^x\,dx = e^x + C$, $\int \frac{1}{x^2-a^2}\,dx\ (x > a) = \frac{1}{2a}\ln\left\lvert\frac{x-a}{x+a}\right\rvert + C$, $\int \frac{1}{a^2-x^2}\,dx = \frac{1}{2a}\ln\left\lvert\frac{x+a}{x-a}\right\rvert + C\ (a > x)$, **integration by parts (both the functions must be polynomial or algebraic in nature), statement of fundamental theorem of integral calculus, definite integration – simple problems only,** **2. Differential Equations** **Definition of differential equations, order and degree of differential equations, formation of a differential equation for simple cases, solving differential equations on simple problems based on algebraic functions using variable separation technique**	**12**	**6**
UNIT-III	**Statistics**	**14**	**7**
	Statistics **Idea of bivariate data: calculation of covariance and correlation coefficient; Geometric point of view of Pearson correlation coefficient and Rank correlation coefficient. Regression coefficient b_{xy} and b_{yx} , finding regression lines x on y, and y on x; the point $(\overline{x}, \overline{y})$ as the point of intersection of these two regression lines**	**14**	**7**
UNIT-IV	**LINEAR PROGRAMMING**	**14**	**7**
	1. Linear Inequalities **Basic idea and locate the region represented by the linear in-equation with respect to the graph of the corresponding equation (hand drawn graph on plain paper)** **2. Simple examples of Linear Programming Problems, Idea of**	**4** **10**	**2** **5**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	Objective function, constraints, feasible solution, convex set of solutions, corner points of solution set(region) **Solving linear programming problem by graphical method (two variable cases, feasible solution cases with non-negativity restriction)**		

[Note:20 Hours reserved for Remedial classes, Tutorials and Home Assignments.]

Course: Project for Class XII

Full Marks: 20

Projects should be conducted regularly throughout the year. A project notebook is to be prepared by each and every student where all the below mentioned activities should be recorded. There should be a project assessment once a year (once in Class XI and once in Class XII) where the student will be asked to do one of the activities and write it in his/her script provided for the purpose. The student should carry his/her project notebook during the assessment. A viva should also be conducted during the assessment to test the knowledge of the student regarding the project activity.

List of Projects for Class XII

Sl. No.	Topics	Activities
1.	Theory of matrices	Emergence of the fact that 'scalar algebra' is different from 'matrix algebra' with the help of posing two matrices A and B such that AB≠BA and posing two non-null matrices X and Y such that XY is a null matrix.
2.	Determinants	Verification of Cramer's rule by posing two independent linear equations containing two variables and by solving them by elimination method beside by Cramer's rule method.
3.	Integration	Evaluation of $\int \frac{dx}{x^2-5x+6}$ by factorising the denominator of the integrand and by using the standard integral-result and comparison between the two answers thus obtained.
4.	Linear programming problem	To form an L.P.P. from a given situation and to find the solution graphically (by corner point method)
5.	Statistics	For a given set of statistical data, draw different types of graphs to represent the data.

Marks division for the Project Assessment

Sl. No.	Item	Marks
1.	Project Notebook	10
2.	Doing and Writing a project during the project assessment	05
3.	Viva	05
	Total	**20**

WEST BENGAL COUNCIL OF HIGHER SECONDARY EDUCATION
SYLLABUS FOR CLASS XI AND XII
SUBJECT: BASIC MATHEMATICS FOR SOCIAL SCIENCES (BMSS)

Course Objectives

The curriculum for 'Basic Mathematics for Social Sciences (BMSS) has been designed in response to the changing demands of society. In order to address the evolving demands of specific disciplines, the current syllabus has been created. More focus has been placed on the application of certain principles, drawing inspiration for the issues from real-world scenarios and other academic disciplines.

The following are the main goals of teaching mathematics to senior school students opting for Social Science, Philosophy, and Education etc:

- To develop general interest in Mathematics as a discipline
- To gain a good measure of insight and knowledge to application oriented problems (daily life problems)
- To experience the fashion of demonstrating an outcome or resolving an issue
- To use the gained information to solve practical life oriented mathematical and statistical problems
- To be able to solve practical problems by forming and solving mathematical and statistical structures associated therewith
- To develop the power of solving problems logically step by step
- To develop a sense of appreciation and respect for notable mathematicians and their contributions to mathematics
- To cultivate an optimistic outlook in order to evaluate and perform coherently

Course Outcomes

At the end of the course the students are expected to develop expertise in various areas of the subject especially in practical and gain critical insights into the background dynamics of the problem solving process.

The following are the major course outcomes. A student is expected to:

- To be able to develop problem solving skills and apply mathematical concepts to real life situations
- To be able to develop a mindset to collaborate with peers to solve mathematical problems
- To be able to understand the graphical representation of curves and to be able to make predictions and draw conclusions based on statistical data
- To be able to communicate mathematical ideas and solutions both verbally and in written form
- To be able to present mathematical arguments and justifications
- To be able to perform up to (at least) satisfactory level in formal evaluation
- To be able to understand the relevance of mathematics in real-world applications
- To be able to compete in the several Entrance Examinations successfully

CLASS - XI

SEMESTER – I

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 100 Hours**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	ALGEBRA	55	22
	1. Theory of Quadratic Equations: General form of quadratic equation $p(x) = 0$ [where $p(x) = ax^2+bx + c, (a \neq 0)$ is a polynomial in x of degree 2, $a, b, c \in R$.]; Zeros of a polynomial $p(x)$, also known as the roots of the polynomial equation $p(x) = 0$, To find the solutions/roots of quadratic equations with rational coefficients by middle-term factorization, the method of perfect squares and by Sridharacharya's method(statement only), Discriminant, Nature of roots [The case of discriminant less than 0 should be excluded], Relation between roots and coefficients [namely $\alpha + \beta = -\frac{b}{a}$, $\alpha\beta = \frac{c}{a}$ $(a \neq 0)$]; Some simple cases to find the values of $\frac{1}{\alpha}+\frac{1}{\beta}$, $\alpha^2 + \beta^2$, $\alpha^3 + \beta^3$ etc.	20	8
	2. Some Important Series: Inductive way of verification of the following formulae: $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$, $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$, $\sum_{i=1}^{n} i^3 = (\frac{n(n+1)}{2})^2$ [Principle of Mathematical Induction is not necessary], Applications of these formulae for some given positive integer	15	6
	3. Laws of Indices	10	4
	4. Logarithm	10	4
UNIT-II	Trigonometry	15	6
	1. Trigonometric ratios; Trigonometric ratios of $0^o, 30^o, 45^o, 60^o, 90^o$; Trigonometric identities like $sin^2x + cos^2x = 1$ and other identities from trigonometric ratios; Complementary angles and supplementary angles and the values of $\sin x, \cos x, \tan x$	15	6

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	for $x = 120^o, 135^o, 150^o, 180^o$etc.		
UNIT-III	Logical Reasoning	15	6
	1. Number series coding and decoding and odd man out 2. Direction Tests 3. Seating Arrangements 4. Blood relations	15	6
UNIT-IV	Theory of Sets	15	6
	Definition of set, Representation of sets: Roster form, Set-builder form, Some types of sets: empty set, singleton sets, universal set, finite sets, infinite sets[for infinite sets examples only, such as $\mathbb{N}$ (set of natural numbers), $\mathbb{W}$ (set of whole numbers), $\mathbb{Z}$ (set of integers), $\mathbb{Q}$ (set of rational numbers), $\mathbb{R}$ (set of real numbers)], Cardinality of finite sets; Set relation: Subset, Superset (Example:$\mathbb{N} \subseteq \mathbb{W}$), Proper subset (Example: $\mathbb{N} \subset \mathbb{W}$), Special Thinking: A$\subset B \Rightarrow$A$\subseteq B$ but converse is not necessarily true (examples only);	15	6

SEMESTER – II

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 80 HOURS**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	ALGEBRA	20	10
	1. Permutations and Combinations: Factorial of any natural number, $0! = 1(axiom)$; $n_{P_r} = \frac{n!}{(n-r)!}$ $(0 \leq r \leq n;\ r, n \in \mathbb{W})$; Very simple problems for linear permutation (circular permutation should be excluded). $n_{C_r} = \frac{n!}{r!(n-r)!}$ $(0 \leq r \leq n;\ r, n \in \mathbb{W})$, $n_{C_r} = n_{C_{n-r}}, n_{C_{r-1}} + n_{C_r} = n+1_{C_r}$ (approach by Including or excluding particular item): use of these formulae for solving simple problems [Inductive method of learning the formulae is to be encouraged. Principle of Mathematical Induction is not necessary] Problems with repetitions; Restricted permutations (simple problems only); Restricted combinations (simple problems only); Problems on dice and cards 5. Binomial Theorem: Formula of general term; Statement of Binomial theorem for positive integral index (proof is not required); Idea of Pascal triangle; Term independent of one term in the expansion; Middle term(s) formulae in the expansion of $(x+a)^n$, where *n* is a positive integer	10 10	5 5
UNIT-II	COORDINATE GEOMETRY (2D)	20	10
	Idea of rectangular Cartesian coordinate system (Recapitulation only, no questions for examination); Inclination and slope/gradient of a straight line; Distance formula between two points in a plane; Section formula (mid- point coordinate calculation), co-ordinates of centroid	8	4

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	of a triangle slope: $m = \frac{y_2 - y_1}{x_2 - x_1}$, for a straight line passing through two distinct points $(x_1, y_1), (x_2, y_2)$, Equation to Straight line and its different forms: $ax + by + c = 0$, $y = mx + c$, Intercept form: $\frac{x}{a} + \frac{y}{b} = 1$ (not passing through origin), Slope-point form: $y - y_1 = m(x - x_1)$ and simple applications	12	6
UNIT-III	Theory of Sets	20	10
	Important Theorem (statement only): Null set is considered as a subset of any set; Power set of a finite set and its cardinality(verification with sets with cardinality ≤ 4); Set operations: Union, Intersection, Difference, Symmetric Difference, and Complement of a set in the universal set, Notion of disjoint sets; Venn Diagram; Some Important Properties (excluding proofs): Commutative property for Union and Intersection of sets, Distributive property of Union over Intersection and Intersection over Union for sets, Verification of the above with Venn diagram and for finite sets(with cardinality ≤ 6), De Morgan's Laws(excluding proof) and verification with sets (with cardinality ≤ 6) Inclusion and Exclusion theorem of set theory(Cardinality theorem) for two sets and three sets; Simple problems including word problems using this theorem; Cartesian product of two finite sets, Ordered pair; Cardinality of Cartesian product of two finite sets Relation: Definition, inverse relation, simple applications Introducing mapping or functions through diagrams, Acquaintance of Mapping as a particular relation and giving the algebraic form(where possible), Idea of injectivity and surjectivity through diagrams and relation, identification of domain, co-domain an range of a function	20	10
UNIT-IV	Limits and Derivatives	20	10
	Types of functions (polynomial functions, rational functions, exponential functions, logarithmic functions and functions like $f(x) =$	10	5

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	$\|x-a\|$, a is an arbitrary constant), graphs of these functions, Idea of limit; Difference between Right hand limit and Left hand limit. Limit formulae: $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}, n\in\mathbb{Q}$, $\lim_{x\to 0}\frac{e^x-1}{x}=1$, $\lim_{x\to 0}\frac{\log_e(1+x)}{x}=1$; Simple problems using these formulae. Representation of a limit of a function like $\lim_{x\to a} f(x)$, limit of addition, subtraction, product and division of two functions Derivative as a rate of change of measure (First principle to calculate derivative is excluded); Differentiation formulae: For an arbitrary constant, $\frac{dc}{dx}=0$ $\frac{dx^n}{dx}=nx^{n-1}, n\in\mathbb{Q}$, $\frac{de^x}{dx}=e^x$, $\frac{d\log_e x}{dx}=\frac{1}{x}$, $\frac{da^x}{dx}=a^x\log_e a\ (a>0)$; Chain rule; Simple problems using these formulae	10	5

[Note: 20 Hours reserved for Remedial classes, Tutorials and Home Assignments.]

Course: Project for Class XI

Full Marks: 20

Projects should be conducted regularly throughout the year. A project notebook is to be prepared by each and every student where all the below mentioned activities should be recorded. There should be a project assessment once a year (once in Class XI and once in Class XII) where the student will be asked to do one of the activities and write it in his/her script provided for the purpose. The student should carry his/her project notebook during the assessment. A viva should also be conducted during the assessment to test the knowledge of the student regarding the project activity.

List of Projects for Class XI

Sl. No.	Topics	Activities
1.	Theory of sets	Evaluation of H.C.F. and L.C.M. of two or three numbers using Venn diagrams
2.	Theory of quadratic equation	For the quadratic equation $ax^2 + bx + c = 0, a \neq 0$, to prove that sum of the roots is equal to $\frac{-b}{a}$ and product of the roots is equal to $\frac{c}{a}$ without using Sridharacharya's formula; Forming of three quadratic equations having roots (i) as integers for the first equation, (ii) as conjugate irrational numbers for the second equation, (iii) as proper fractions for the third equation, to verify the above mentioned formulae
3.	Combinations	Derivation of the formula $\boldsymbol{n_{C_{r-1}} + n_{C_r} = n + 1_{C_r}}$ and verification of this formula for at least three pairs positive integers
4.	Trigonometry	The key source of the trigonometric identities, namely $\boldsymbol{sin^2x + cos^2x = 1, tan^2x + 1 = sec^2x}$, $\boldsymbol{cot^2x + 1 = cosec^2x}$ as the Pythagoras theorem for right angled triangle
5.	Relations and Functions	To verify that for two sets A and B, $n(A \times B) = pq$ and the total number of relations from A and B is 2^{pq}, where $n(A) = p$ and $n(B) = q$
6.	Limits and Derivatives	Evaluating $\lim_{x\to c} \frac{x^2-c^2}{x-c}$, $\lim_{x\to c} \frac{x^3-c^3}{x-c}$, $\lim_{x\to c} \frac{x^4-c^4}{x-c}$, and inductive learning of the generalized formula $\lim_{x\to c} \frac{x^n-c^n}{x-c}$ for integer *n*

Marks division for the Project Assessment

Sl. No.	Item	Marks
1.	Project Notebook	10
2.	Doing and Writing a project during the project assessment	05
3.	Viva	05
	Total	**20**

CLASS - XII

SEMESTER – III

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 100 Hours**

COURSE CODE : THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	Algebra	30	12
	1. Arithmetic progressions and sequences: Idea through examples, formulae for general term, sum of the first n terms and related simple problems	12	5
	2. Geometric progression and sequences: Idea through examples, formulae for general term, sum of the first n terms and simple problems	12	5
	3. Concept of arithmetic mean and geometric mean of positive numbers, simple problems and simple applications on AM $\geq$ GM	6	2
UNIT- II	Mathematical Reasoning	10	4
	Statement, truth value, truth table, tautology, contradiction in mathematical reasoning OR ($P \vee Q$), AND ($P \wedge Q$), NOT ($\sim P$). IF THEN ($P \rightarrow Q$), IF AND ONLY IF ($P \leftrightarrow Q$) statements (where P and Q are two statements), and their truth tables and simple applications	10	4
UNIT-III	Statistics	20	8
	Measure of Central Tendency (Mean, Median, Mode for discrete data and grouped data); Arithmetic mean (A.M.)and geometric mean(G.M.) for two positive numbers; A.M.$\geq$G.M.(verification only)	20	8
UNIT-IV	Coordinate Geometry	40	16
	1. Two dimensional geometry: Circle: Different forms: $x^2 + y^2 = r^2$,	20	8

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	$(x-a)^2+(y-b)^2=r^2$, $x^2+y^2+2gx+2fy+c=0$, Determining Centre, Radius etc., Simple problems Parabola: Different forms: $y^2=4ax$,$x^2=4ay$, geometrical interpretations, Determining Focus, Directrix, Axis and Length of Latus Rectum of a Parabola; Simple problems **2. Three dimensional geometry:** Developing it as an extension of two dimensional geometry, idea of rectangular coordinate system(X-axis, Y-axis, Z-axis), distance formula between two points, section formula, simple applications, coordinates of the centroid of a triangle in space	20	8

SEMESTER – IV

SUBJECT: Basic Mathematics for Social Sciences (BMSS)

FULL MARKS: 40 **CONTACT HOURS: 80 HOURS**

COURSE CODE: THEORY

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-I	Algebra	24	12
	1. Matrix-I Theory of Matrices (order up to 3×3) Idea of rows and columns of a matrix, idea of equal matrices, null matrix, square matrix, diagonal matrix, scalar matrix, identity matrix, Transpose of a matrix Algebra of matrices: addition, subtraction, multiplication by a scalar and multiplication of matrices	6	3
	2. Determinants Solving system of linear equations in two or three variables using Cramer's rule (number of independent equations is same as number of variables), minors and cofactors of an element in a determinant	8	4
	3. Matrix-II Adjoint of a matrix, singular and non-singular matrices, Inverse of a non-singular matrix of order 2×2, Solution of system of two independent linear equations of two variables using matrix inversion method	6	3
	4. Linear inequalities Basic idea and location of region represented by a linear in-equation in one or two variable(s) with respect to the graph of the corresponding equation (hand drawn graph on plain paper)	4	2

UNIT No.	TOPICS	CONTACT HOURS	MARKS
UNIT-II	**CALCULUS**	**30**	**15**
	1. Continuity- by definition: $\lim_{x\to a^+} f(x) = \lim_{x\to a^-} f(x) = f(a)$. Differentiation (up to second order), simple problems, maxima and minima(local)- related to the problems involving marginal cost, demand function, cost function etc., basic idea of slope of a tangent to a curve at some point using derivative, simple problems	**8**	**4**
	1. Integration **Integration as an operation just opposite process of differentiation;** **Simple problems using formulae:** **$\int x^n\,dx = \frac{x^{n+1}}{n+1} + c(n \neq -1)$,** **$\int \frac{1}{x}dx = \log_e\lvert x\rvert + c$, $\int e^x\,dx = e^x + c$, integration by parts (excluding trigonometric functions), statement of fundamental theorem of integral calculus, definite integration – simple problems only**	**8**	**4**
	2. Application of integral calculus **Finding area bounded by the plane curves- straight lines, parabola**	**6**	**3**
	3. Differential Equations **Definition of differential equations, order and degree of a differential equation, formation of a differential equation for simple cases, solving differential equations on simple problems based on algebraic functions using variable separation technique, homogeneous differential equation, differential equation of the form like $\frac{dy}{dx} = f(ax + by + c)$**	**8**	**4**
UNIT-III	**Probability and statistics**	**16**	**8**
	1. Probability **Important terminology: random experiment, sample space,**	**8**	**4**

UNIT No.	TOPICS	CONTACT HOURS	MARKS
	events, simple event, compound event , mutually exclusive events, collectively exhaustive events, equally likely events (regarding the number of sample points), classical definition of probability and related problems Conditional probability- idea of independent events: Idea of probability distribution, Formation of distribution function from statistical approach – very simple cases only: Random variable and its probability distribution, mean and variance of a random variable for discrete case from given distribution 2. Statistics Idea of bivariate data: calculation of covariance and correlation coefficient; Geometric point of view of correlation coefficient	8	4
UNIT-IV	LINEAR PROGRAMMING	10	5
	Simple examples of Linear Programming Problems, Idea of convex set: Objective function, constraints, feasible solution, convex set of solutions, corner points of solution set(region): Maximization problem, minimization problem; Solving linear programming problem by graphical method (Two variable cases, feasible solution cases)	10	5

[Note:20 Hours reserved for Remedial classes, Tutorials and Home Assignments.]

Course: Project for Class XII

Full Marks: 20

Projects should be conducted regularly throughout the year. A project notebook is to be prepared by each and every student where all the below mentioned activities should be recorded. There should be a project assessment once a year (once in Class XI and once in Class XII) where the student will be asked to do one of the activities and write it in his/her script provided for the purpose. The student should carry his/her project notebook during the assessment. A viva should also be conducted during the assessment to test the knowledge of the student regarding the project activity.

List of Projects for Class XII

Sl. No.	Topics	Activities
1.	Arithmetic progression	By using the notion of arithmetic progression to establish (i) $1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$ (ii) Sum of the first *n* odd positive integers is a perfect square for any positive integer *n*
2.	Geometric Progression	Algebraic derivation of A.M. is greater than equal to G.M. for sets of two and four positive real numbers. And use of this fact for at least two problems
3.	Statistics	Representation of geometric mean of two positive numbers geometrically and hence proves geometrically that A.M. is greater than equal to G.M. for two positive numbers Evaluation the criteria for equality
4.	Calculus	Study of continuity of modulus functions graphically. Verification of those ideas by definition of continuity, Posing two functions one of his continuous and other is not at o point of the domain
5.	Calculus	Difference between global and local optimum values, considering the function $f(x) = x + \frac{1}{x}$ one can see that the local maximum is less than the local minimum.
6.	Probability	Posing a particular random experiment and considering two particular events A and B, which are independent, it is to be proved that the events (i) A^c, B; (ii)A, B^c; (iii) A^c, B^c by evaluating the actual numerical values of the probabilities of the respective events.
7.	Probability	To write the sample space, when a coin is tossed once, two times, three times. If X stands for the number of heads then find the all possible values of X along with the corresponding probabilities for above three cases.

Marks division for the Project Assessment

Sl. No.	Item	Marks
1.	Project Notebook	10
2.	Doing and Writing a project during the project assessment	05
3.	Viva	05
	Total	**20**

CLASS-XI

SUBJECT : ENVIRONMENTAL SCIENCE (EVSC)

SEMESTER-I

FULL MARKS:35 **CONTACT HOURS :80 HOURS**

COURSE CODE : THEORY

Chapter	Subtopics	Contact Hours	Marks
1.Environment Through Ages	**1.1 Origin of Earth** • The processes and events leading to the formation of Earth. **1.2 Evolution of Earth** • **Lithospheric Evolution:** Development and transformation of Earth's crust. • **Atmospheric Evolution:** Changes in Earth's atmosphere over time. • **Hydrospheric Evolution:** Formation and progression of Earth's water systems. • Origin and Evolution of Life • Development of life on Earth before the emergence of humans. • Origin of Human Beings • The appearance and development of humans on Earth. **1.3 Human Interaction with the Environment** • Concept of Natural Resources • Definition and Types: Various categories of natural resources and their significance. • Exploitation and Degradation: Human use of natural resources and the resulting environmental impacts.	**16**	**8**
2. Concept of Ecology	**2.1 Basic Concepts and Definitions** • Key terms: Ecology, landscape, habitat, ecological niche, eco-zones, biosphere, ecosystems, ecosystem stability, ecotone, edge effect. • Branches of Ecology: Autecology (individual species) and Synecology (communities). • Overview of major terrestrial biomes. **2.2 Types of Ecosystems** • **Categories:**Terrestrial: Forests, grasslands, deserts; Aquatic: Lentic (still water), lotic (flowing water), estuarine, marine, and wetlands.	**32**	**15**

	• **Structure and Function:** Biotic (living) and abiotic (non-living) components. • **Metabolism:** Primary production and energy flow models. **2.3 Ecosystem Connections** • **Energy Flow:** Food chains, food webs, Lindeman's 10 Percent Energy Law. • **Characteristics:** Decomposition, ecological efficiencies, ecological pyramids (number, biomass, energy). **2.4 Biogeochemical Cycles and Nutrient Cycles** • **Key Cycles:** Oxygen, carbon, nitrogen, phosphorus, sulfur. • **Nutrient Dynamics:** Models, inputs, biotic accumulation, and losses.		
3.Biodiversity and Conservation	**3.1 Biodiversity** • **Concept:** Biodiversity, Definition, and importance of speciation in biodiversity. • **Types:** Species, genetic, ecosystem, and domestic diversity. • **Importance:** Biodiversity's role in ecosystem function. • **Highlights:** Hotspots of biodiversity, India's mega biodiversity. • **3.2 Loss of Biodiversity** • **Causes and Effects:** Factors driving biodiversity loss and their impacts. • **IUCN Red List:** Categories (e.g., Extinct, Critically Endangered, Vulnerable). Red Data Book. • **Extinction:** Chronospecies extinction, true extinction. • **Trade :** Wildlife trade **3.3 Biodiversity Conservation Strategies** • **In-situ:** Biosphere reserves, national parks, sanctuaries. • **Ex-situ:** Aquariums, botanical gardens, zoos, cryopreservation, DNA banks. • **Significance:** Importance of biodiversity conservation. **3.4 Biodiversity Assessment** • **Parameters:** Frequency, density, abundance, relative density**.** • **Indices:** Shannon-Wiener diversity index, Simpson's index, evenness index • **Nutrient Dynamics:** Models, inputs, biotic accumulation, and losses.	**32**	**12**

CLASS-XI

SUBJECT : ENVIRONMENTAL SCIENCE (EVSC)

SEMESTER-II

FULL MARKS:35 **CONTACT HOURS : 80 HOURS**

COURSE CODE : THEORY

Chapter	Subtopics	Contact Hours	Marks
4. Environment and sustainability	**4.1 Sustainable Development** • Definition and origin of sustainable development. • Relationship between environment and development. • Importance for present and future quality of life. • Brief overview of the Brundtland Commission Report. **4.2 Science of Sustainability** • Concepts: Sustainability, carrying capacity, deep and shallow ecology, sustainability index. • Population growth vs. resource availability. • Sustainable consumption. **4.3 Sustainable Agriculture** • Concept, need, and action plan for sustainable agriculture. • Green Revolution: Impact of fertilizers, pesticides, mechanization. • New practices: Animal husbandry, livestock management, aquaculture. **4.4 Urban Environmental Challenges and Sustainability** • Urban Heat Island (UHI) and its impact on city climates. • Urban Stress and its effects on human health and quality of life. • Mitigation strategies for urban environmental issues. **4.5 Global Sustainability Challenges and Solutions** • SDGs and global sustainability efforts • Circular economy and sustainable waste practices • Water management and governance • Fossil fuels vs. renewable energy	**30**	**13**

	• Technological innovations for sustainability • Life cycle assessment and eco-labelling		
5. Environmental Physics	**5.1. Basic Concepts of Light and Matter** • **Spectroscopy:** Absorption and emission spectra, Beer-Lambert law, light transmission, and scattering. • **Laws of thermodynamics:** Entropy, enthalpy, and free energy. • **Heat transfer:** Conduction, convection, and radiation. **5.2 Atmospheric Physics** • Albedo, solar constant, and Earth's heat budget. • Radiation and subsidence inversion, mixing depth, and pollutant dispersal. **5.3Physics of Climate** • Temperature, humidity (absolute, relative, specific), dew point, pressure, wind, and precipitation. • Climatological norms, Earth's conveyor belt, ocean circulation, and ocean-atmosphere interactions. • Cyclone and anticyclone formation, climate classification.	**25**	**10**
6. Environmental Chemistry	**6.1 Introduction to Environmental Chemistry** • Definition & Scope: Overview of environmental chemistry and its importance. • Applications of Environmental Chemistry **6.2Air Chemistry** • Atmosphere composition and stratification. • Photochemical reactions: NOx, SOx, O_3, O_2, CO_2, CO, ions, and radicals. • Issues: Acid rain, ozone depletion, particulate matter, aerosols. **6.3Water Chemistry** • Physical and chemical properties of water. • Dissolved gases (O_2, CO_2) and Henry's Law. • Heavy metals (As, Hg, Pb), acidity, alkalinity, and water hardness. **6.4Soil Chemistry** • Soil composition: Inorganic and organic components. • Cation/anion exchange, and key nutrients (N, P, K) in soil.	**25**	**12**

CLASS-XII

SUBJECT : ENVIRONMENTAL SCIENCE (EVSC)

SEMESTER-III

FULL MARKS:35 **CONTACT HOURS :80 HOURS**

COURSE CODE : THEORY

Chapter	Subtopics	Contact Hours	Marks
7.Environmental microbiology and biotechnology	**7.1 Introduction to Microbiology** • Definition & Scope: Study of microorganisms and their roles. • Types of Microorganisms: Bacteria, fungi, algae, protozoa, viruses. • Microbial World: Habitats of microorganisms and their ecological roles. **7.2 Microbial Ecology** • Symbiotic Relationships: Mutualism, commensalism, parasitism. • Microbial Communities: Presence in soil, water, and air. • Nutrient Cycles: Microbes' role in nitrogen, carbon, sulfur, and phosphorus cycles. **7.3 Microorganisms and Human Health** • Impact on Health: Disease-causing microorganisms (e.g., E. coli, Salmonellosis). • Immunology: Antigen-antibody interactions, vaccines. **7.4 Biotechnology for Environmental Sustainability** • Introduction to Biotechnology: Definition, branches, and tools/techniques. • Genetic Engineering: GMOs with examples. • Sustainable Agriculture: Biofertilizers, organic farming, vermicomposting, integrated pest management. •Concept of Bioremediation with their types. •Microbes for wastewater treatment and pollutant cleanup. • Biofuels: Concepts and types of biofuels based on generations. •Biosensors: Role in environmental monitoring. • Ethics & Biosafety: Guidelines and protocols for safe biotechnology use	**30**	**12**
8. Environmental Health and Toxicology	**8.1 Environmental Health** • Concept, Principle, and Components: Understanding environmental factors affecting health. • Epidemiological Concepts: Measurement of	**30**	**12**

	mortality, morbidity, screening, and surveillance. • Public Health & Environmental Stewardship: Promoting health through environmental protection. **8.2 Community and Health** • Health Education & Communication: Introduction to health programs and family planning in India. **8.3 Occupational Health:** Health issues in various occupations (e.g., Anthracosis, Silicosis, Asbestosis). **8.4 Concept of Toxicology** • **Toxicants & Xenobiotics**: Types of toxic substances, exposure routes, and their effects. Toxicokinetic and Toxicodynamic. • **Acute & Chronic Toxicity**: Understanding dose-response (LD50, LC50). • **Sublethal Concentration**: NOEL, MATC for safe levels. • **Bioassay**: Types and methodologies for toxicity testing. • **Biomarkers, Bioaccumulation, Bioconcentration, and Biomagnification**: Key concepts in tracking toxic substance effects.		
9. Environmental legislation and policy	9.1 **Environmental Conservation in British India & Independent India**: • Indian Penal Code 1860, Van Mahotsava (1950), National Forest Policies (1952, 1988), National Water Policy (2002), National Environment Policy (2006). 9.2 **Legal Provisions for Environmental Management**: • Indian Forest Act (1927), Wildlife (Protection) Act (1972), Water (Pollution Control) Act (1974), Water Cess Act (1977), Forests (Conservation) Act (1980), Air (Pollution Control) Act (1981), Environment (Protection) Act (1986), Motor Vehicle Act (1988), Public Liability Insurance Act (1991), Noise Pollution Rules (2000), Biological Diversity Act (2002). 9.3 **International Environmental Agreements**: • Ramsar Convention (1971), Stockholm Conference (1972), Montreal Protocol (1987), UN Conference on Environment and Development (1992), Kyoto Protocol (1997), Convention on Climate Change, Carbon Credit and Trading, Clean Development Mechanism (CDM), World Summit on Sustainable Development (2002), Paris Agreement (2015).	**20**	**11**

CLASS-XII

SUBJECT : ENVIRONMENTAL SCIENCE (EVSC)

SEMESTER-IV

FULL MARKS:35 **CONTACT HOURS :80 HOURS**

COURSE CODE : THEORY

Chapter	Subtopics	Contact Hours	Marks
10.Environmental pollution control and Green Technology	**10.1 Introduction to Environmental Pollution** • **Pollutants**: Definition and types. **10.2 Air Pollution** • **Pollutants**: Major primary and secondary pollutants. • **Effects**: Health impacts, photochemical smog, industrial smog, temperature inversions, greenhouse effect, and global warming. • **Control**: Gaseous absorption, adsorption, cyclone separators, ESP. • **Case Studies**: Black carbon aerosol in the Himalayas, Bhopal Gas Tragedy. • **NAAQS & AQI**: Standards and calculations. **10.3 Water Pollution** • **Sources**: Surface, ground, and ocean water pollution. • **Concepts**: DO, BOD, COD, Eutrophication. • **Health Impact**: Waterborne diseases (Diarrhea, Typhoid). • **Control**: Water quality standards, STP, ETP, WHO guidelines. • **Case Studies**: Ganga Action Plan (GAP), Minamata Disaster. **10.4 Soil Pollution** • **Causes and Effects**: Impact on environment, vegetation, and life forms. • **Control**: Soil reclamation and pollution control measures. **10.5 Noise Pollution** • **Sources & Effects**: Measurement, current situation in India, prevention, and control. **10.6 Radioactive Pollution** • **Types & Sources**: Hazards and disposal methods. • **Case Study**: Chernobyl disaster, 1986. **10.7 Analytical Methods with principles and application** • **Techniques**: UV-VIS Spectrophotometry, Atomic Absorption Spectrophotometry, Electrophoresis, Chromatography, and Microscopy—properties, types, and applications.	**30**	**13**

	10.8 Green Technologies with principles and application • **Technologies**: CFLs, motion detection lighting, programmable thermostats, carbon capture and storage (CCS), Flue Gas Desulfurization (FGD), and solvent recovery systems.		
11.EIA and Environmental management	**11.1 Concept of Environmental Management** • **Need for Environmental Management**: Importance of managing environmental resources for sustainable development. • **Environmental Aspects**: Social, economic, and moral approaches to environmental management. **11.2 Waste Management** • **Solid Waste**: Disposal, recycling, and treatment methods. • **Liquid Waste**: Management of wastewater, and treatment technologies. • **Biomedical Waste**: Proper disposal and treatment of healthcare-related waste. • **Hazardous Waste**: Handling, disposal, and risk mitigation. **11.3 3R Management**: • **Reduce, Reuse, Recycle** Key principles for waste minimization and resource efficiency. **11.4 Environmental Impact Assessment (EIA)** • **Introduction to EIA**: Definition, objectives, and significance of conducting EIA for development projects. • **Types of EIA**: o **Rapid EIA**: Quick assessment for urgent projects. o **Comprehensive EIA**: In-depth evaluation of large-scale projects. o **Strategic EIA**: Focused on policies, plans, and programs. • **Methodologies of EIA**: General procedures used to evaluate the environmental impacts of projects. • **Fundamentals of the Latest EIA Notification (Draft) 2020**: Overview of the new guidelines and changes in the draft notification. • **Case Studies of EIA**: o **Hydropower Projects**: Environmental concerns and EIA studies for hydroelectric plants. o **Thermal Power Projects**: Environmental impact assessment for coal and gas-fired power plants.	**30**	**12**
12.Environmental statistics	12.1• **Statistical Analysis Tools**: Brief principle of Sampling, probability theory, distributions (Normal, Lognormal, Binomial, Poisson, t, F). Basic concepts of mean, median ,mode, standard error, standard deviation, correlation, regression, hypothesis testing (t-test, Chi-square) with examples. 12.2 • **Data Presentation**: Basic concepts of Frequency, histograms, pie charts, and pictograms. 12.3 • **Environmental Modelling**: Principles of Linear simple and multiple regression models, validation, and forecasting.	**20**	**10**

	12.4 • **Air Pollution Dispersion**: Principles of Box model for air pollution modelling and prediction.		

CLASS XI

SUBJECT: ENVIRONMENTAL SCIENCE (EVSC)

COURSE CODE: PRACTICAL

FULL MARKS: 30 **CONTACT HOURS: 40**

Evaluation Scheme	Marks
One experiment from Group A	7
One experiment from Group B	7
Spotting (Total three) from Group C. One from each set.	(3X2)=6
Practical Record Book +Viva Voce	(3+2)=5
One Investigatory field study from Group D + viva voce on field study	(3+2)=5

A. List of experiments:

1. Determination of total hardness of water sample provided by EDTA method.
2. Determination of total alkalinity of water sample provided by phenolphthalein/methyl orange.
3. Characterization of water samples: Turbidity, Color, Odor, Temperature, pH,
4. To test the presence of chloride, nitrates, carbonates and bicarbonates in the water sample provided.

B. List of experiments:

5. To measure the climate temperature by Six's maximum and minimum Thermometer : Correctly read the maximum and minimum temperature from Six's Thermometer and record them in a proper table.
6. To measure the humidity by hygrometer : Note down the dry bulb and wet bulb temperature reading in a proper table and find out the Relative Humidity of the atmosphere with the help of relative humidity chart.
7. To measure atmospheric pressure: Correctly read the atmospheric pressure from the

Fortin's Barometer with the help of Vernier scale and record them in a proper table. Calculate the atmospheric pressure.

8. To Study the effect of light on the growth of plants (Moong /Pea/ barley/ wheat) provided (Grown in two pots in light and dark conditions). Make the following observations using your experimental data and record in a tabular form as given below.

   Number of seeds germinated in each pot, Color of seedling and leaves ,Height of seedlings, Length of internodes, Number of leaves produced per plant (seedlings)

C. Study and observe the following (Spotting):

(Set-I): Identification of specimen (photograph/museum specimen) and comment on their importance: Sarpagangha, Yam, Sami, Cinchona, Neem

(Set-II): Identification of specimen (Photograph) and comment on their cause of endangeredness : Red panda, Snow leopard, Cheetah, Koala, one horned rhino , Ginkgo biloba.

(Set-III): Identification of specimen (photograph/museum specimen) and comment on their impact on biodiversity of India: *Lantana sp, Parthenium sp, Tilapia sp.*

D. Field study

1. Field study in ecology using both qualitative and quantitative studies (Checklist/Quadrat /Transect) from any one of the following bio-geographical area (plain/coastal/ forest/ Hills) with report submission.
2. Identification of flora with highlight on economic significance and importance to ecological balance
3. Identification of fauna with highlight on economic significance and importance to ecological balance
4. Choice of five plants of your neighbourhood and description in terms of height and leaf characteristics.
5. To describe: a) climate of an urban area b) yearly variation in suspended particulate matter in the same area.

CLASS XII

SUBJECT: ENVIRONMENTAL SCIENCE (ENVSC)

COURSE CODE: PRACTICAL

FULL MARKS: 30 **CONTACT HOURS: 40**

Evaluation Scheme	Marks
One experiment from Group A	7
One experiment from Group B	7
Spotting (Total three) from Group C. One from each set.	(3X2)=6
Practical Record Book +Viva Voce	(3+2)=5
One Investigatory field study from Group D + viva voce on field study	(3+2)=5

A. List of experiments:

1. Determination of LC50 and LD50 with data provided.
2. Determination of Water Holding Capacity of soil sample provided (at least two samples).
3. Determination of soil moisture content.
4. Determination of soil pH of at least soil sample.

B. List of experiments:

5. Determination of Dust fall rate.
6. Estimation of Noise level (dB(A).
7. Studies on goodness of fit for regression model with given data set on any environmental issues.
8. Simple staining using curd.

C. Study and observe the following (Spotting):

(Set-I):Identification of pest in agriculture (photographs/ museum specimen) and comment on their economic importance: *Leptocorisa sp , Scirpophaga incertulus , Gryllinae sp , Amphipyra pyramidoides.*

(Set-II): Identification of Microorganisms in environmental sample (Permanent slide / photograph) and comment on their economic importance: *Escherichia col, Bacillus sp, Staphylococcus aureus , Plasmodium sp , Aspergillus sp*

(Set-III): Identification of bio-indicators (Photograph/ museum specimen/permanent slides):

Microbes: *Escherichia coli, Lichens*

Plants: *Mosses, Water hyacinth*

Animals: *Dragonfly larva, Earthworm*

D. Field study

1. Preparation of an Environmental Management Plan on the basis of given scenario.
2. Review on local environmental issues and making design of action plan.
3. Review on social responsibility of environmental management and report submission.
4. Report on global/ local environmental pollution issues.
5. To segregate domestic waste into bio-degradable and non-biodegradable components.
6. To make an audit of the electrical energy consumption by various household appliances.

Fisheries and Aquaculture [FSAQ]

Class XI : Semester 1

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 1 **Introduction to Fisheries**	Chapter 1- Diversity of Aquatic Organisms • Brief concept of aquaculture • Definition and importance of fisheries • Types of fisheries - inland, brackish and marine • Basic concept of extensive, intensive and super intensive aquaculture and integrated farming Chapter 2- Introduction to Taxonomy • Taxonomy- Definition and taxonomical hierarchy, • Systematics- Definition and importance • Species concept- Biological and evolutionary concept • Speciation (Allopatric, parapatric, peripatric, sympatric- definition and one example each) Chapter 3- Taxonomy of fish • Salient features and classification of fish up to class level • Diagnostic features *Labeo rohita* (Rohu*), Chitala chitala (*Chital), *Tenulosa ilisha* (Ilish), *Lates calcarifer* (Bhetki), *Barilius barila* (boroli), *Clarius batracus* (Magur), Chapter 4- Taxonomy of crustacea and mollusca • Salient features of Prawn (*Macrobrachium rosenbergii, Penaeus monodon*), Crab (Scylla serrata), Bivalves (*Pinctada sp.*), Gastropod (*Pila sp.*), Cephalopod (squid)	24	15

Unit 2 **Biology of Digestion and Respiration**	<u>Chapter 5- Fish Morphology</u> • Morphology and diversity of skin, scales, mouth, fins and tails <u>Chapter 6- Digestion</u> • Food and feeding habit of fish- herbivores, carnivores and omnivores. • Internal anatomy of alimentary system of herbivorous, carnivorous and omnivorous fishes. • Fish growth- isometric and allometric <u>Chapter 7- Respiration</u> • General description of respiratory organs in fish (Shark and Rohu) • Accessory respiratory organs in air breathing fishes (*Anabas sp. Clarias sp., Heteropneustes sp.)*	16	12
Unit 3 **Biology of excretion, circulation and reproduction**	<u>Chapter 8- Excretion</u> • Structure of fish kidney • Osmoregulation in freshwater and marine teleosts (Euryhaline and stenohaline fishes), osmoregulators and osmoconformers. • Accessory excretory organs in fish (gills and skin) <u>Chapter 9- Circulation</u> • Structure of fish gill- Gill filaments, gill lamellae, gill arch and gill epithelium • General features of venous heart <u>Chapter 10- Reproduction</u> • Structure of ovary and testis in fish • Sexual dimorphism in fish • Oviparous, viviparous and ovo-viviparous fishes	15	8

Class XI : Semester 2

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 4 **Aquatic environment and ecology**	Chapter 11- Understanding of basic aquatic ecology • Concept of habitat and ecological niches • Structure and function of aquatic ecosystem- productivity, energy flow in ecosystem, food chain, food web • Elementary idea of pond ecosystem and marine ecosystem Chapter 12- Water Quality Parameters • pH, turbidity, temperature, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD). • Definition and significance of planktons (Zooplanktons and phytoplanktons- each with two examples.	32	13
Unit 5- Aquaculture systems and practices	Chapter 13- Systems of Aquaculture • Criteria for the selection of site and species for freshwater aquaculture- monoculture, polyculture, composite fish culture, brief concept of sustainable aquaculture (aquaponics). • Culture of air breathing fishes- *Anabas* sp. Chapter 14- Culture and prawn and molluscs • Culture of *Macrobrachium rosenbergii, Penaeus monodon* • Freshwater pearl culture- brief culture methodology, present status and prospects of pearl culture in India	35	12
Unit 6 **Fisheries resources**	Chapter 15- Inland Fisheries Resources • Brief idea about freshwater resources- status, prospects and problems in West Bengal	30	10

	• Brief idea about brackish water resources - present status, prospects and problems in West Bengal • Brief idea about coastal resources - present status, prospects and problems in West Bengal • Brief idea about sewage fed resources - present status, prospects and problems in West Bengal		

Class- XI

SUBJECT- FISHERIES SCIENCE /FISHERIES AND AQUACULTURE

COURSE CODE: PRACTICAL

CONTACT HOURS- 30 CONTACT HOURS- 30

TIME ALLOWED– 3 Hours MAXIMUM MARKS - 30

EVALUATION SCHEME	MARKS
One major experiment Part- A (experiment no.- 1, 2, 3, 4, 5,6)	6
One minor experiment Part- A (experiment no.- 7,8,9)	5
Slide preparation Part- A (experiment no.- 10,11)	3
Spot identification (Part- B) (three)	6 (2X3)
Investigatory project (Part- C)+ Viva voce	5 (3+2)
Practical record + Viva voce	5 (3+2)

A. List of experiments:
   1. Study and describe locally available common Indian major carp (any one specimen).
   2. Study and describe locally available common Indian minor carp (any one specimen).
   3. Study and describe locally available common exotic carps (any one specimen).
   4. Study and describe locally available common air- breathing fishes (any one specimen).
   5. Study and describe locally available crustacea (any one specimen).
   6. Water quality parameter analysis (pH, turbidity, temperature)
   7. Study and description of swim bladder of any common carp
   8. Morphometry (General length, eye diameter, pectoral fin, pelvic fin, tail fin)
   9. Study of locally available aquatic weed (any one)
   10. Prepare a temporary mount to observe zooplankton/ phytoplankton available in pond water
   11. Study of different types of fish scales (cycloid, ctenoid and placoid)

B. Study and observe the following (Spot identification)

1. Specimens/slides/models. Identify with reasons- prawn (*Macrobrachium* sp./ *Penaeus* sp.), Crab (*Scylla* sp.), gastropod (Pila sp.), Bivalve (Pinctata sp.), starfish, Cephalopod (Squid), Cartilaginous fish (Shark)
2. Virtual specimens/slides/models. Identifying features of – fish blood. Venous heart, structure of fish gill, anatomy of alimentary system.
3. Microscopic identification of zooplankton and phytoplankton (Daphnia, Cyclops, Spirogyra, Oscillatoria, Volvox)

C. Investigatory Project: (any one)
   1. Nature study (visit to a local water body)
   2. Enlistment of locally available aquatic organisms (Fish, crustaceans, gastropods, bivalves, aquatic weeds etc.).
   3. Nutrient profiling (Chart preparation) of indigenous fishes, crustaceans, gastropods, bivalves etc.

Class XII : Semester 3

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 7- Fish feed and feed management	Chapter 1: Fish feed manufacturing • Types of feed- live, Dry (pellets, flakes, powdered, micro-encapsulated, micro bound and micro-coated diet) and non-dry diets (Definition) • Storage and transportation of feeds • Quality problems- toxins (Aflatoxin) and pests (beetles and mites) Chapter 2: Feed management • Feeding strategies- feed ration, feed quantity estimation, feeding methods (check trays, demand feeders, automatic feeders, feed dispensers- definition only) • Feed storage: Hydro-stability of feed and their storage (brief concept) • Prevention of spoilage from rancidity Chapter 3: Feed quality • Feed conversion ratio, protein efficiency ratio, feed conversion efficiency, specific	40	16

	growth rate, average weight gain, gross growth coefficient (Definition only)		
Unit 8- Fish pathology and health management	Chapter 4: Fin Fish Pathology • Fungal disease- Saprolegniasis • Bacterial disease- Dropsy • Protozoan disease- white spot disease • Metazoans- Argulus • Viral disease- IPN (Causative agents, symptoms and prophylaxis) Chapter 5: Shell Fish Pathology • Black gill disease • Brown spot disease (Causative agents, symptoms and prophylaxis) Chapter 6: Fish health management • Defense system and mechanism in fish and shellfish: innate and acquired immunity • Application of vaccines and antibiotics in fish (Examples)	38	13
Unit 9- Fish behavior	Chapter 7: Fish parental care • Patterns of parental care- Fish species that build nests, fish species that do not build nests, viviparity, care for young (one example for each type) Chapter 8: Fish migration • Definition • Patterns of migration- anadromous, catadromous and amphidromous (definition and one example from each) • Causes of migration • Migratory species (example: Cod, Salmon, eel and ilisha)	12	6

Class XII : Semester 4

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 10- Aquarium fisheries	Chapter 9: Aquarium design and construction • Design and construction of domestic and commercial aquaria (freshwater and marine) • Aquarium accessories- aerators, filters (different types) and lighting • Water quality requirement Chapter 10: Ornamental fishes • Indigenous ornamental fishes (freshwater and marine) of West Bengal • Diagnostic features of *Carassius auratus* (Gold fish), Pterophyllum scalare (Angel fish), Poecilia sphenopes (Molly), *Betta sp*. (Fighter). • Economic Importance	15	10
Unit 11- Commercial fish management	Chapter 11: Induced breeding of fishes • Concept of induced breeding, captive breeding of carps • Methods of pituitary extract preparation, dosage determination and injection to the brood fishes. Chapter 12: Rearing of larval and brood fishes • Nursery tank • Rearing tank • Storage tank Chapter 13: Fish By-products and Waste utilization • Fish body oil • Fish liver oil • Fish meal • Fish gelatin • Fish manure	20	12

Unit 12- Fisheries Economics and Entrepreneurship	Chapter 14: Fishing crafts and gear • Types of fishing crafts in India (Fishing boats, trawlers, deep sea vessels, trollers, gill netters) • Types of fishing gear (nets, lines, traps, hooks, rope, floats, sinkers) • Fish finding devices (GPS navigator, Sonar, Remote sensing) Chapter 15: Responsible Fisheries and Fisheries Legislation: • Monsoon trawl ban, mesh size regulation, juvenile fishing, overfishing • Important Acts about fisheries in India (West Bengal Inland Fisheries Act 1984, West Bengal Marine Fishery Rules 1995, Coastal Aquaculture Authority Act 2005, Fisheries Act 2018) Chapter 16: Entrepreneurship Development: • Need, scope, characteristics, and types of entrepreneurships • Social responsibility and business ethics • Prospective of Aquaculture in Socio-economic impact and rural development of respective areas • Marketing strategies and storage • Financial management	23	13

Class- XII

SUBJECT- SUBJECT- FISHERIES SCIENCE /FISHERIES AND AQUACULTURE

COURSE CODE: PRACTICAL

CONTACT HOURS- 30

TIME ALLOWED– 3Hours MAXIMUM MARKS - 30

EVALUATION SCHEME	MARKS
One major experiment Part- A (experiment no.- 1, 2, 3,4)	6
One minor experiment Part- A (experiment no.- 5,6,7,8)	5
Identification of fishing crafts and gears (Part B)	6 (3+3)
Field visit (Part- C) + Viva voce	8 (5+3)
Practical record + Viva voce	5(3+2)

A. List of experiments:

1. Set up of domestic aquarium
2. Bait preparation
3. Study and describe **any one** fish pathogen and its related disease. Comment on the symptoms of the disease.
4. Estimation of production cost/ Preparation of balance sheet for commercial aquarium
5. Describe **any one** fish migratory pattern (through picture)
6. Identifying characters of **any one** ornamental fish
7. Identifying characters of **any one** aquarium accessory
8. Identifying characters of **any one** fish feed

B. Identification of fishing crafts and gears (Models/pictures):
   1. Net (Knot-less net/ gill net/hand net)
   2. Fishing hook (Barbless/barbed)
   3. Cage trap
   4. Commercial fishing rope (any)
   5. Deep sea vessels
   6. Fishing boat
   7. Trawlers

C. Field visit: (any one)
   a. Local fish market visit
   b. Visit to hatcheries/nurseries/fish culture units
   c. Visit to any ICAR institutes (CIFE/CIBA/CIFRI/BWTC etc.)
   d. Visit to aquarium fish culture units

SUBJECT: FISHERIES AND AQUACULTURE (FSAQ)

Class XI TOTAL THEORY MARKS: 70

CLASS XI SEMESTER 1 TOPICS: [MCQ] MARKS: 35 [1 MARK PER QUESTION]

Sl. No.	Topic	Marks alloted
1	**Unit 1: Introduction to Fisheries** Chapter 1- Diversity of Aquatic Organisms Chapter 2- Introduction to Taxonomy Chapter 3- Taxonomy of fish Chapter 4- Taxonomy of crustacea and mollusca	1X15=15
2	**Unit 2: Biology of Digestion and Respiration** Chapter 5- Fish Morphology Chapter 6- Digestion Chapter 7- Respiration	1X12=12
3	**Unit 3: Biology of excretion, circulation and reproduction** Chapter 8- Excretion Chapter 9- Circulation Chapter 10- Reproduction	1X8=8

Semester 2

CLASS XI SEMESTER 2 TOPICS: [SAQ, LAQ] MARKS: 35

Sl. No.	Topic	Short Answer Type Questions Type-1 (2 marks)	Short Answer Type Questions Type-2 (3 marks)	Competency-based Questions (4 marks)	Descriptive Type Questions (5 Marks)	Total
4	**Unit 4: Aquatic environment and ecology** Chapter 11- Understanding of basic aquatic ecology	2X2=4	3X3=9	-	-	13

	Chapter 12- Water Quality Parameters					
5	**Unit 5- Aquaculture systems and practices** Chapter 13- Systems of Aquaculture Chapter 14- Culture of prawn and molluscs	2X1=2	3X2=6	4X1=4	-	12
6	**Unit 6: Fisheries resources** Chapter 15- Inland Fisheries Resources	2X1=2	3X1=3	-	5X1=5	10
	Total	08	18	04	05	35

Semester 3

Class XII TOTAL THEORY MARKS: 70

CLASS XII SEMESTER 1 TOPICS: [MCQ] MARKS: 35 [1 MARK PER QUESTION]

Sl. No.	Topic	Marks allotted
1	**Unit 7: Fish feed and feed management** Chapter 1: Fish feed manufacturing Chapter 2: Feed management Chapter 3: Feed quality	1X16=16
2	**Unit 8: Fish pathology and health management** Chapter 4: Fin Fish Pathology Chapter 5: Shell Fish Pathology Chapter 6: Fish health management	1X13=13
3	**Unit 9- Fish behavior**	1X6=6

	Chapter 7: Fish parental care Chapter 8: Fish migration	

Semester 4

CLASS XII SEMESTER 2 TOPICS: [SAQ, LAQ] MARKS: 35

Sl. No.	Topic	Short Answer Type Questions Type-1 (2 marks)	Short Answer Type Questions Type-2 (3 marks)	Competency-based Questions (4 marks)	Descriptive Type Questions (5 Marks)	Total
4	**Unit 10- Aquarium fisheries** Chapter 9: Aquarium design and construction Chapter 10: Ornamental fishes	2X2=4	3X2=6	-	-	10
5	**Unit 11- Commercial fish management** Chapter 11: Induced breeding of fishes Chapter 12: Rearing of larval and brood fishes Chapter 13: Fish By-products and Waste utilization	2X1=2	3X2=6	4X1=4	-	12
6	**Unit 12- Fisheries Economics and Entrepreneurship**	2X1=2	3X2=6	-	5X1=5	13

	Chapter 14: Fishing crafts and gear Chapter 15: Responsible Fisheries and Fisheries Legislation Chapter 16: Entrepreneurship Development					
	Total	08	18	04	05	35