Program Learning Outcomes (POs) in B.Sc in Botany (General)

The student who completes their studies with a Bachelor of Science (Honours) degree in Botany should be able to-

- Develop a strong foundation in the subject of Botany, as well as related subject areas, ensuring their fundamental competency in these fields. The students will demonstrate the capability to
 - i. Categorise primary plant groups and analyse the distinguishing features of lower (e.g. algae and fungus) and higher (angiosperms and gymnosperms) plants.
 - ii. Elucidate diverse plant processes and functions, metabolic activities, notions of genes and genome, as well as how the functioning of organisms is impacted at the cellular, tissue, and organ levels.
 - iii. Comprehend the interrelationships of life on Earth and to trace the flow of energy through nutrient cycles.
- Showcase their proficiency in the experimental techniques and methodologies specific to their specialised field of Botany.
- Utilize scientific methodologies to solve varied questions which involves establishing hypotheses, collecting data, and critically analysing the facts to determine the extent to which their scientific work corroborates their hypotheses.
- Improve their ethical and moral views and develop the ability to address psychological vulnerabilities.
- Acquire collaboration and cooperation skills to work as a team thereby effectively contributing to institutions, industry, and society.
- Establish themselves as independent learner by gaining subject-specific abilities. In the field of botany, the programme outcome will provide information and skills that may be applied to pursue higher education, competitive tests, and employment opportunities. An outcomes-based curriculum would guarantee uniform academic standards across and provide a comprehensive assessment of students' abilities.

Sl.	DO _a	CC 1	CC 2	CC 3	CC 4	SEC-	SEC-	DSE-	DSE-
No.	POS	UU-1	CC-2	CC-3	CC-4	Α	В	Α	В
1	Develop a strong foundation in the subject	\checkmark							
2	Showcase the proficiency in the experimental techniques	\checkmark	\checkmark	\checkmark	V	-	-	\checkmark	\checkmark
3	Utilize scientific methodologies to solve varied questions	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	-	-
4	Improve their ethical and moral views	\checkmark							
5	Acquire collaboration and cooperation skills to work as a team	\checkmark	-	\checkmark	V	\checkmark	-	-	-
6	Establish themselves as independent learner	\checkmark							

Core Course & Skill Enhancement Course & Discipline Specific Electives for B.Sc Botany (General)

Core Courses

CC-1: Plant Diversity I (Phycology, Mycology, Phytopathology, Bryophytes and Anatomy)

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

- Acquire an understanding of various algal and fungal groups including their diagnostic characters and examples.
- Identify the kingdom of fungi and illustrate the concepts of plant pathology as well as its application in the management of plant diseases.
- Develop an awareness of the ideas and fundamentals of plant internal structure.
- Study the internal anatomy underlying plant systems and organs.
- Demonstrate a grasp of bryophytes, their life history and economic values.

CC- 2: Plant Diversity II (Pteridophytes, Gymnosperms, Palaeobotany, Morphology and Taxonomy)

At the end of this course, students will be able to -

- Acquire knowledge of the morphology and reproduction procedures of pteridophytes, and gymnosperms
- Demonstrate the fundamentals of plant fossils and conditions of fossilisation.
- Acquire a grasp of angiosperm morphology, especially of flower and fruits.
- Develop understanding on pollen structure and morphology
- Generalize the characteristics of selected families under the classification scheme developed by Bentham and Hooker.
- Grasp practical knowledges to the collection, systematic study and identification of plants.

CC- 3: Cell Biology, Genetics and Microbiology

With the help of this course, students will be able to -

- Classify viruses according to their characteristics and structures
- Investigate the general properties of bacteria as well as their cell reproduction and recombination.
- Have a conceptual knowledge of the rules of inheritance, the genetic foundation of loci and alleles, and the linkage between them.
- Possess an understanding of the impact that chromosomal abnormalities have on structural changes that will ultimately result in genetic diseases.
- Learn the types and causes of mutations that have impact on the functions of genes.
- Analyze the structural and chemical characteristics of DNA and RNA through an array of earlier experiments.
- Acquire an overall comprehension of the different steps involved in the processes of transcription and protein synthesis.

CC- 4: Plant Physiology and Metabolism

The course will enable the students to -

- Acquire an understanding of the relationship between water and plants in regard to the various physiological processes.
- Determine the difference between dormancy and germination occurring in plants
- Discuss the significance of photosynthesis and respiration and demonstrate the process of ATP synthesis
- Differentiate between anabolic and catabolic routes of metabolism
- Understand the biological process of nitrogen fixation in the metabolic process.
- Recognize the significance of Auxin, Gibberellin, Cytokinin, Ethylene, ABA

Skill Enhancement Courses

SEC-A: Biofertilizers

On successful completion of the course, students will be able to -

- Acquire a comprehension of the idea of bio-fertilizer.
- Recognize the various types of bio-fertilizers and the applications for each of them.
- Learn how to develop an integrated management system for improved crop production by employing vesicular arbuscular mycorrhiza (VAM) as well as biofertilizers that contain both nitrogenous and phosphate compounds simultaneously.
- Provide an interpretation and explanation of the components, patterns, and processes of bacteria that are involved in the growth of crops.

SEC-B: Plant Biotechnology

Following the completion of this course, the students will be able to -

- Acquire an understanding of the principles and fundamental concepts of plant biotechnology and genetic engineering.
- Develop their expertise in the many types of plant tissue culture.
- Conduct an analysis of the enzymes and vectors used for genetic manipulations.
- Have an understanding of the Gene cloning process and various approaches to gene transfer.

Discipline Specific Electives

DSE-A: Phytochemistry and Medicinal Botany

Students will be able to -

- Be familiar with the fundamental pharmacognosy and its importance in modern medicine, crude drugs and Classification of drugs.
- Have in depth knowledge on pharmacologically active constituents and biosynthesis of various secondary metabolites.
- Learn the procedure of chemical, microscopic and histochemical tests for identification of medicinal herbs.
- Have an idea on strategies to implement the knowledges of ethnomedicine, taking into consideration the practical concerns that are relevant to India.

DSE-B: Economic Botany

The course will enable the students to -

- Gain an comprehension of the development of the concept of organization of new crops and varieties, the significance of germplasm diversity.
- Have a fundamental understanding of the taxonomic diversity and notable families of plants that are of practical utility.
- Raise people's awareness of and appreciation for the plants and plant products that they come into contact with in their daily lives.
- Recognize the wide variety of plant species and the varieties of plant products that are used by humans.

Course credits summary

Course	Credits					
	Theory	Practical	Total			
CC-1: Plant Diversity I (Phycology, Mycology, Phytopathology, Bryophytes And Anatomy)	04	02	06			
CC- 2: Plant Diversity II (Pteridophytes,						
Gymnosperms, Palaeobotany, Morphology and	04	02	06			
Taxonomy)						
CC- 3: Cell Biology, Genetics and Microbiology	04	02	06			
CC- 4: Plant Physiology and Metabolism	04	02	06			
SEC-A: Biofertilizers	02		02			
SEC-B: Plant Biotechnology	02		02			
DSE-A: Phytochemistry and Medicinal Botany	04	02	06			
DSE-B: Economic Botany	04	02	06			

Course Learning Outcomes B.Sc CHEMISTRY GENERAL

The course learning outcomes are aligned with program learning outcomes but these are specific-to-specific courses offered in a program. The course level learning shall be reflected as program level learning. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with multi-dimensional and multidisciplinary approach.

In course learning outcomes, the student will attain subject knowledge in terms of individual course as well as holistically. The example related to core courses and their linkage with each other is stated below:

S1.	POs	CC-	CC-2/	CC-	CC-	DSE	DSE
No.		1/GE-	GE-2	3/	4/	A2	B1
		1		GE -3	GE -4		
1	Fundamental understanding of the field	X	Х	X	X	Х	X
2	Application of basic Chemistry concepts	X	Х	Х	Х	Х	Х
3	Linkages with related disciplines	X	Х	X	X	Х	X
4	Procedural knowledge for professional Subjects	X	Х	X	X	Х	X
5	Skills inrelated field of Specialization	Х	Х	Х	Х	Х	X
6	Ability to usein Chemistry problems	Х	Х	X	Х	Х	X
7	Skills in Mathematical modeling	Х	Х	Х	Х	_	-
8	Skills in performing analysis and Interpretation of data	Х	Х	Х	Х	Х	Х
9	Develope investigative Skills	Х	Х	Х	Х	Х	Х
10	Skills in problem solvinging Chemistry and related discipline	Х	Х	Х	X	Х	Х
11	DevelopeTechnical Communication skills	Х	X	X	X	X	X
12	Developing analytical skills and poular communication	X	Х	Х	Х	Х	Х

13	Developing ICT skills	Х	Х	Х	Х	-	_
14	DemonstrateProfessional behavior with respect to attribute like objectivity, ethical values,selfreading, etc	X	X	X	X	X	X

CC-1/GE-1

(Credits:06,Theory-04,Practicals-02)

Course learning outcome(COs):

After going through the course the student should be able to understand

1. Kinetic theory of gases, Liquids its characteristics. Chemical Kinetics.

2. Atomic structure, different theories ,explaination etc.

3. Chemical Periodicity and Acids and bases

4. Fundamentals of Organic chemistry and Stereochemistry

5. Nucleophilic Substitution and Elimination Reactions

CC-2/GE-2

(Credits:06,Theory-04,Practicals-02

Course learning outcome(COs):

After going through the course the student should be able to understand

1. Chemical Thermodynamics & Chemical Equilibrium

2. Solutions and Phase Equilibria

3. Solids

4. Organic chemistry of Aliphatic hydrocarbons

5. Error Analysis and Computer Applications.

6.Redox reactions.

CC-3/GE-3

(Credits:06,Theory-04,Practicals-02)

Course learning outcome(COs):

After going through the course the student should be able to understand

1. Chemical bonding and molecular structure. Comparitive study of p- block elements.

2. Transition elements & Coordination chemistry.

3. Eletrochemistry.

4. Aromatic hydrocarbons, Organometallic compounds, Aryl halides.

CC-4/GE-4

(Credits:06, Theory-04, Practicals-02)

Course learning outcome(COs):

After going through the course the student should be able to understand

1.Crystal Field Theory: Crystal field effect on octahedral symmetry and Tetrahedral symmetry, rystal field stabilization energy(CFSE). Spectrochemical series etc.

2. Quantum chemistry and Spectroscopy

3. Alcohols, Phenols and Ethers, Carbonyl Compounds, Carboxylic Acids and Their Derivatives

4. Amines and Diazonium Salts

5. Amino Acids and Carbohydrates

DSE-A2: INORGANIC MATERIALS OF INDUSTRIAL IMORTANCE (Credits:06,Theory-04,Practicals-02)

Courselearningoutcome(COs):

After the successful completion of the course the students expected to master

the following

- 1. Silicate Industries: manufacturing and processing of glass, composition and properties of different types of glass. Manufacturing of high technology ceramics and their applications. Cements: classification of cement. Manufacturing of cement and the setting process, quick setting cements.
- 2. Fertilizers: different types of fertilizers their manufacturing and uses.
- 3. Batteries: Primary secondary batteries, Battery components and their role, characteristics of battery.
- 4. Surface coatings classification, Paint and pigment-formulations and composition, ecofriendly paints and plastic paint, electrolytic and electroless metallic coatings.
- 5. Classification of alloys, properties of elements in alloy, Steel: manufacturing, surface treatment, composition and properties.
- 6. Industrial applications of catalyst, deactivation or regeneration of catalyst, phase transfer catalyst and application of zeolites as catalyst.
- 7. Origin of explosive properties, preparation and explosive properties of lead azide, PETN, RDX.Introduction to rocket propellants.

DSE-B1: GREEN CHEMISTRY AND CHEMISTRY OF NATURAL PRODUCTS

(Credits:06, Theory-04, Practicals-02)

Course learning outcome(COs):

After the successful completion of the course the students expected to master the following

1. Classification, structure, mechanism of reactions of few selected alkaloids and

terpenes.

- 2. Alkaloids and Terpenes
- 3. Green chemistry and its principles.
- 4. Green synthesis and reactions.
- 5. Green chemistry for sustainable solutions.
- 6. Understanding principles of green chemistry.
- 7. Understanding design of chemical reactions/chemical synthesis using green chemistry principles.
- 8. Atom economy and design of chemical reactions using the principle.
- 9. Understanding the use of green chemistry principle and processes in laboratory reactions

Programme Learning Outcome (POs) in B.Sc. Economics (General)

Each programme vividly explains its nature and promises the outcomes that are to be accomplished by studying the courses. The Bachelor of Arts (Programme) with Economics states the attributes that it aims to inculcate at the point of graduation. These attributes encompass values related to wellbeing, emotional stability, critical thinking, social justice and skills for employability. On completion of the programme students are expected to have learnt the skills of effective communication, critical thinking, social research methods and social outreach. The qualities expected from the graduates of B.A. (Programme) with Economics as subject are:

- A holistic knowledge and understanding of basic concepts in economics and will be exposed to the real-world data related to industries and society, identifying the problems and working towards their solutions through various analytical andstatistical techniques.
- The capacity to identify, understand and solve the problems of society.
- The ability to collect, analyse, interpret and present the data and bring out the meaning, correlations and interrelationships.
- Team building and leadership skills, communication, creative and critical thinkingskills and innovative problem-solving skills.

Objectives of the Programme

- 1. To imbibe strong foundation of economics in students.
- 2. To update students with statistical tools that aid in economic theory.
- 3. To teach/strengthen students' concepts related to Microeconomics and Macroeconomics.
- 4. To promote application-oriented pedagogy by exposing students to real world data.
- 5. To prepare students for projects which form them for jobs.

Core Course & Generic Elective & Discipline Specific Electives & Skill Enhancement Course for B.Sc General (Economics)

SL. No	PO's	GE 1	GE 2	GE3	GE4	DSE-5- 1A/2A- MB	DSE-5 1A/2A- SD	DSE-6 1B/2B- PF	DSE-6 1B/2B- EHI	SEC3- 1A- (IMFS)	SE C3- 1A-	SEC4 - 1B(E	SEC- 4 (ED)
											(ER D)	DAR W)	
1	To develop analytical ability among students	V				\checkmark						V	
2	To have an idea about how the Governme nt functions	V	V			V							\checkmark
3	To have an idea about the evolution of the present day Indian Economy	V		~								1	1
4	To maximise standard of living and to achieve stable Economic Growth	V				V						V	1
5	To understand and apply core Economic Principles related to consumers, producers and market	V				\checkmark						\checkmark	V
6	To know policy making mechanism related to money and currency from an applied finance context	V	V									V	$\overline{\mathbf{v}}$
7	Applicatio n of	\checkmark				\checkmark						\checkmark	\checkmark

-										
	Statistics									
	and									
	Mathemati									
	cs in									
	Economics									
	usually									
	used for									
	forecasting									
8	Basic idea									
	of Indian									
	Economic									
	structure.									
	problems									
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10	То					\checkmark	\checkmark	\checkmark	\checkmark	
	generate									
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12	To give an overall idea about share market derivative market and financial instrument s as a whole.						V	V

Course Learning Outcomes (CLO) General Elective Course I Name of the Course: Introductory Microeconomics (GE-1) Total Credits: [5(Th)+1(Tu)]=6

Course Learning Outcome (CLOs):

After going through the course, the student should be able to

1. Explore Economics

- Recognize the significance of studying economics.
- Analyse the scope and methodology of economics.
- Comprehend the economic problem: scarcity, choice, and resource allocation.
- Evaluate the concepts of what, how, and for whom to produce.
- Interpret the science of economics and the basic competitive model.
- Understand the role of prices, property rights, profits, incentives, and information.
- Explain rationing, opportunity sets, and different economic systems.
- Interpret and apply reading skills with graphs in economic contexts.

2. Supply and Demand: Markets and Welfare

- Differentiate markets and competition.
- Analyse determinants of individual demand and supply.
- Interpret demand/supply schedules and curves, laws of demand and supply.
- Illustrate market versus individual demand/supply.
- Evaluate shifts in demand/supply curves and their effects.
- Discuss price mechanisms in resource allocation.
- Analyse elasticity of demand and its applications.
- Examine controls on prices, taxation costs, consumer, and producer surplus in market efficiency.

3. The Households

- Understand utility maximization through cardinal and ordinal approaches.
- Analyse total utility, marginal utility, and the law of diminishing marginal utility.
- Interpret consumption decisions, budget constraints, and income/price changes.
- Illustrate preferences using indifference curves and their properties.
- Explain consumer's optimal choice and derivation of demand curves.

4. The Firm and Market Structure

- Analyse the production function, total, average, and marginal products.
- Understand isoquants, returns to scale, and profit-maximizing firm behaviour.

- Evaluate cost functions, short-run costs, and long-run output decisions.
- Explain features of a perfectly competitive market and equilibrium conditions.
- Analyse short-run and long-run equilibriums under perfect competition.

5. Imperfect Market Structure

- Differentiate monopoly equilibrium from perfect competition.
- Understand the fundamentals of a price-discriminating monopolist.

6. Input Markets

- Explain basic labour market concepts: derived demand, productivity, and marginal productivity.
- Analyse the land market, rent, and quasi-rent concepts.

These learning outcomes aim to equip learners with a comprehensive understanding of economic principles, market structures, household behaviour, and input markets, fostering analytical and decision-making skills within economic frameworks.

Course Learning Outcomes (CLO) General Elective Course II Name of the Course: Introductory Macroeconomics (GE-II) Total Credits: [5(Th)+1(Tu)]=6

Course Learning Outcomes:

- 1. Introduction to Macroeconomics and National Income Accounting:
 - Comprehend the fundamental concepts of macroeconomics.
 - Analyse and differentiate between GDP, GNP, NDP, and NNP.
 - Understand the methodologies for measuring national income.
 - Explain the circular flow of income and the value-added method.
 - Distinguish between real and nominal GDP.
- 2. The Simple Keynesian Model in a Closed Economy:
 - Define the Keynesian consumption and saving functions.
 - Interpret the Simple Keynesian Model of income determination.
 - Analyse the concept of effective demand and the Keynesian Multiplier.
 - Evaluate the government's role in the Simple Keynesian Model.
- 3. The Classical System:
 - Understand the basic principles of the classical system.
 - Explain Say's Law, the Quantity Theory of Money, and income determination.
- 4. Money Supply and Money Demand:

- Analyse the money supply, measures, and monetary policy tools.
- Understand credit creation by commercial banks.
- Evaluate the demand for money in classical and Keynesian systems.
- 5. Inflation:
 - Differentiate demand-pull and cost-push inflation.
 - Analyse the social costs of inflation and hyperinflation.
 - Evaluate the Phillips Curve and the trade-off between inflation and unemployment.
 - Assess anti-inflationary monetary and fiscal policies.
- 6. The External Sector:
 - Define absolute and comparative advantage in trade.
 - Analyse arguments for free trade and protectionism.
 - Understand Balance of Payments, its equilibrium, and disequilibrium.
 - Evaluate the role of the Marshall-Lerner condition in devaluation.

Course Learning Outcomes (CLO) General Elective Course III Name of the Course: Issues in Economic Development and India Total Credits: [5(Th)+1(Tu)]=6

Course Learning Outcomes:

- 1. Meaning of Economic Development:
 - Distinguish between economic growth and development
 - Explore the concept of human development and methods for measurement
 - Analyse the relationship between population and human development
 - Evaluate the status of education and healthcare sectors in India
 - Identify features and causes contributing to underdevelopment in the Indian economy
 - Examine the growth and development of the Indian economy under various policy regimes
- 2. Poverty, Inequality, and Development:
 - Define and comprehend the fundamental aspects of poverty and inequality
 - Discuss methodologies for measuring poverty and establishing the poverty line

- Assess historical trends and governmental policies aimed at reducing poverty and income inequality in India
- 3. Development of the Dual Economy and Development Strategies:
 - Understand surplus labour and disguised unemployment concepts
 - Analyse the Lewis model of economic development concerning an abundant labour supply
 - Compare and contrast balanced and unbalanced growth as strategies for development
- 4. International Organizations and Economic Development:
 - Evaluate the roles and functions of the IMF and World Bank in fostering economic development
 - Examine the functions and significance of the World Trade Organization (WTO)
 - Investigate India's interactions with and position within the WTO

Learning outcomes include a deep understanding of economic development, poverty, inequality, dual economy development strategies, and the roles of international organizations, enabling critical analysis of policy implications and economic growth.

Course Learning Outcomes (CLO) General Elective Course IV Name of the Course: Indian Economic Policies Total Credits: [5(Th)+1(Tu)]=6

Course Learning Outcomes:

- 1. Macroeconomic Policies and their Impact
 - Analyse the effects of fiscal policy on aggregate demand and economic growth.
 - Evaluate the impact of trade and investment policies on international competitiveness and domestic industries.
 - Assess the effectiveness of financial and monetary policies in regulating inflation, interest rates, and overall economic stability.
 - Examine the influence of labour regulations on employment levels and wage dynamics.
- 2. Policies and Performance in Agriculture
 - Measure the correlation between policy interventions and agricultural growth rates.
 - Assess the impact of policies on enhancing agricultural productivity and technological advancements.

- Analyse the influence of agrarian structure on rural development and income distribution.
- Evaluate policies related to capital formation, trade facilitation, and procurement in agriculture.
- 3. Policies and Performance in Industry
 - Analyse the role of policies in stimulating industrial growth and productivity.
 - Evaluate policies promoting diversification and the growth of small-scale industries.
 - Assess the impact of public sector involvement and competition policies on industrial development.
 - Analyse the influence of foreign investment policies on industrial expansion and global competitiveness.
- 4. Policies and Performance of Indian Foreign Trade
 - Evaluate the changes in India's foreign trade patterns post-liberalization.
 - Analyse the Balance of Payments situation and its implications for the economy.
 - Assess the effectiveness of India's export and import policies in promoting trade growth.
 - Evaluate the impact of trade policies on fostering international competitiveness and sustainable trade balances.

Course Learning Outcomes (CLO) General Elective Course V Name of the Course: Money and Banking (MB) Total Credits: [5(Th)+1(Tu)]=6

Course Learning Outcomes:

After going through the course, the student should be able to Money Supply and Banking System in India

- Understand and differentiate between various measures of money supply (M1, M2, M3, M4) in the Indian context.
- Analyse the balance sheet of the banking sector and its implications on money supply accounting.
- Interpret the Reserve Bank of India's balance sheet and high-powered money, and define its significance.

- Comprehend the concept of high-powered money and the money multiplier theory in the context of Indian commercial banks.
- Evaluate sterilization methods employed by Central Banks and their impact on the economy.
- Examine the changing role and structure of the Indian banking system and reforms.

2. Financial Institutions and Financial Markets

- Assess the role of financial markets and institutions in Indian economic development using practical examples.
- Understand the organization, structure, and reforms within money and capital markets in India.
- Evaluate the significance of financial derivatives and innovations in the Indian financial landscape.

3. Interest Rates

- Analyse the determination of interest rates and factors causing interest rate differentials.
- Evaluate theories explaining the term structure of interest rates.
- Interpret interest rate dynamics within the Indian context.

4. Central Banking and Monetary Policy

- Evaluate instruments of monetary control in India, including SLR, CRR, and reporter rates, and their roles.
- Understand the concept of monetary management in an open economy.
- Critically analyse India's current monetary policy, including the impact of demonetization on the economy.

These outcomes provide a comprehensive understanding of monetary systems, financial markets, interest rate mechanisms, and central banking policies with specific reference to India's economic landscape.

Course Learning Outcomes (CLO) General Elective Course V Name of the Course: Sustainable Development (SD) Total Credits: [5(Th)+1(Tu)]=6

Course Learning Outcomes:

After going through the course, the student should be able to

1. The Approach Towards Sustainability-Introductory Ideas

- Comprehension of key environmental issues and problems
- Understanding the economic perspective on environmental problems
- Familiarity with the circular flow of environmental pollutants and waste recycling
- Understanding the laws of thermodynamics in relation to sustainability

- Differentiating between renewable and non-renewable resources
- Grasping the concept and challenges associated with sustainability
- 2. The Meaning of Sustainable Development
 - Analysing various definitions of sustainable development
 - Understanding the principles and rules guiding sustainable development
 - Proficiency in measuring sustainable development indicators
 - Examining sustainable resource management strategies
 - Recognizing the role of property rights in sustainable development
 - Identifying stakeholders involved in sustainable management of resources
 - Understanding sustainable livelihood within the context of resource management
- 3. Trans-boundary Pollution, Climate Change, and Sustainable Development
 - Evaluating the implementation of environmental policies in developing nations
 - Understanding transboundary environmental issues and their impact
 - Familiarity with international meetings, protocols, and treaties addressing environmental concerns
 - Comprehending the economics of climate change
 - Exploring carbon credit markets, clean development mechanisms, and international emission trading

4. Sustainable Resource Management Policies in India

- Understanding India's water policy and its fundamental objectives
- Analyzing the forestry policy of India, its goals, and visions
- Examining India's fishery policy and its underlying objectives
- Evaluating the effectiveness and challenges of these policies
- Relating policy objectives to sustainable resource management practices in India

These learning outcomes cover a range of fundamental concepts, principles, and practical applications related to sustainability, sustainable development, global environmental challenges, and specific policy frameworks

General Elective Course VI Name of the Course: Public Finance (PF)

Course Learning Outcomes:

After going through the course, the student should be able to

- Understand the fiscal functions and tools used in normative analysis.
- Analyse concepts of Pareto efficiency, equity, and their impact on social welfare.
- Identify market failures, public goods, and externalities in economic scenarios.
- Evaluate elementary theories concerning product and factor taxation, including excess burden and tax incidence.

Issues from Indian Public Finance:

- Assess the complexities and current challenges within India's tax system.
- Analyse the functioning of monetary and fiscal policies within the Indian economic context.
- Evaluate budget analysis techniques and understand deficits in the Indian economy.
- Examine fiscal federalism in India and its implications for state and local finances.

These outcomes aim to provide a comprehensive understanding of theoretical frameworks in public finance and their application to the specific economic context of India.

Course Learning Outcomes:

Introductory Methods of Field Survey

ECO-G-SEC-3-1A-TH/ECO-G-SEC-5-2A-TH

- Understanding Economic Concepts in the Field:
- Apply economic theories and concepts to real-world situations encountered during field surveys.
- Demonstrate a deep understanding of economic principles relevant to the survey context.
- Understanding Data Collection for Economic Research:
- Design and implement surveys that collect data relevant to economic research questions.
- Demonstrate proficiency in selecting appropriate economic indicators and variables for investigation.
- Understanding Econometric Techniques:
- Apply basic econometric techniques to analyse survey data.
- Interpret and draw economic inferences from statistical results.

- Utilize quantitative and qualitative methods to analyse economic phenomena observed in the field.
- Understand the complementarity of quantitative and qualitative data in economic research.
- Policy Implications:
- Analyze and discuss the potential policy implications of economic survey findings.
- Relate field survey results to economic theories and evaluate their relevance for policymaking.
- Sector-specific Surveys:
- Conduct surveys focusing on specific economic sectors (e.g., agriculture, finance, labor) to understand sector-specific dynamics.
- Explore the interconnections between different sectors of the economy.

Course Learning Outcomes: Elementary Rural Development ECO-G-SEC-3-1A-TH/ECO-G-SEC-5-2A-TH

After going through the course, the student should be able to

- Understanding of Rural Development Concepts:
- 1. Gain a comprehensive understanding of the key concepts, theories, and models related to rural development.
- 2. Identify and analyze the factors influencing rural development processes.
- Knowledge of Rural Socioeconomic Issues:
- 1. Explore the socioeconomic challenges faced by rural communities, including poverty, unemployment, education, and healthcare.
- 2. Analyze the impact of these issues on rural development.
- Awareness of Agricultural Practices:
- 1. Understand the role of agriculture in rural development.
- 2. Explore sustainable agricultural practices and their contribution to rural economies.
- Policy Analysis and Implementation:
- 1. Analyze government policies related to rural development.
- 2. Understand the process of policy formulation and its implications for rural areas.

Course Learning Outcomes:

Economic Data analysis and report writing

ECO-G-SEC-4-1B-TH/ECO-G-SEC-6-2B-TH

- Define the Purpose and Scope:
- 1. Clearly state the purpose of your analysis and the questions you aim to answer.
- 2. Define the scope of your report. What specific aspects of the economy are you analyzing?
- Gather Data:
- 1. Collect relevant economic data from reliable sources. This may include government reports, statistical agencies, academic journals, and industry reports.

- Data Cleaning and Preparation:
 - 1. Clean and organize your data. This involves handling missing values, outliers, and ensuring consistency.
- 2. Transform the data into a format suitable for analysis. Use spreadsheets or statistical software for this purpose.
- Exploratory Data Analysis (EDA):
 - 1. Conduct EDA to understand the patterns, relationships, and trends in the data.
- 2. Use descriptive statistics, charts, and graphs to present key insights.
 - Interpretation of Results:
 - 1. Present your findings in a clear and concise manner.
 - 2. Use visualizations and tables to support your interpretations.
 - Discussion of Implications:
 - 1. Discuss the implications of your findings. What do they mean for the economy, businesses, or policy?

Course Learning Outcomes: Entrepreneurship and Development

ECO-G-SEC-4-1B-TH/ECO-G-SEC-6-2B-TH

- Understanding of Entrepreneurship Concepts:
- 1. Students should gain a solid understanding of key entrepreneurship concepts, including the entrepreneurial mindset, innovation, opportunity recognition, and risk management.
- Business Planning and Strategy:
- 1. Ability to develop a comprehensive business plan, including market analysis, financial projections, and strategic planning.
- Start-up Skills:
- 1. Acquisition of practical skills required to start and manage a business, such as financial management, marketing, operations, and human resources.
- Critical Thinking and Problem-Solving:
- 1. Development of critical thinking skills to analyze and solve problems that entrepreneurs commonly face in real-world scenarios.
- Risk Management:
- 1. Understanding and managing the risks associated with entrepreneurship, including financial risks, market risks, and operational risks.
- Networking and Communication:
- 1. Building effective communication and networking skills, as these are crucial for entrepreneurs to pitch ideas, attract partners, and connect with potential customers.
- Ethical and Social Responsibility:
- 1. Awareness of ethical considerations in business and the importance of social responsibility in entrepreneurship.
- Global Perspective:
- 1. Recognition of the global aspects of entrepreneurship, including international markets, cross-cultural communication, and global business trends.
- Real-world Application:
- 1. Applying theoretical concepts learned in the course to real-world situations, possibly through case studies, guest lectures, or practical projects.

Program Learning Outcomes (POs) in B.A/B.Sc Geography (General)

The student graduating with the Degree B.A orB.ScGeneral should be able to:

- To understand the physical aspects of earth comprising of land, water and air, their structure, composition, classification, distributional patterns and developmental processes. It helps the students to identify and analyse the various facets of geography, geographical features and processes.
- Completion of this course highlights the purpose of enhancing the capability of the students in perceiving, creating and analyzing sound geographical bases and concepts. This is how they have find the different linkages of geographical knowledge with other disciplines.
- To study human population and their activities, distribution of resources and mapping of different types of land use. It also focuses on globalization that affects the settlement as well as the cultural landscape with help of multiple innovations.
- To provide them an understanding of the basic principles of updated technology based on Remote Sensing, Geographical Information System etc along with the conventional knowledge of coordinate systems and map projections.
- To develop the skill and ability to draw and interpret different types of maps (Land use Map, Thematic Map and Map making from Satellite Imageries).
- To make the students familiar with different types of geographical data and its analysis for determining growth rate, structure, graphical plotting and interpretation.
- To develop students' aptitude for acquiring basic skills of carrying out field work. In this way, the students can directly interact with the environment to gather information relevant to their studies. The students get the necessary guidance to learn the science and art of collecting, processing and interpreting the data.

• Overall, this entire course has been a shift from teacher centric to student centric study by strengthening the quality of teaching and learning in the present day real life scenario of global, regional and local level. It is considered learning as an activity of creativity of innovations and analyzing geographical phenomena.

Core Course & Generic Elective & Discipline Specific Electives & Skill Enhancement Course for B.A/B.Sc General

Sl	РО	CC1/	CC2/	CC3/	CC4/	DSE	DSE	SEC	SEC
No.		GE1	GE2	GE3	GE4	A1	B4	A2	B4
1	Fundamental understanding and application of basic the concept							\checkmark	\checkmark
2	Linkages with other disciplines	V	V	V			V		
3	Ability to understand issues related to man-environment relation	V	V	V		V	V	V	V
4	Developing problem solving techniques			V				V	V
5	Understanding of different kinds of maps and satellite images	V	V	V	V				
6	Map making skills	V	V	V	V				
7	Construction, measurements and drawing of diagrams	\checkmark	\checkmark						
8	Analysis & interpretation of data		V						
9	Fieldwork and communication skills		V						
10	Understanding the concepts of growth, change and development in geographical perspective	V	V	V		V	V		V
11	Focus on gender studies								
12	Understanding models related to development					V	V		V
13	Policy making for society						V		V
14	Globalization, conservation & management	$\overline{\mathbf{v}}$	$\overline{\mathbf{v}}$	$\overline{\mathbf{v}}$		V	$\overline{\mathbf{v}}$	V	V

CC-1/GE-1: PHYSICAL GEOGRAPHY (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

- Understand the concepts related to Geotectonics, Geomorphology, Hydrology and Oceanography which are important sub-disciplines of the physical part of Geography.
- Highlights the structure of the earth's interior, different endogenetic forces like seismic waves and certain resultant surface expression in form of folds and faults.
- Learn about the formation of relief features of continents and ocean floor according to Plate Tectonic theory.
- Study the various exogenetic agents and processes and the evolution of different landforms curved out by them.
- Know about the basic models of slope evolution.
- Understand the associated role of Global Hydrological cycle and ecological flow.
- Study the techniques of watershed management in any drainage basin which is considered as an hydrological unit.
- Identify the physical and chemical properties of ocean water, its pattern of circulation and generation of wave and tide.
- Learn about the availability of various resources in the ocean water and their sustainable management and conservation.
- The practical part includes megascopic identification of some rock and mineral samples and detailed study of any selected topographical map (R.F = 1:50,000) for construction of relief profiles, relative relief map and extraction of drainage patterns and channel features along with proper interpretation.

CC-2/GE-2: ENVIRONMENTAL GEOGRAPHY (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

- Understand the concepts related to Climatology, Soil Geography and Biogeography which are important sub-disciplines of the physical part of Geography.
- Study in detail about the factors affecting insolation, heat budget of earth and distribution of atmospheric temperature and pressure and the major global climatic changes due to effect of Greenhouse gases and depletion of ozone layer of earth.
- Get a description of planetary wind systems influencing the general wind circulation and the mechanisms of India Monsoons.
- Learn about the formation, life cycle and types of tropical cyclone, temperate cyclone and thunderstorm.
- Discuss about the world climatic classification propounded by Koppen, its merits and demerits.
- Understand the factors of soil formation and development of Podzol, Chernozem and Laterite soil profile.
- Study the physical and chemical properties of soil which includes texture, structure, pH, salinity and NPK status.
- Get a description about an elaborate classification of soil put forward by USDA, causes of soil erosion and their management.
- Understand the concepts of Ecosystem, Biome and Biodiversity, their types and major causes of depletion and management of Biodiversity in India.
- Learn about the distribution and characteristics of Tropical rain forest, Savannah grassland, Hot desert biome and ecological adaptation of different plant types like Halophytes, xerophytes, hydrophytes and mesophytes.

• The practical part includes interpretation of weather map of India, construction of hythergraph, climograph and wind rose, determination of soil type by ternary diagram textural plotting and preparing people's biodiversity register by collecting data from any selected area with ample vegetation.

CC-3/GE-3-: HUMAN GEOGRAPHY (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

- Understand the concepts related to Economic Geography, Social Geography and Cultural Geography which are important sub-disciplines of the human part of Geography.
- Provide a proper description of the various sectors of the economy emphasizing on the theories of Von-Thunen, Losch and Weber that explains the location of different economic activities.
- Learn about the factors influencing the location of cotton, iron and steel industries in India and how globalization has helped in the integration of world economies.
- Study the structure, function and characteristics of primitive, hunting-gathering, agrarian and industrial society and the causes and impact of migration on population.
- Highlight the various social issues of diversity, conflict and transformation after knowing the basic concepts of race, language and religion.
- Understand the concept of cultural landscape given by Carl Sauer and identify the differences in cultural landscapes of urban and rural areas.
- Discuss about the definition, types, formation of cultural regions, cultural realms, cultural diffusion and innovation.
- The practical part includes construction of proportional divided circles to depict occupational structure, time series analysis of industrial production, calculation of arithmetic growth rate of population and nearest neighbour analysis of rural settlement from Indian topographical maps (R.F = 1:50,000).

CC-4/GE-4: CARTOGRAPHY (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

- Understand the concepts related to scales and projections, topographic and thematic maps, Remote Sensing and Geographical Information System and surveying which are important cartographic techniques of Geography.
- Learn and apply the basic concepts associated with maps, scales, map projections and bearing, their classification and uses.
- Emphasize on the polar and rectangular coordinate systems along with the significance of UTM projection.
- Study in detail about information on the margins and referencing schemes of old and open series of Indian topographical maps.
- Know the theoretical concept of representation of data by dots, proportional circles, isopleth and choropleth.
- Acquaintance with thematic maps producing national agencies like GSI, NATMO, NBSSLUP, NHO, Bhuvan platform.
- Understand the basic concepts of Remote Sensing that includes sensors, bands and resolution of the satellites sent by ISRO and principles of standard false colour composition of raster images.
- Learn the basic concepts of GIS that includes vectors, attribute table, buffer and overlay analysis.
- Study the theoretical background of surveying using Prismatic Compass and Dumpy level.
- The practical part includes graphical construction of scales (plain and comparative), projections (Simple Conic with one standard parallel, Cylindrical Equal Area, Polar Zenithal Stereographic), thematic maps and annotated thematic overlays from satellite imageries.

DSE A1: REGIONAL DEVELOPMENT (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

- Understand the basic concept and significance of regions and regional planning emphasizing on characteristics and demarcation of a planning region.
- Learn about the concept of development, underdevelopment that supports the efficiency-equity debate.
- Study the pattern of regionalization of India for planning with special reference to agro-ecological zones.
- Discuss in detail about important aspects, merits and demerits of the models of regional development like Growth pole model by Perroux, Growth centre model in Indian context and emergence of the concept of village cluster.
- Explain the various problems associated with regional planning in backward regions, special area development plans focusing on D.V.C in India.
- Identify the indicators of different categories of development (economic, social, environmental, human) and the existing inequality, diversity and disparity in the term of regional development in India.
- Analyze the development and regional disparities in terms of agriculture, industries and education and health resources in India since independence.
- The practical part includes Weaver's method of delineation of region, determination of sphere of influence by gravity model, inequality measurements by Lorenz curve and location Quotient and calculation of Z score and Composite Index.

DSE B4: POPULATION GEOGRAPHY (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

- Study the concepts of Population dynamics by understanding the evolution of Population Geography as a field of specialization and its relation to Demography. It also identifies the sources of population data, their authenticity and the problems associated with population mapping.
- Explain the population distribution, density and growth in India and world.
- Learn the classical and modern theories of population growth with special emphasis on Demographic Transition model.
- Discuss the composition of Indian population in terms of age-sex, rural-urban, occupation, urbanization and literacy and education.
- Understand the concepts of optimum population, cohort, life table, fertility and mortality.
- Study the causes, types and patterns of migration with reference to India.
- Explain the relation between population and development based on populationresource region and Human Development Index.
- Learn about the various population policies in developed and less developed countries of the world focusing on India's population policies and its implications on environment and society as a whole.
- Identify the problems existing in population in terms of aging, declining sex ratio, population and environment dichotomy and impact of HIV/AIDS.
- The practical part includes population projection by arithmetic method, state-wise density mapping and analysis of work participation rate of India, interpretation of occupational structure of West Bengal by dominant and distinctive functions.
SEC A2: FOREST AND WILDLIFE MANAGEMENT (Credits: 02, Theory-02)

Course learning outcome (COs):

After going through the course, the student should be able to:

- Understand the necessity of forest and wildlife management emphasizing on the role of different stakeholders.
- Give an account of the tangible and intangible benefits of forest and wildlife management.
- Study the legalities of various forest and wildlife protection acts in India which were formulated to save the biodiversity and identify the forest rights focusing the rights of tribals.
- Explain the relation between gender and forest, management of forest as common property resource and causes and management of poaching and illegal logging.
- Learn the principles of community participation and joint forest management.
- Analyze the reasons and steps to be taken to control the growing human-wildlife conflict with special reference to JangalMahal, Sundarban and Duars.

SEC B4: SUSTAINABLE DEVELOPMENT (Credits: 02, Theory-02)

Course learning outcome (COs):

After going through the course, the student should be able to:

- Understand the basic concept of sustainable development, its historical background, elements, determinants and limitations.
- Study the linkage among sustainable development, environment and poverty emphasizing on the challenges of sustainable development.
- Identify the different environmental issues concerning population, income and urbanization, health care, forest and water resources.
- Learn about the domain, conflict, crisis and compromise regarding the goals of sustainable development.

Three-year B.Sc. in Mathematics (General) under CBCS System

Graduate Attributes in Mathematics

The aspiring mathematician embarks on a journey woven from logic, proof, and the boundless beauty of numbers. As they progress, they cultivate a unique set of attributes, becoming not just masters of calculation, but architects of knowledge and contributors to the advancement of science and society.

- 1. **Disciplinary Expertise:** A deep understanding of the fundamental concepts, theories, and techniques across various subfields of mathematics forms the bedrock of their intellectual prowess. From abstract number theory to real-world applications in optimization and modeling, their knowledge empowers them to tackle diverse challenges with clarity and rigor.
- 2. Algorithmic Architects: They wield algorithms as tools, constructing computational solutions to complex problems. Be it optimizing financial models, forecasting weather patterns, or deciphering the inner workings of physical systems, their fluency in the language of algorithms equips them to bridge the gap between theory and practice.
- 3. **Crystal Clear Communicator:** The arcane language of mathematics becomes transparent in their articulation. They translate complex concepts into clear and concise explanations, fostering collaboration and nurturing the next generation of mathematical talent.
- 4. **Critical Problem Solver:** Faced with an enigmatic mathematical puzzle, their mind delves into a tapestry of logical deduction. They dissect assumptions, forge elegant solutions, and navigate intricate complexities with unwavering persistence.
- 5. **Inquiry Weaver:** A burning curiosity propels them forward. They craft insightful questions that challenge established paradigms and pave the way for groundbreaking discoveries. They meticulously conduct proofs, present their findings with conviction, and contribute to the ever-evolving dialogue of mathematical inquiry.
- 6. **Collaborative Virtuoso:** The spirit of teamwork flourishes in diverse mathematical ensembles. They seamlessly integrate their expertise, learn from fellow explorers, and cultivate a synergistic environment where knowledge thrives.
- 7. **Project Maestro:** Orchestrating research projects becomes an art form. They identify crucial resources, map strategic pathways, and navigate challenges with meticulous planning and unwavering ethical conduct.
- 8. **Digital Wizardry:** The computer becomes their laboratory, where algorithms paint vibrant landscapes of data. They wield advanced computational tools with mastery, transforming raw numbers into profound insights and unraveling the hidden patterns within.
- 9. Ethical Architect: Integrity becomes the cornerstone of their work. They identify and navigate ethical dilemmas with transparency and fairness, upholding the highest standards of academic conduct and intellectual property.
- 10. **Global Citizen:** Their perspective transcends borders, embracing a deep understanding of the international landscape of mathematics. They see their contributions as threads woven into

the global tapestry of scientific progress, driving advancements for the betterment of humanity.

11. **Lifelong Learner:** The quest for knowledge knows no bounds. They remain self-directed learners, constantly seeking new avenues to refine their skills, update their knowledge, and reshape their expertise. The journey through the boundless world of mathematics is a lifelong pursuit, fueled by unwavering dedication and a boundless passion for exploration.

These attributes paint a portrait of a graduate mathematician poised to make a significant impact on the world. They are not just skilled technicians, but architects of knowledge, collaborators, and leaders in the pursuit of understanding the very fabric of reality through the lens of mathematics.

<u>Program Learning Outcomes (POs) in a B.Sc. (Honours)</u> <u>Mathematics</u>

Program Learning Outcomes (POs) in a Bachelor of Science (Honours) Mathematics program outline the specific knowledge, skills, and abilities that students are expected to acquire by the end of their studies. These outcomes reflect the overall goals of the program and serve as a guide for curriculum development and assessment. Here are some key Program Learning Outcomes for a B.Sc (Honours) Mathematics program:

- 1. **Mathematical Knowledge and Understanding:** Graduates should demonstrate a comprehensive understanding of foundational mathematical concepts, theories, and principles across various branches of mathematics, including but not limited to algebra, calculus, analysis, geometry, and discrete mathematics.
- 2. **Problem-Solving Proficiency:** Graduates should be proficient in applying mathematical techniques to solve complex problems. This involves the ability to analyze problems, formulate mathematical models, and apply appropriate methods for solution.
- 3. **Mathematical Reasoning and Proof:** Graduates should possess strong mathematical reasoning skills and be able to construct rigorous mathematical proofs. This includes understanding the logical structure of mathematical arguments and the ability to communicate proofs effectively.
- 4. Advanced Calculus and Analysis: Graduates should have a deep understanding of advanced calculus and mathematical analysis, including the convergence of sequences and series, limits, continuity, and the fundamental theorems of calculus.
- 5. Algebraic Structures: Graduates should be familiar with algebraic structures such as groups, rings, and fields, and be able to apply abstract algebraic concepts to various mathematical problems.
- 6. **Geometry and Topology:** Graduates should have a solid understanding of geometry and topology, including concepts such as symmetry, transformations, and the properties of geometric shapes.
- 7. **Applied Mathematics:** Graduates should be able to apply mathematical techniques to real-world problems in various scientific and engineering domains. This includes proficiency in mathematical modeling, data analysis, and numerical methods.
- 8. **Mathematical Software and Technology:** Graduates should be proficient in using mathematical software and technology to aid in problem-solving, visualization, and data analysis.

- 9. Effective Communication: Graduates should be able to communicate mathematical ideas clearly and effectively, both in written and oral forms, to diverse audiences, including peers and non-specialists.
- 10. **Independent Research Skills:** Graduates should demonstrate the ability to conduct independent research in mathematics. This includes formulating research questions, conducting literature reviews, and applying appropriate research methodologies.
- 11. Ethical and Professional Conduct: Graduates should adhere to ethical standards in mathematical research and practice, including proper citation of sources, integrity in data analysis, and responsible use of mathematical knowledge.
- 12. Lifelong Learning: Graduates should recognize the importance of lifelong learning in mathematics, staying abreast of new developments in the field, and continuously enhancing their mathematical skills and knowledge.

These Program Learning Outcomes collectively ensure that graduates of the B.Sc (Honours) Mathematics program are well-prepared for a variety of career paths, including further study at the graduate level or employment in fields requiring strong analytical and mathematical skills.

S. No.	POs	CC1/GE1	CC2/GE2	CC3/GE3	CC4/GE4
1	Fundamental understanding of the field	~	~	~	v
2	Application of basic Mathematics concepts	~	~	~	v
3	Linkages with related disciplines	~	~	~	~
4	Procedural knowledge for professional subjects	~	~	~	\checkmark
5	Skills in related field of specialization	~	~	~	v
6	Ability to use in Mathematics problem	~	~	~	~
7	Skills in Mathematical modeling	~	~	~	~
8	Skills in performing analysis and interpretation of data	~	~	~	v
9	Develop investigative Skills	~	~	~	v
10	Skills in problem solving in Mathematics and related discipline	~	~	~	V
11	Develop Technical Communication skills	~	~	~	v
12	Developing analytical skills and popular communication	~	~	~	v
13	Developing ICT skills	~	~	~	v
14	Demonstrate professional behaviour with respect to attribute like objectivity, ethical values, self reading, etc	V	~	~	V

Core Course for B.Sc Mathematics (General)

Discipline Specific Electives (DSE) and

Skill Enhancement Course (SEC) for B.Sc. Mathematics (General)

Sl.	POs	DSE	DSE	DSE P 1	DSE	SEC A	SEC	SEC P 1	SEC B 2
110		AI	A Z	DI	D 2	1	A 2	DI	D Z
1	Fundamental understanding of the field	~	>	~	~	~			
2	Application of basic Mathematical concepts	~	>	~	~	~			
3	Linkages with related disciplines	~	~	~	~	~	<	<	~
4	Procedural knowledge for professional subjects	-	-	-	-	-	~	~	7
5	Skills in related field of specialization	~	>	~	~	~	~	~	>
6	Ability to use in Mathematics problem	~	>	~	~	~	-	>	>
7	Skills in Mathematical modeling	-	-	-	-	-	-	-	-
8	Skills in performing analysis and interpretation of data	-	-	-	-	-	-	>	>
9	Develop investigative Skills	-	-	-	-	-	-	2	7
10	Skills in problem solving in Mathematics and related discipline	•	•	~	~	~	-	-	-
11	Develop Technical Communication skills	-	-	-	-	-	~	~	7
12	Developing analytical skills and popular communication	-	-	-	-	-	~	~	7
13	Developing ICT skills	-	-	-	-	-	~	~	~
14	Demonstrate Professional behaviour with respect to attribute like objectivity, ethical values, self-reading, etc	~	V	~	V	~	~	~	~

Course Learning Outcomes (CLO)

Core Courses (CC)

CC1/GE1 (Credits: 06, Theory-05, Tutorial-01)

Course learning outcome (COs):

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

Unit 1: Algebra-I

- Apply De Moivre's Theorem to solve problems involving complex numbers.
- Calculate exponential, sine, cosine, and logarithm of a complex number.
- Understand the concept of complex exponential and its applications.
- Analyze inverse circular and hyperbolic functions.
- Apply the Fundamental Theorem of Algebra (statement only) to understand polynomials.
- Recognize the nature of roots of an equation using Descarte's rule of signs.
- Utilize Rolle's Theorem and its applications to solve problems.
- Understand the relationship between roots and coefficients, symmetric functions of roots, and transformations of equations.
- Solve cubic equations using Cardan's method.
- Determine the rank of a matrix using minors or sweep-out process.
- Apply matrix methods to solve consistent and inconsistent systems of linear equations with up to 3 variables.

Unit 2: Differential Calculus-I

- Differentiate between rational and irrational numbers, and understand their geometrical representations.
- Explain how real numbers are represented as points on a line and identify basic properties of real numbers.
- Define the limit of a function using Cauchy's definition and perform algebra of limits.
- Analyze the continuity of a function at a point and in an interval.
- Understand the concept of derivative and its geometrical and physical interpretations.
- Determine the sign of a derivative to identify monotonic increasing and decreasing functions.
- Recognize the relationship between continuity and derivability.
- Apply differentials to find approximations.
- Understand the concept of successive derivatives and use Leibnitz's theorem.

- Visualize and analyze functions of two and three variables using geometrical representations.
- Define and apply the concepts of limit and continuity (definitions only) for functions of two variables.
- Calculate partial derivatives and utilize the chain rule for solving problems.
- Identify exact differentials and solve related problems.
- Understand the concepts of successive partial derivatives and apply Schwarz's Theorem and Euler's Theorem.
- Apply differential calculus to solve problems involving curvature of plane curves, rectilinear asymptotes, envelopes of families of lines and curves, and singular points.

Unit 3: Differential Equations-I

- Define the order, degree, and solution of an ordinary differential equation (ODE) in the presence of arbitrary constants.
- Understand the formation of ODEs.
- Solve first-order differential equations for various cases, including:
 - Exact equations and those reducible to such equations
 - Ricatti and Bernoulli equations (linear)
 - Clairaut's equations (general and singular solutions)
- Analyze second-order linear differential equations, including those with constant coefficients and Euler's homogeneous equations.
- Apply the methods of variation of parameters and undetermined coefficients to solve second-order differential equations.

Unit 4: Coordinate Geometry

- Understand and apply transformations of rectangular axes, including translation, rotation, and their combinations, and recognize invariants.
- Analyze the general equation of the second degree in x and y, including reducing it to standard forms and classifying conics.
- Determine the conditions for the general equation of the second degree in x and y to represent two straight lines, and find the point of intersection of two intersecting straight lines.
- Calculate the angle between two lines given by the equation $ax^2 + 2hxy + by^2 = 0$ and find the equations of bisectors.
- Derive the equations of two lines joining the origin to the points where a line meets a conic.
- Analyze the equations of a pair of tangents from an external point, chord of contact, poles and polars for conics in general, with a focus on particular cases for parabola, ellipse, circle, and hyperbola.
- Understand polar equations of straight lines and circles, and the polar equation of a conic

referred to a focus as the pole.

- Calculate the equations of a chord joining two points and the equations of tangent and normal.
- Analyze the equation of a sphere and its tangent plane, as well as the equation of a right circular cone.

- Develop their problem-solving and critical thinking skills.
- Enhance their mathematical communication and reasoning abilities.
- Gain confidence in applying mathematical concepts to real-world scenarios.

CC2/GE2 (Credits: 06, Theory-05, Tutorial-01)

Course learning outcome (COs):

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

Unit 1: Differential Calculus-II

- Define and analyze sequences of real numbers, including bounds, monotone sequences, limits, convergence, and divergence.
- Apply Cauchy's general principle of convergence to infinite series of constant terms.
- Utilize various tests like comparison test, D'Alembert's ratio test, Cauchy's nth root test, Raabe's test, and Leibnitz test to determine the convergence or divergence of infinite series of positive terms and alternating series.
- Understand and apply Rolle's Theorem, Lagrange's mean value theorem, and Cauchy's mean value theorem to real-valued functions on an interval.
- Analyze indeterminate forms using L'Hospital's rule.
- Apply the principle of maxima and minima for a function of a single variable in various contexts, including geometrical, physical, and other problems.
- Solve problems involving maxima and minima of functions of not more than three variables using Lagrange's method of undetermined multipliers.

Unit 2: Differential Equation-II

- Solve linear homogeneous and non-homogeneous differential equations with constant coefficients using various methods, including the method of variation of parameters.
- Analyze Cauchy-Euler equations.
- Understand and solve systems of simultaneous differential equations.
- Introduce the concept of eigenvalue problems and solve simple cases.

Unit 3: Vector Algebra

- Perform operations on vectors, including addition, scalar multiplication, collinear and coplanar analysis, scalar and vector products, and applications to problems in geometry.
- Derive and utilize the vector equation of a plane and a straight line.
- Calculate the volume of a tetrahedron.
- Apply vector concepts to problems in mechanics, such as work done and moment.

Unit 4: Discrete Mathematics

- Understand and utilize the principle of mathematical induction in various forms, including the strong form, and apply it to solve different problems.
- Prove the division algorithm and use it to uniquely represent an integer in an arbitrary base and perform base conversions.
- Understand the concept of prime integers and prove fundamental theorems in number theory, including Euclid's theorem.
- Solve linear Diophantine equations and apply them to practical problems.
- Define congruence relations on integers and analyze their basic properties.
- Solve linear congruences and apply the Chinese Remainder Theorem to systems of linear congruences.
- Utilize congruences to develop divisibility tests and implement check-digit systems for error detection.
- Define and perform operations on congruence classes and apply Fermat's Little Theorem, Euler's Theorem, and Wilson's Theorem to solve problems.
- Understand the principles of Boolean algebra, analyze Boolean functions, design logic gates, and minimize circuits.

- Develop their problem-solving and critical thinking skills.
- Enhance their mathematical communication and reasoning abilities.
- Gain confidence in applying mathematical concepts to real-world scenarios.

CC3/GE3 (Credits: 06, Theory-05, Tutorial-01)

Course learning outcome (COs):

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

Unit 1: Integral Calculus

- Evaluate definite integrals using various techniques.
- Understand the concept of integration as the limit of a sum and apply it to solve problems with both equally spaced and unequal intervals.
- Utilize reduction formulae to integrate functions of the form sin^m x cosⁿ x and tan^m x, and solve related problems.
- Define improper integrals and analyze their convergence using µ-test and comparison test.
- Work with Beta and Gamma functions, assuming knowledge of their convergence and important relations.
- Have a working knowledge of double integrals.
- Apply integral calculus to solve problems in rectification, quadrature, volume and surface areas of solids of revolution, and area calculations.

Unit 2: Numerical Methods

- Understand the basics of approximate numbers, significant figures, and rounding off numbers.
- Analyze different types of errors, including absolute, relative, and percentage error.
- Define and utilize operators Δ , ∇ , and E, and understand their relationships.
- Perform interpolation using various methods, including Newton's forward and backward interpolation formulas (with understanding of remainder terms) and Lagrange's interpolation formula for unequally spaced arguments.
- Solve numerical integration problems using Trapezoidal and Simpson's 1/3-rd formulas.
- Find the real root of an algebraic or transcendental equation using numerical methods such as location of root (tabular method), bisection method, and Newton-Raphson method (with an understanding of its geometrical significance).
- Emphasize problem-solving skills within this unit.

Unit 3: Linear Programming

- Grasp the motivation and understand the statement and formulation of a linear programming problem (LPP).
- Analyze the role of slack and surplus variables, and express LPPs in matrix form.
- Define and differentiate between convex sets, hyperplanes, extreme points, convex polyhedrons, basic solutions, and basic feasible solutions (BFS). Understand degenerate and non-degenerate BFS.
- Prove statements like "the set of all feasible solutions of an LPP is a convex set" and "the objective function of an LPP assumes its optimal value at an extreme point of the convex set of feasible solutions."
- Understand the Fundamental Theorem of LPP and its implications.
- Reduce a feasible solution to a BFS and solve LPPs using both graphical (for two variables) and simplex methods.
- Introduce the concept of duality and understand the relationships between primal and dual problems.
- Solve dual problems with specific limitations (e.g., one unrestricted variable, one equality constraint).
- Understand and solve transportation and assignment problems to find optimal solutions.

- Develop their problem-solving and critical thinking skills.
- Enhance their mathematical communication and reasoning abilities.
- Gain confidence in applying mathematical concepts to real-world scenarios.

CC4/GE4

(Credits: 06, Theory-05, Tutorial-01)

Course learning outcome (COs):

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

Unit 1: Algebra-II

- Define and demonstrate the concept of group theory with examples from various branches of mathematics and science.
- Analyze elementary properties of groups and sub-groups based on the definition.
- Distinguish and provide examples of rings, fields, sub-rings, and sub-fields.
- Understand the concept of vector space over a field, including examples, linear combinations, linear dependence and independence, sub-spaces, generators, and basis of a finite-dimensional vector space.
- Solve problems related to forming the basis of a vector space without needing to prove theoretical concepts.
- Analyze real quadratic forms involving up to three variables through problem-solving.
- Determine eigenvalues and eigenvectors for square matrices of order at most three using the characteristic equation and understand the Cayley-Hamilton Theorem through illustrations.

Unit 2: Computer Science & Programming

- Understand the historical development, current generation, and anatomy of computers, including different components, operating systems, hardware, and software.
- Analyze positional number systems, including binary, decimal conversions, other systems, binary arithmetic, and data storage in computers using bits, bytes, and words.
- Grasp the concepts of coding data with ASCII and other methods.
- Differentiate between machine language, assembly language, and high-level languages, and understand compilers, interpreters, object programs, and source programs.
- Gain basic knowledge of some high-level languages like BASIC, FORTRAN, C, C++, COBOL, and PASCAL.
- Understand the utilities and functionalities of algorithms and flowcharts, and recognize the concept of algorithmic complexity.
- Apply these concepts to solve simple problems.
- Have foundational knowledge of FORTRAN 77/90, including data types, keywords, constants, variables, Fortran expressions, and basic programming concepts.

Unit 3: Probability & Statistics

- Understand the elements of probability theory, including random experiments, outcomes, events, mutually exclusive and exhaustive events, classical definition of probability, theorems of total probability, conditional probability, statistical independence, Bayes' Theorem, and limitations of the classical definition.
- Solve problems related to these concepts.
- Grasp the axiomatic approach to probability and problems related to random variables and their expectation.
- Analyze joint distributions of two random variables.
- Define and differentiate between discrete and continuous probability distributions, focusing on binomial, Poisson, and normal distributions and their properties.
- Understand the elements of statistical methods, including variables, attributes, primary and secondary data, population and sample, census and sample survey, tabulation charts and diagrams, frequency distributions, measures of central tendency (averages, median, mode), measures of dispersion (range, quartile deviation, mean deviation, variance/standard deviation, moments, skewness, and kurtosis).
- Learn about sampling theory, its purpose, methods of selecting samples, and the difference between statistics and parameters.
- Understand the four fundamental distributions derived from the normal: standard normal, chi-square, Student's t, and Snedecor's F-distribution.
- Gain insight into estimation and test of significance, including statistical inference, theory of estimation (point estimation and interval estimation), confidence intervals/limits, statistical hypotheses (null and alternative hypotheses), level of significance, critical region, type I and II errors, and problem-solving.
- Analyze bivariate frequency distributions using scatter diagrams, co-relation coefficient with its properties, and regression lines.

- Develop their problem-solving and critical thinking skills.
- Enhance their mathematical communication and reasoning abilities.
- Gain confidence in applying mathematical and statistical concepts to real-world scenarios.

SEC A 1: C Programming Language (Credits: 02, Full Marks- 80+20)

Course Outcomes:

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

- Understand the basic concepts of theoretical computers and the history of computer development.
- Describe the fundamental architecture of a computer and its core components.
- Differentiate between compilers, assemblers, machine language, high-level languages, object-oriented languages, and programming languages in general.
- Explain the importance of C programming in various applications.
- Define and utilize different data types (character, integer, float, etc.) in C programs.
- Declare and initialize variables in C programs following proper syntax and conventions.
- Construct and evaluate arithmetic, relational, and logical expressions in C programs.
- Implement decision-making control structures using if statements, if-else statements, nested if statements, switch statements, and break and continue statements.
- Control program flow using loop statements like while loops, do-while loops, and for loops.
- Define and create one-dimensional, two-dimensional, and multidimensional arrays in C programs.
- Understand the process of user-defined function creation and implementation, including scope of variables, return values and their types, function declaration, call by value, function nesting, passing arrays to functions, and recursion.
- Utilize basic library functions from standard libraries like stdio.h, math.h, string.h, stdlib.h, and time.h to perform common tasks in C programs.

- Develop their problem-solving and critical thinking skills.
- Improve their logical reasoning and algorithmic thinking abilities.
- Enhance their coding skills and understanding of fundamental programming concepts.
- Gain confidence in writing simple C programs to solve problems.

SEC B 1: Mathematical Logic (Credits: 02, Full Marks- 80+20)

Course Outcomes:

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

Unit 1: Introduction to Logic

- Define fundamental concepts in logic, such as propositions, truth tables, negation, conjunction, and disjunction.
- Analyze the truth values of complex propositions using truth tables.
- Understand and apply implications, biconditional propositions, converse, contrapositive, and inverse propositions.
- Identify the precedence of logical operators in complex expressions.
- Introduce the concepts of formal language, object and meta language, and provide a general definition of a formal theory and formal logic.

Unit 2: Propositional Logic

- Analyze the formal theory for propositional calculus, including the concepts of derivation, proof, theorem, deduction theorem, conjunctive and disjunctive normal forms.
- Understand the semantics of propositional logic through truth tables.
- Identify tautologies and determine an adequate set of connectives for propositional logic.
- Apply propositional logic to analyze and design switching circuits.
- Differentiate between logical consequence, consistency, maximal consistency, and understand the implications of the Leindenbaum lemma.
- Prove the soundness and completeness theorems for propositional logic.
- Introduce algebraic semantics as a representation of propositional logic.

Unit 3: Predicate Logic

- Understand the concepts of first-order language and the process of symbolizing ordinary sentences into first-order formulae.
- Differentiate between free and bound variables in first-order formulae.
- Analyze the interpretation and satisfiability of first-order formulae, and introduce the concept of models.
- Define logical validity in predicate logic and develop a formal theory for it.
- Understand and apply various rules like the deduction theorem, equivalence theorem, replacement theorem, and choice rule to derive new formulae.
- Convert formulae to Prenex normal form for clearer analysis.

- Prove the soundness theorem for predicate logic, and understand the implications of the completeness and compactness theorems.
- Extend the theory to include equality and provide examples of first-order theories for structures like groups, rings, and fields.

- Develop their critical thinking and analytical skills.
- Enhance their ability to formulate arguments and reasoning precisely.
- Gain an understanding of the foundations of formal logic and its applications in various fields, including mathematics, computer science, and philosophy.
- Improve their communication skills by learning to express complex ideas clearly and concisely using formal language.

SEC A 2: Object Oriented Programming in C++ (Credits: 02, Full Marks- 80+20)

Course Outcomes:

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

Unit 1: Introduction to C++

- Define and differentiate between various programming paradigms, with a specific focus on the characteristics of object-oriented programming languages.
- Provide a brief history of the C++ programming language and its development.
- Understand the basic structure of a C++ program and compare it to C programs.
- Differentiate between C and C++ with respect to syntax, features, and capabilities.
- Explain and utilize various basic C++ operators for performing different operations.
- Effectively add comments to C++ programs for improved readability and documentation.
- Work with variables in C++, understanding different data types, declaration, initialization, and assignment.
- Introduce the concepts of enumeration, arrays, and pointers in C++ and their basic usage.

Unit 2: Object-Oriented Programming in C++

- Define and create objects and classes in C++, understanding their relationship and structure.
- Explain the role and implementation of constructors and destructors in managing object lifecycles.
- Utilize friend functions and inline functions within C++ programs, understanding their advantages and limitations.
- Understand the concept of encapsulation and its role in data abstraction and protection.
- Implement inheritance in C++ programs to achieve code reuse and extend functionalities.
- Explain the concept of polymorphism, including static and dynamic binding, and its benefits in object-oriented programming.
- Overload operators in C++, including arithmetic and comparison operators, to customize their behavior for specific data types.
- Differentiate between method overloading and operator overloading and their respective applications.

Unit 3: Advanced C++ Features

- Understand and utilize template classes in C++ for generic programming and code reuse.
- Implement copy constructors in C++ programs to handle object copying efficiently.
- Define and utilize subscript and function call operators in C++ to provide custom behavior for accessing and manipulating objects.
- Explain the concept of namespaces in C++ and their role in organizing and preventing name conflicts.
- Implement exception handling techniques in C++ programs to manage and recover from errors during runtime.

- Develop their problem-solving and critical thinking skills.
- Enhance their logical reasoning and algorithmic thinking abilities.
- Improve their coding skills and understanding of object-oriented programming concepts.
- Gain confidence in writing C++ programs for various applications.

SEC B 2: Boolean Algebra (Credits: 02, Full Marks- 80+20)

Course Outcomes:

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

- Define and recognize ordered sets and provide examples.
- Analyze the basic properties of ordered sets, including the duality principle, existence of maximal and minimal elements, and operations like meet and join.
- Understand the connection between lattices and ordered sets, recognizing lattices and their properties.
- Identify and differentiate between complete lattices and non-complete lattices.
- Analyze lattices as algebraic structures, understanding sublattices, products, and homomorphisms.
- Define and distinguish between modular and distributive lattices, providing examples.
- Understand the concept of Boolean algebras and identify their properties.

Boolean Algebra:

- Work with Boolean polynomials, understanding their structure and operations.
- Determine the minimal forms of Boolean polynomials using techniques like Quinn-McCluskey method and Karnaugh diagrams.
- Design and analyze switching circuits, utilizing Boolean algebra principles.
- Apply Boolean algebra techniques to minimize switching circuits for efficient implementation.

- Develop their skills in mathematical reasoning and proof techniques.
- Enhance their ability to think abstractly and apply mathematical concepts to practical problems.
- Gain a deeper understanding of logic and its applications in computer science and engineering.
- Improve their problem-solving abilities and critical thinking skills.

DSE-A 1: Particle Dynamics (Credits: 06, Theory-05, Tutorial-01)

Course Outcomes:

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

Unit 1: Kinematics

- Understand the concepts of velocity and acceleration for a particle moving in a plane.
- Calculate the velocity and acceleration of a particle using both rectangular Cartesian and polar coordinate systems.
- Analyze the tangential and normal components of velocity and acceleration for a particle moving along a plane curve.

Unit 2: Kinetics

- Explain the fundamental principles of Newtonian mechanics and apply Newton's laws of motion to solve problems involving forces acting on particles.
- Define and calculate work, power, and energy for a particle undergoing various motions.
- Apply the principles of conservation of energy and momentum to predict the behaviour of mechanical systems.
- Analyze the motion of a particle under impulsive forces and solve the equations of motion for particles moving in both straight lines and planes.

Unit 3: Special Cases of Motion

- Investigate the motion of a particle in a straight line under different force conditions, including constant forces, variable forces (simple harmonic motion, inverse square law, damped oscillation, forced and damped oscillation, motion in an elastic string), and analyze the corresponding energy equation.
- Differentiate between conservative and non-conservative forces.

Unit 4: Two-Dimensional Motion

- Analyze the motion of projectiles in both vacuum and a medium with resistance varying linearly as velocity.
- Solve problems involving particles moving under forces varying as distance from a fixed point.

Unit 5: Central Force Motion

- Understand Kepler's laws of planetary motion and apply them to analyze the motion of orbiting bodies.
- Investigate the motion of a particle under an inverse square law force and solve the related equations of motion.

- Develop their problem-solving and critical thinking skills.
- Enhance their ability to apply mathematical concepts to physical problems.
- Gain a deeper understanding of the fundamental principles of motion and their applications in various disciplines.
- Improve their communication skills by formulating and explaining solutions to mechanics problems clearly and concisely.

DSE-A 2: Graph Theory (Credits: 06, Theory-05, Tutorial-01)

Course Outcomes:

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

Basic Graph Concepts:

- Define and identify different types of graphs, including pseudographs, complete graphs, bipartite graphs, and recognize isomorphisms between graphs.
- Analyze paths and circuits in graphs, understanding the concepts of Eulerian circuits and Hamiltonian cycles.
- Utilize the adjacency matrix to represent weighted graphs and perform operations on them.
- Formulate and solve the traveling salesman problem using appropriate algorithms.
- Determine the shortest path between two nodes in a graph using algorithms like Dijkstra's algorithm and Floyd-Warshall algorithm.

Trees and Planar Graphs:

- Define and recognize different types of trees and their fundamental properties.
- Understand the concept of planar graphs and identify non-planar graphs using Kuratowski's theorem.

- Develop their problem-solving and critical thinking skills.
- Enhance their ability to represent and analyze complex relationships using graph models.
- Gain insights into efficient algorithms for solving optimization problems related to graphs.
- Improve their communication skills by explaining graph concepts and reasoning logically about graph properties.

DSE-B 1: Advanced Calculus

(Credits: 06, Theory-05, Tutorial-01)

Course Outcomes:

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

Unit 1: Convergence of Sequences and Series of Functions

- Differentiate between point-wise and uniform convergence for sequences and series of functions.
- Apply the Weierstrass M-test for determining uniform convergence of both sequences and series of functions.
- Solve basic problems demonstrating the application of the M-test.
- Analyze the implications of uniform convergence, including boundedness, continuity, differentiability, and integrability of the limit function for sequences and the sum function for series.
- Determine the radius of convergence for power series using established methods.
- Explain the continuity properties of the sum function of power series.
- Apply term-by-term integration and differentiation techniques to power series when valid.
- Understand and utilize Abel's theorems on power series for analyzing their convergence.
- Expand various elementary functions like e^x, sin(x), ln(1+x), and (1+x)ⁿ using power series and solve related problems.

Unit 2: Fourier Series

- Define and analyze periodic functions defined on the interval $(-\pi, \pi)$.
- Calculate Fourier coefficients for representing periodic functions as Fourier series.
- Understand and apply Dirichlet's conditions for the convergence of Fourier sine and cosine series.
- Explain the theorem on the convergence of Fourier series under Dirichlet's conditions.

Unit 3: Laplace Transform and Applications

- Define and understand the concepts of Laplace transform and its inverse.
- Explain the existence theorem for Laplace transforms.
- Analyze the elementary properties of Laplace transforms and their inverses.
- Apply Laplace transforms to solve second-order ordinary differential equations with constant coefficients.

- Develop their theoretical understanding of convergence concepts in real analysis.
- Enhance their ability to analyze and manipulate series of functions effectively.
- Gain proficiency in applying various theorems and techniques to solve problems related to Fourier series and Laplace transforms.
- Improve their critical thinking and problem-solving skills in the context of advanced mathematical concepts.

DSE-B 2: Mathematical Finance

(Credits: 06, Theory-05, Tutorial-01)

Course Outcomes:

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

Financial Fundamentals:

- Understand the basic principles of finance, including comparison, arbitrage, risk aversion, and the role of interest (simple, compound, discrete, and continuous) in time value of money.
- Analyze the impact of inflation on financial decisions and calculate net present value of cash flows to account for it.
- Determine the internal rate of return (IRR) of an investment using both bisection and Newton-Raphson methods.
- Compare and contrast NPV and IRR as investment decision criteria.

Debt Instruments:

- Understand the concepts of bonds, bond pricing, and yields.
- Evaluate different types of bonds, including floating-rate bonds, and explore techniques like immunization to manage interest rate risk.

Investment Analysis:

- Analyze the returns of individual assets, including the concept of short selling.
- Calculate the return and variance of a portfolio, understanding the benefits of diversification.
- Visualize the feasible set of portfolios and utilize the Markowitz model (with a review of Lagrange multipliers) to optimize portfolio composition for efficient risk-return trade-offs.

- Develop their quantitative and analytical skills by applying mathematical concepts to financial problems.
- Enhance their critical thinking and decision-making abilities in the context of investments.
- Gain an understanding of fundamental financial instruments and their risks and returns.
- Improve their communication skills by explaining financial concepts and reasoning about investment decisions.

Program Learning Outcomes (POs) in B.Sc Physics (General)

The student graduating with the Degree B.Sc General should be able to

• Acquire

(i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications in basic Physics.

(ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;

(iii) skills in areas related to one's specialization area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.

- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Recognize the importance of mathematical modeling simulation and computing, and the role of approximation and mathematical approaches to describing the physical world.
- Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.

- Demonstrate relevant generic skills and global competencies such as (i) problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries; (ii) investigative skills, including skills of independent investigation of Physics-related issues and problems; (iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature; (iv) analytical skills involving paying attention to detail and ability to translate them with popular language when needed; (v) ICT skills; (vi) personal skills such as the ability to work both independently and in a group.
- Demonstrate professional behavior such as (i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism; (ii)the ability to identify the potential ethical issues in work-related situations; (iii) appreciation of intellectual property, environmental and sustainability issues; and (iv) promoting safe learning and working environment.

Core Course & Generic Elective & Discipline Specific Electives & Skill Enhancement Course for B.Sc General

S1.	POs	CC-1/	CC-2/	CC-3/	CC-4/	DSE A1	DSE	SEC	SEC
No.		GE-1	GE-2	GE-3	GE-4		B1	A1	B1
1	Fundamental understanding	Х	X	Х	Х	Х	Х	-	-
2	Application of basic Physics concepts	X	X	Х	Х	Х	Х	-	-
3	Linkages with related disciplines	X	X	X	Х	X	Х	Х	Х
4	Procedural knowledge for professional subjects	X	Х	X	Х	X	Х	Х	Х
5	Skills in related field of specialization	X	X	Х	Х	Х	Х	Х	Х
6	Ability to use in Physics problem	Х	Х	Х	Х	Х	Х	-	Х
7	Skills in Mathematical modeling	X	X	X	Х	_	-	-	-
8	Skills in performing analysis and interpretation of data	X	X	X	Х	X	Х	-	X
9	Develop investigativeSkills	Х	X	Х	Х	X	Х	-	Х
10	Skills in problem solving in Physics and related discipline	X	X	Х	Х	X	Х	-	-
11	Develop Technical Communication skills	X	Х	Х	Х	Х	Х	Х	Х
12	Developing analytical skills and popular communication	X	X	Х	Х	Х	Х	Х	Х
13	Developing ICT skills	X	X	X	Х	-	-	Х	X
14	DemonstrateProfessional behavior with respect to attribute like objectivity, ethical values, selfreading, etc	X	X	X	Х	X	Х	X	X

CC-1/GE-1: MECHANICS

(Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

After going through the course, the student should be able to

- Understand the role of vectors and coordinate systems in Physics.
- Write the expression for the moment of inertia about the given axis of symmetry for different uniform mass distributions.
- Explain the conservation of energy, momentum, angular momentum and apply them to basic problems.
- Understand the analogy between translational and rotational dynamics, and application of both motions simultaneously in analyzing rolling with slipping.
- Apply Kepler's law to describe the motion of planets and satellite in circular orbit.
- Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.
- Explain the general properties of matter like surface tension and elasticity.
- In the laboratory course, after acquiring knowledge of how to handle measuring instruments (like screw gauge, vernier callipers, Travelling microscope) student shall embark on verifying various principles learnt in theory. Measuring 'g' using Bar Pendulum, and measuring different elastic constants, moment of inertia of materials,

CC-2/ GE-2: ELECTRICITY AND MAGNETISM (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

After going through the course, the student should be able to

- Learn essential vector analysis.
- Demonstrate Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- Explain and differentiate the vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
- Apply Gauss's law of electrostatics to solve a variety of problems.
- Articulate knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.
- Describe the magnetic field produced by magnetic dipoles and electric currents.
- Explain Faraday-Lenz and Maxwell laws to articulate the relationship between electric and magnetic fields.
- Describe how magnetism is produced and list examples where its effects are observed.
- Learn the basics of electrodynamics.
- In the laboratory course the student will get an opportunity to measure unknown resistance using Carey-Foster bridge, measurement of a current flowing through a resistance using potentiometer, determination of horizontal components of earth's magnetic field, conversion of a voltmeter to an ammeter and vice versa.

CC-3/ GE-3: THERMAL PHYSICS AND STATISTICALMECHANICS (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

- Learn the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations. They are also expected to learn Maxwell's thermodynamic relations.
- Know the fundamentals of the kinetic theory of gases, Maxwell-Boltzman distribution law, equipartition of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.
- Learn about the black body radiations, Stefan- Boltzmann's law, Rayleigh-Jean's law and Planck's law and their significances.
- Learn the quantum statistical distributions, viz., the Bose-Einstein statistics and the Fermi-Dirac statistics.
- In the laboratory, the students are expected to perform the following experiments:
 - (i) To determine Stefan's Constant,
 - (ii) To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method
 - (iii) Determination of thermal coefficient of resistance using Carey-Foster bridge.
 - (iv) To determine the coefficient of linear expansion by optical lever method.
 - (v) To determine the pressure coefficient of air by using Jolly's apparatus.
CC-4 & GE-4: WAVES AND OPTICS (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

This course will enable the student to

- Recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems.
- Understand the principle of superposition of waves, so thus describe the formation of standing waves.
- Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.
- Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.
- Understand the working of selected optical instruments like biprism, interferometer, diffraction grating,.
- In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, determining focal length of concave lens by auxiliary method, measurement of thickness of a paper using wedge shaped film, measurement of specific rotation using polarimeter, determination of frequency of a tuning fork using sonometer.

DSE-A1: ANALOG ELECTRONICS (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs) :

After the successful completion of the course the student is expected to master the following

- Active and passive components of a circuit and different Network theorems.
- Working of P and N type semiconductors, P-N junctions, Forward and Reverse biased junctions, LEDs, photodiode and solar cells, p-n-p,n-p-n transistors, different characteristics of CB,CE and CC configurations, load line, gain and biasing for CE amplifiers and classification of amplifiers.
- Construction and characteristics of regulated power supply.
- Characteristics, operations of different types of field effect transistors.
- Feedback amplifiers and its characterization.
- Operational amplifiers and its characterization, circuits using Op-Amp for making Summing and subtracting circuits, differentiators and integrators.
- Operation of different sinusoidal amplifiers.
- At the successful completion of the laboratory course the student is expected to acquire hands on skills/ knowledge on the following:
 - i. Verification of Network theorems
 - ii. Emitter characteristics of a LED
 - iii. Characteristics of transistor in CE configuration
 - iv. Construction of Regulated power supply
 - v. Study of OPAMP : inverting, non-inverting amplifier, adder, substractor.

DSE-B1: DIGITAL ELECTRONICS (Credits: 06, Theory-04, Practicals-02)

Course learning outcome (COs):

After the successful completion of the course the student is expected to master the following

- Difference between analog and digital circuits,
- Number systems, their inter conversions,
- Basic logic gates and combinational circuits to construct half adders, full adders, substractors, 4 bit binary Adder -Subtractor and synthesis of circuits using Boolean algebra.
- Operation of different data processing circuits and different flip-flops.
- Working principles of counters and registers.
 - At the successful completion of the laboratory course the student is expected to acquire hands on skills/ knowledge on the following:-
- i) Verify and construct AND, OR, NOT, XOR gate using NAND gates.
- ii) Construction of half adder, full adder using universal gates.
- iii) Construction of different flip flops using NAND gates.
- iv) Construction of shift register using D type FF.
- v) Construction of multiplexer.

SEC-A1: SCIENTIFIC WRITING

(Credits: 02, Theory-01, Project-01)

Course learning outcome (COs):

At the end of the course the student is expected to have an idea/concept of the following,

- Introduction to scientific writing using LATEX and its different packages.
- Different document classes, page layout and list structure.
- Representation of different mathematical functions and equations.
- Usage of different fonts, creating tables, inserting figures.
- Students are expected to complete a project by writing articles, laboratory reports including graphical analysis of data, bio-data etc using LATEX.

SEC-B1: ARDUINO

(Credits: 02, Theory-01, Project-01)

Course learning outcome (COs):

At the end of the course the student is expected to have an idea/concept of the following,

- Introduction to open source electronic prototyping: ARDUINO.
- Basic idea of ARDUINO board and installation of IDE for programming..
- Structure of ARDUINO programming and interfacing with different devices.
- Students are expected to complete a project by performing simple experiments like LED blinking, interfacing of 7 segment display, construction of thermometer, constructing data logger for studying charging and discharging of capacitor

Programme Learning Outcomes (PO) in B.Sc. (General) Zoology

1. Demonstrate (i) in-depth knowledge and understanding about the fundamental concepts, principles and processes underlying the academic field of Zoology and its different subfields (animal diversity, principles of ecology, comparative anatomy and developmental biology of vertebrates, physiology and biochemistry, genetics and evolutionary biology, animal biotechnology, applied Zoology, aquatic biology, immunology, reproductive biology, and insect, vectors and diseases, apiculture, aquarium fish keeping, medical diagnostics, and sericulture) (ii) procedural knowledge that creates different types of professionals in the field of Zoology and related fields such as, apiculture, aquarium fish keeping, medical diagnostics, and sericulture, etc.(iii) skills related to specialization areas within Zoology as well as within subfields of Zoology, including broader interdisciplinary subfields (Chemistry, Physics and Mathematics).

2. Appreciate the complexity of life processes, their molecular, cellular and physiological processes, their genetics, evolution and behaviour and their interrelationships with the environment.

3. Study concepts, principles and theories related with animal behaviour and welfare.

4. Understand and interpret data to reach a conclusion

5. Design and conduct experiments to test a hypothesis.

6. Understand scientific principles underlying animal health, management and welfare.

7. Accept the legal restrictions & ethical considerations placed for animal welfare.

8. Understand fundamental aspects of animal science relating to management of animals.

9. Assess problems and identify constraints in management of livestock.

Course Learning Outcomes (CO) in B.Sc. (General) Zoology

CC1 Animal diversity

1. Students will learn the general characteristics and classifications of phylum Non chordate and Chordate help student to know animal kingdom properly

2. Students will be familiar with the non- chordate world that surrounds us

3. Students learn to identify the invertebrates and classify them up to the class level with the basis of systematics.

4. Students understand the basis of life processes in the non-chordates and recognize the important invertebrate fauna.

5. Students knowledge about the various internal systems within students.

6. Students learn about the evolution, hierarchy and classification of different classes of chordates.

7. Students get an overview of the morphology and physiology of typical examples

8. Students are acquainted with the systematic positions of animals, morphological features and relations among different animals through charts, models and e-resource.

CC2 Comparative Anatomy & Developmental Biology

1. Students come know integument with respect to glands

2. Students come to know different types of internal organs, like- digestive system, circulatory system, respiratory system, urino- genital system.

3. Students come the processes of early embryonic development like- gametogenesis, fertilization, fate map, gastrulation.

4. Students learn the processes of late embryonic development like placenta, metamorphosis in frog.

5. Students develop the comparative idea of osteology of Pigeon, Guineapig and Dog in students.

6. Students develop the comparative idea of different types of placenta in students.

7. Students develop the comparative idea of developmental stages of chick embryo and morphological features of larva in students.

CC3 Physiology and Biochemistry

1. Students learn about structure and function of nerve and muscle

2. Students understand physiology of digestion

3. Students understand physiology of respiration and transportation of oxygen and carbon- di- oxide

4. Students understand composition of blood, structure of heart to this through this module.

5. Students learn about excretion system

6. Students understand reproduction and effect of endocrine in reproduction

7. Students understand metabolism of carbohydrate, lipid, protein

8. Students understand the action of enzyme to students.

9. Students develop the idea of histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, duodenum, liver, lung, kidney. and qualitative test of carbohydrate.

CC4 Genetics and Evolutionary Biology

1. This unit gives the concept of procedure of genetic inheritance with special reference of White eye locus & Thalassemia.

2. Students get idea on crossing over techniques and linkage of gene.

3. Students learn about types of gene mutation and procedure of gene mutation students.

4. Students learn about sex determination process in Drosophila to students.

5. Students get idea about origin of life (chemical).

6. Students will be taught the evolutionary theories like Lamarckism, Darwinism, Neo-Darwinism.

7. Students learn about isolation mechanism and natural selection

8. Students learn about speciation procedure like Sympatric, Allopatric and Parapatric.

9. Students are taught verification of Mendelian ration through Chi- square test.

10. Through karyotypes students learn to identify aneuploidy.

11. Students learn phylogeny of horse by diagram of skull and limb.

12. Students learn the adaptive radiation through studying the photographs of Darwin's finches.

13. Visiting to natural history museum and submission of report teaches tracking the fosile record, and evolutionary mechanism of life.

SEC A-3-1 Apiculture

1. Students learn about the morphology of bees and their social behaviour.

2. Students understand the culture methods of honey bees and introduce with different modern instruments.

3. Students gain idea about disease of honey bees and control measures.

4. Students understand about the apiary products and their uses.

5. Students come to know about the modern methods introduced to improve bee industry

SEC B-4-2 Aquarium Fishery

1. The students are introduced in Aquarium fishery, its potential, candidate fishes.

2. The students get a basic idea of the biology of some indigenous as well as exogenous ornamental fishes.

3. Students get knowledge of use of live feed in aquarium culture, feed formulation and larval control by ornamental fishes.

4. Students gain knowledge about fish handling techniques, transport and packaging.

5. Students gain practical knowledge regarding the set-up of an aquarium and its budget.

SEC A-5-3 Sericulture

1. This unit provides students with a basic idea about taxonomy, morphology and distribution silk moth.

2. Students gain knowledge the life history of Bombyx mori.

3. Students can understand the culture of mulberry plant through this unit.

4. Through this unit students get knowledge about pest and disease of silk moth

SEC B-6-4 Medical Diagnosis

1. Through this unit of practical students are taught about Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentation Rate.

2. The students get knowledge of Urine Analysis, Physical characteristics; Abnormal constituents, Urine culture to students.

3. Students gain knowledge about the causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

4. This unit helps students to learn to find out causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis, Malarial parasite

5. Students learn to study Lipid profiling, Liver function test. PSA test.

6. Students are taught about Antibiotic Sensitivity Test

7. It provides the students with the idea of types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture.

8. Visit to Pathological Laboratory and Submission of Project helps the students to have a hands-on training on Pathology.

9. Visit to a pathological laboratory helps the students to gain a hands-on knowledge of the techniques and submission of a project report enhances the ability of the students to document and represent data.

DSE A-5-1 Applied Zoology

1. Students get idea of types of parasites, types of host and their interactions.

2. Students learn epidemiology of diseases, transmission processes and teir prevention.

3. Students are taught life History and pathogenicity of Entamoeba histolytica, Plasmodium vivax and Trypanosoma gambiense.

4. Students are taught about life cycles of parasitic helminths.

5. Students learn about biology, control and damage created by economically important insects.

6. students about medical importance and control of Anopheles sp.

7. Students will gain concepts of animal husbandry.

8. It provides students with the knowledge of principles of poultry breeding, management of breeding stock and broilers, Processing and preservation of eggs.

9. It teaches students the procedures of genetic improvements in aquaculture industry, induced breeding and transportation of fish seed

10. Students learn about parasite through *Entamoeba*, *Wuchereria Plasmodium vivax*, *Trypanosoma*, *Ancylostoma* life stages through permanent-slides/photomicrographs or specimens.

11. Students get an idea of arthropod vectors associated with human diseases: *Pediculus, Culex, Anopheles, Aedes*

12. Students are taught the Study of insect damage to different plant parts/stored grains through damaged products/photographs.

13. Students will be taught about Identifying feature and economic importance of *Helicoperva; Heliothisarmigera*, *Papiliodemoleus*, *Pyrillaper pusilla*, *Callosobruchuschinensis*, *Sitophilus oryzae and Triboliumcastaneum*.

14. Visit to poultry farm or animal breeding centre and Submission of visit report provides the basic ideas of pisiculture, parasitology, interaction of host, parasite and vectors and their characteristic features, and medical and economical importance of some insects.

DSE A-5-2 Aquatic Biology

- 1. From this unit students gather knowledge about aquatic ecosystem.
- 2. Students learn about the lake ecosystem. CO8.3: Students get familiar with marine life.
- 3. Students will learn about the aquatic pollution and its effects on aquatic bodies.
- 4. Students learn to estimate of dissolve O2 and CO2
- 5. Through this unit students acquire knowledge about different aquatic microorganism
- 6. The module helps students to learn about aquatic ecosystem and measuring technique

DSE B-6-1 Biology of Insect

- 1. Students get the knowledge about insect and their morphology.
- 2. Students get familiar with vectors and their adaptation.
- 3. Students understand the taxonomy of insect trough this unit.
- 4. Students learn about the Dipterans and its negative role in human pathology.
- 5. Students understand various disease vectors through this unit.
- 6. Students learn about the Siphunenlata and its harmful effect in human population.
- 7. Students are introduces with different bugs and their harmful effect and control measure.
- 8. Students are demonstrated about different insect vectors through photographs
- 9. Students learn about morphology of insect
- 10. Students learn to prepare project report

DSE B-6-2 Ecology & Wild life Biology

- 1. Students gather knowledge about ecology, environment.
- 2. Students learn about helps to learn about the population.
- 3. Students gain skill to acquire data about the community, nature, structure etc.
- 4. Students get ability to learn about ecosystem, its composition, energy, development, growth etc.
- 5. Students are introduced to wild life, its conservation, methodology, types etc.
- 6. Students learn to measure pH of different water sample using pH meter, estimation of O2 & CO2
- 7. Students get familiar with different instruments for ecological study
- 8. Students get a basic idea of flora and fauna