SNDT Women's University, Mumbai

Bachelor of Science (Chemistry)

B.Sc. (Chemistry)

As Per NEP - 2020

Syllabus

(2024-2025)

Credit structure For Under Graduate Programmes in Humanities, Science and Technology and Interdisciplinary Studies Faculties
(2024 May as per GR dated 13/03/2024)

	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
Subject No 1 (to be treated as Major)	4		12	12	8	10	**46**
Subject No 2 (A and B), so minor	2	2	2		4	4	**14**
Subject No 3		4					**4**
VSC S1	2				2		**4**
VSC S2		2					**2**
VSC S3		2					**2**
Major (Elective)					4	4	**8**
OEC	4	4	2	2			**12**
SEC	2	2		2			**6**
AEC (English)	2	2	2	2			**8**
AEC (Modern Indian Language)			2	2			**4**
VEC	2	2					**4**
CC	2	2	2	2			**8**
IKS (Generic)	2						**2**
IKS (Major-Specific)					2		**2**
FP					2		**2**
OJT						4	**4**
	22	**22**	**22**	**22**	**22**	**22**	**132**

Terminologies

Abbreviation	Full-form	Remarks	Related to Major and Minor Courses
Major (Core)	Main Discipline		
Major (Elective)	Elective Options		related to the Major Discipline
Minor Stream	Other Disciplines (Inter/ Multidisciplinary) not related to the Major	either from the same Faculty or any other faculty	
OEC	Open Elective Courses/ Generic		Not Related to the Major and Minor
VSC	Vocational Skill Courses		Related to the Major and Minor
SEC	Skill Enhancement Courses		Not Related to the Major and Minor
AEC	Ability Enhancement Courses	Communication skills, critical reading, academic writing, etc.	Not Related to the Major and Minor
VEC	Value Education Courses	Understanding India, Environmental science/education, Digital and technological solutions, Health & Wellness, Yoga education, sports, and fitness	Not Related to the Major and Minor
IKS	Indian Knowledge System	I. Generic IKS Course: basic knowledge of the IKS II. II. Subject-Specific IKS Courses: advanced information about the subject: part of the major credit	Subject Specific IKS related to Major
OJT	On-Job Training (Internship/Apprenticeship)	corresponding to the Major Subject	Related to the Major
FP	Field projects	corresponding to the Major Subject	Related to the Major
CC	Co-curricular Courses	Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts	Not Related to the Major and Minor
CE	Community Engagement and service		Not Related to the Major and Minor
RP	Research Project	corresponding to the Major Subject	Related to the Major

Programme Template

Degree		B.Sc.
Program		Chemistry
Preamble (Brief Introduction to the program)		The undergraduate program in Chemistry, aligned with NEP 2020 guidelines, offers a robust foundation in chemical sciences, blending core subjects, electives, and hands-on laboratory experiences. This program prepares students for careers in academia, industry, research, environmental science, pharmaceuticals, and entrepreneurship. Graduates will be equipped with critical thinking, problem-solving skills, and a deep understanding of chemical principles, ready to contribute to sustainable development and innovation. The program emphasizes a comprehensive understanding of various chemistry disciplines, practical application of knowledge, and the development of advanced laboratory techniques. After completing this program, students will develop expertise in instrumentation and laboratory techniques, enabling them to conduct independent experiments and interpret data accurately. They will demonstrate strong theoretical and practical knowledge, applying it effectively in professional settings. Students will enhance their analytical and problem-solving skills, understanding the societal and environmental impact of chemical solutions and advocating for sustainable practices. Additionally, they will engage in lifelong learning, integrate interdisciplinary knowledge, and demonstrate effective communication and teamwork skills, preparing them for a dynamic and evolving job market.
Programme Specific Outcomes (PSOs)		After completing this program, the learner will be able to,
	1.	Apply principles of chemistry and creative thinking to solve diverse problems in chemistry
	2.	Critically analyze chemical data, evaluate scientific literature, and construct coherent scientific arguments.
	3.	Design experiments and use appropriate methodologies for data collection and analysis.
	4.	Effectively communicate chemical concepts and research findings clearly in writing and orally.
	5.	Work effectively in diverse teams and exhibit leadership skills in guiding projects and research initiatives.
	6.	Utilize ICT tools for data analysis and research.
	7.	Apply ethical principles, promote sustainability, and engage in community outreach to advance public understanding of chemistry
Eligibility Criteria for Programme		12^{th} standard Science
Intake		120

Structure with Course Titles

B. Sc Chemistry

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester I					
1.1	Surface Chemistry	Major (Core)	2	50	50	00
1.2		Major (Core)	2	50	0	50
1.3		Major (Core)	2	50	50	00
1.4	Dyes and Pigment	OEC	4	100	50	50
1.5	Practical of Chemistry	VSC	2	50	50	0
1.6	Leadership development program	SEC	2	50	50	0
1.7	English - I	AEC (English)	2	50	0	50
1.8	Inception of Indian Knowledge System	IKS (Generic)	2	50	0	50
1.9		VEC	2	50	0	50
1.10	Co-curricular activity	CC	2	50	50	0
			22	**550**	**300**	**250**
	Semester II					
2.1	Aromatic Chemistry	Major (Core)	2	50	0	50
2.2		Major (Core)	2	50	50	00
2.3		Major (Core)	2	50	0	50
2.4		VSC S2	2	50	50	0
2.5		VSC S3	2	50	50	0
2.6	Science Cafe	OEC	4	100	50	50
2.7	Personality And Communication	SEC	2	50	50	0
2.8	English -II	AEC (English)	2	50	00	50
2.9		VEC	2	50	0	50
2.10	Co-curricular activity	CC	2	50	0	50
			22	**550**	**250**	**300**

Exit with UG Certificate with 4 extra credits (44 + 4 credits)

Course Syllabus

Semester I

1.1 Major (Core)

Course Title	Surface Chemistry
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. Apply adsorption principles using Freundlich and Langmuir isotherms in industrial processes
	2. Analyze physisorption and chemisorption characteristics and factors affecting gas adsorption on solids.
	3. Evaluate the effectiveness and selectivity of homogeneous, heterogeneous, and enzymatic catalysts
	4. Design experiments to investigate colloid properties and phenomena like Tyndall effect and Brownian movement
Module 1 (Credit 1) - Adsorption & Catalysis	
Learning Outcomes	After learning the module, learners will be able to,
	1. Utilize the Freundlich and Langmuir isotherms to address adsorption issues involving gases on solids.
	2. Assess the effectiveness and selectivity of homogeneous and heterogeneous catalysts, including enzymatic mechanisms.
Content Outline	• Adsorption- Physisorption and chemisorption and their characteristics, factors affecting adsorption of gasses on solids - Freundlich and Langmuir adsorption isotherms, adsorption from solutions. • Catalysis - Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzymecatalysis and its mechanism. • Colloidal state- distinction among true solutions, colloids and suspensions, classification of colloids -lyophilic. Lyophobic; multimolecular, macromolecular and associated colloids (micelles). preparation and properties of colloids - • Tyndall effect. Brownian movement, electrophoresis, dialysis, coagulation and flocculation: Emulsions and their characteristics.
Module 2 (Credit 1) - Reaction Dynamics	

	After learning the module, learners will be able to,
	1. Implement the concepts of inductive, electromeric, resonance, and mesomeric effects in analyzing organic reactions.
	2. Examine the types, shapes, and relative stability of electrophiles, nucleophiles, and reaction intermediates like carbocations and free radicals.
Content Outline	• Electronic Displacements: Inductive, electromeric, resonance and mnesomeric effects,hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relativestrength. Homolytic and heterolytic fission with suitable examples. Curly arrow rules; • Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and relative stability of carbocations, carbanions, free radicals and carbenes. Introduction to types of organicreactions and their mechanism: Addition, Elimination and Substitution reactions. • Carbon-carbonsigma bonds Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1 - Adsorption & Catalysis

Project 1: Household Adsorbent Investigation

Description: Students will explore adsorption principles using household materials like activated charcoal, tea bags, and various colored solutions such as food coloring or ink. By placing the household adsorbents in containers with colored solutions, they will observe and document the changes in color over time. Through simple filtration techniques, students will separate the adsorbents from the solutions and analyze the remaining color concentration. This project not only demonstrates adsorption concepts but also connects classroom learning to real-world scenarios, such as water purification or air filtration systems, that are applicable in both urban and rural environments.

Safety Measures: Ensure students handle materials safely, avoid ingestion of any chemicals, and conduct experiments in well-ventilated areas to prevent exposure to harmful fumes.

Project 2: Kitchen Catalyst Investigation

Description: Students will explore catalysis principles using common kitchen ingredients like potatoes, yeast, and hydrogen peroxide. By mixing hydrogen peroxide with grated potatoes and yeast solutions in separate containers, students will observe the production of foam over time. They will measure and compare the quantity of foam produced by each catalyst to evaluate their effectiveness in catalyzing the decomposition of hydrogen peroxide. This project provides a hands-on experience that bridges classroom learning with real-world applications, such as understanding

the role of catalysts in food processing or environmental remediation, and can be easily conducted in home kitchens or school labs.

Safety Measures: Students should handle hydrogen peroxide with care, wear protective gloves and goggles, and conduct experiments in a controlled environment to prevent spills and accidents.

Module 2 (Credit 1) - Reaction Dynamics

Project 1: Kitchen Chemistry: Organic Reactions

Description: Students will explore organic reaction mechanisms using readily available kitchen ingredients such as vinegar, baking soda, and lemon juice. By conducting simple experiments like vinegar-baking soda reaction or lemon juice with milk, students will observe the formation of reaction products and propose mechanisms based on their understanding of inductive and resonance effects. This project fosters a connection between classroom learning and real-world scenarios, such as understanding the chemistry behind food preservation or cooking processes, and can be easily conducted in home kitchens or school labs.

Safety Measures: Students should handle chemicals with care, avoid ingestion, and conduct experiments in a well-ventilated area to prevent exposure to fumes.

Project 2: Home Chemistry: Alkane Reactivity

Description: Students will investigate alkane reactivity using common household solvents like rubbing alcohol and various cleaning agents containing chlorine. By mixing alkanes with these solvents in separate containers, students will observe the formation of reaction products and assess the relative reactivity and selectivity of different halogens. This project allows students to connect classroom learning with real-world applications, such as understanding the chemistry behind cleaning products or disinfectants used in everyday life, and can be easily conducted in home environments or school labs.

Safety Measures: Students should handle chemicals with care, avoid ingestion, and conduct experiments in a well-ventilated area to prevent exposure to fumes.

Reference Books:

1. Cotton, F. A., Wilkinson, G., & Gaus, P. L. (1987). Basic Inorganic Chemistry (5th ed.). John Wiley.
2. Rao, C. N. R. (2000). University General Chemistry. Macmillan, India.
3. Chanda, M. (2000). Atomic Structure and Chemical Bond (4th ed.). Tata McGraw-Hill.

1.4 Open Elective Course (OEC)

Course Title	Dyes and Pigment
Course Credits	4
Course Outcomes	After going through the course, learners will be able to
	1. Apply fundamental dye concepts practically in textiles.
	2. Analyze diverse dye, pigment, and auxiliaries' applications.
	3. Evaluate production methods and properties of dyes.
	4. Design innovative solutions for textile industry challenges.
Module 1 (Credit 1) - Dye Fundamentals	
Learning Outcomes	After learning the module, learners will be able to,
	1. Investigate fundamentals of dyes, including chemical chromophores.
	2. Assess dye classes and their principal applications, including synthesis of commercial dyes.
Content Outline	• Fundamental of dyes: General, Important chemical chromophore of dyes • Dyes Class for principle applications, Description of individuals of class and synthesis of some commercial dyes.
Module 2 (Credit 1) - Textile Dyeing Techniques	
Learning Outcomes	After learning the module, learners will be able to,
	1. Explore dying processes of textiles, including pre-treatment of fibers and dyeing methods for various textiles, as well as textile finishes and auxiliaries.
	2. Examine non-textile dyes, such as those used in leather, fur, hair, food, ink, photography, and as indicator dyes.
Content Outline	• Dying processes of textiles: Pre-treatment of textile fibers, dyeing methods for various textiles,Textile finishes and Textile auxiliaries. • Non textile dyes: Leather, Fur, Hair, Food, Ink, Photographic, indicator dyes.
Module 3 (Credit 1) - Zinc Oxide Pigments	
Learning Outcomes	After learning the module, learners will be able to,
	1. Develop a study on fundamentals, properties, and production of Iron Oxide pigments, specifically focusing on the precipitation process.
	2. Examine fundamentals, properties, and production methods of Zinc Oxide pigments, including raw materials and processes such as the Direct (American) and Precipitation processes.

Content Outline	• Zinc Oxide pigments (Fundamentals and properties, Raw materials, Direct process (American process), Precipitation process) • Iron oxide pigments (Fundamentals and properties, Production of iron oxide pigment by precipitation process)
Module 4 (Credit 1) - Advanced Dye Applications	
Learning Outcomes	After learning the module, learners will be able to,
	1. Design experiments for synthesis, characterization, and application of dyes.
	2. Explore additional aspects of dyes, such as non-mutagenic variants and colorants for high-tech fluorescent brightening agents.
Content Outline	• Synthesis, Characterization and application. • Some other aspects related to dyes: Non mutagenic dyes, colorants for high technology Fluorescent Brightening agents.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1 - Dye Fundamentals

Project 1: Chromophore Exploration

Description: Students will investigate the fundamentals of dyes by analyzing the chemical chromophores responsible for coloration. They will select common household items such as food coloring, ink cartridges, or fabric dyes and perform simple separation techniques like paper chromatography to isolate and identify the chromophores present. Through observation and analysis, students will deepen their understanding of dye chemistry and its practical applications, particularly in textile dyeing processes.

Safety Measures: Ensure students handle chemicals safely and conduct experiments in a well-ventilated area.

Module 2 - Textile Dyeing Techniques

Project 1: Fabric Dyeing Experiment

Description: Students will explore textile dyeing techniques by designing and conducting experiments to dye fabric samples using natural or synthetic dyes. They will pre-treat fabric fibers to enhance dye uptake and select appropriate dyeing methods such as immersion, padding, or printing techniques. Through hands-on experimentation, students will observe and analyze the effects of different dyeing parameters on color intensity, fastness properties, and overall textile appearance. This project provides practical experience in textile dyeing processes and allows students to apply their knowledge to address challenges in the textile industry.

Safety Measures: Ensure students handle dyes and chemicals safely, follow proper dyeing protocols, and dispose of waste materials appropriately.

Module 3 - Zinc Oxide Pigments

Project 1: Zinc Oxide Pigment Production Simulation

Description: Students will simulate the production process of zinc oxide pigments, focusing on the precipitation method. They will research the raw materials and equipment used in the Direct (American) and Precipitation processes and develop a step-by-step simulation. Using available

resources, students will set up experimental setups mimicking the precipitation reaction, observing the formation and properties of zinc oxide pigments. Through this hands-on simulation, students will gain a deeper understanding of the fundamentals and production methods of zinc oxide pigments, preparing them for real-world applications in the pigment industry.

Safety Measures: Ensure students handle chemicals safely and conduct experiments in a well-ventilated area.

Module 4 - Advanced Dye Applications

Project 1: Dye Synthesis and Application Design

Description: Students will design and execute a series of experiments to synthesize novel dyes and evaluate their application potential. They will explore various synthetic routes to prepare new dye compounds and characterize their chemical structures using spectroscopic techniques. Students will then test the synthesized dyes on different substrates such as fabrics, plastics, or paper to assess their coloration efficiency and fastness properties. Through this project, students will gain hands-on experience in dye synthesis, characterization, and application, fostering innovation and problem-solving skills in dye chemistry.

Safety Measures: Ensure students handle chemicals safely and wear appropriate personal protective equipment.

Reference Books:

1. Sharma, B. K. (2014). Industrial Chemistry (18th ed.). Goel Publishing House.
2. Kent, J. A. (Ed.). (Year of Publication). Riegel's Handbook of Industrial Chemistry (9th ed.). CBS Publishers.
3. Satyaprakash, Tuli, & Basu. (Year of Publication). Advanced Inorganic Chemistry (pp. 458-463).
4. Satyaprakash, Tuli, & Basu. (Year of Publication). Advanced Inorganic Chemistry (pp. 830-849).
5. Kent, J. A., Bommaraju, T. V., & Barnicki, S. D. (Year of Publication). Handbook of Industrial Chemistry and Biotechnology (13th ed.). Springer.

1.5 Vocational Skill Courses (VSC)

Course Title	Practical of chemistry (Lab)
Course Credits	2
Course Outcomes	After going through the course, learners will be able to,
	1. Apply titration and hydrolysis techniques to determine the concentrations of iodine, phenol, aniline, acetamide, and ethyl benzoate using standard methods.
	2. Analyze complexometric and Mohr's titrations to quantify sodium carbonate, sodium bicarbonate, carbonate, hydroxide, and magnesium in mixtures.
	3. Evaluate the precision and effectiveness of analytical methods like bromination and hydrolysis for determining chemical compositions.
	4. Design experiments to measure concentrations of ferrous and ferric ions, Mohr's salt, and oxalic acid using internal indicator methods and standardized solutions.
Module 1 (Credit 1) - Quantitative Chemical Analysis	
Learning Outcomes	After learning the module, learners will be able to,
	1. Utilize titration techniques to determine the concentration of iodine using standardized sodium thiosulphate and potassium dichromate solutions.
	2. Examine bromination methods to quantify phenol and aniline accurately.
	3. Assess hydrolysis methods for determining the concentrations of acetamide and ethyl benzoate.
	4. Develop and conduct experiments to accurately measure the concentration of various compounds using standard analytical techniques.
Content Outline	• Determination of iodine using sodium thiosulphate (Standardize sodium thiosulphate solution) using standard potassium dichromate solution. • Determination of phenol by bromination method. • Determination of aniline by bromination method. • Determination of acetamide by hydrolysis method. • Determination of ethyl benzoate by hydrolysis method.
Module 2 (Credit 1) - Analytical Methods for Salt Mixtures	
Learning Outcomes	After learning the module, learners will be able to,

	1. Utilize titration techniques to determine the concentrations of sodium carbonate and sodium bicarbonate in a mixture. 2. Examine the presence and quantification of carbonate and hydroxide together in a mixture. 3. Assess the concentrations of Mohr's salt and oxalic acid separately using standardized KMnO4 solution. 4. Determine the concentrations of ferrous and ferric ions in a solution using the internal indicator method with a standard K2Cr2O7 solution. 5. Develop accurate measurements of magnesium using standardized EDTA and zinc sulfate solutions.
Content Outline	• Determination of sodium carbonate and sodium bicarbonate in a mixture. • Determination of carbonate and hydroxide present together in a mixture. • Determination of Mohr's salt and oxalic acid separately using standardized KMnO4 solution. • Determination of ferrous and ferric ions in a solution using standard solution of K2Cr2O7 byinternal indicator method (diphenylamine or N- phenylanthranilic acid). • Determination of magnesium using standard EDTA solution (Standardize EDTA solution using standard zinc sulfate solution).

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. **Project 1: Iodine Determination**

   Design an experiment to determine the concentration of iodine in a sample using titration with standardized sodium thiosulphate and potassium dichromate solutions. Prepare a detailed report analyzing the procedure, results, and potential sources of error.

2. **Project 2: Phenol and Aniline Quantification**

   Conduct bromination reactions to accurately quantify the concentrations of phenol and aniline in given samples. Document the experimental setup, observations, and evaluate the effectiveness of the bromination method.

3. **Project 3: Hydrolysis of Acetamide and Ethyl Benzoate**

   Perform hydrolysis reactions to determine the concentrations of acetamide and ethyl benzoate in mixtures. Include a step-by-step procedure, results interpretation, and a discussion on the precision of the hydrolysis method.

4. **Project 4: Complexometric and Mohr's Titrations**

Utilize complexometric titration to measure magnesium using standardized EDTA and perform Mohr's titration to quantify sodium carbonate and bicarbonate in mixtures. Write a comprehensive report on the methodologies, results, and accuracy of the titrations.

References:

1. Sharma, B. K. (2014). Industrial Chemistry (18th ed.). Goel Publishing House.
2. Kent, J. A. (1997). Riegel's Handbook of Industrial Chemistry (9th ed.). CBS Publishers.
3. Prakash, S., Tuli, G. D., & Basu, S. K. (1944). Advanced Inorganic Chemistry - Volume II (pp. 458-463, 830-849). Perfect Paperba

1.6 Skills Enhancement Course

Course Title	Leadership Development Program
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. Apply leadership theories and models to enhance their understanding of leadership traits, styles, and behaviors. 2. Explore the impact of different personality types, as per the Five Factor Model, on leadership effectiveness. 3. Examine the applicability and effectiveness of diverse leadership theories, such as Trait, Behavioral, and Contingency theories, in varying organizational contexts. 4. Develop personalized leadership development and succession plans, integrating essential qualities of effective leaders and followers, to foster collaboration and long-term organizational success
Module 1 (Credit 1) - Leadership Fundamentals	
Learning Outcomes	After learning the module, learners will be able to, 1. Apply leadership theories and models to enhance their understanding of leadership traits, styles, and behaviors. 2. Explore the impact of different personality types, as per the Five Factor Model, on leadership effectiveness.
Content Outline	• Traits, styles, skills, behaviors, vision, inspiration and momentum of leadership • International framework for analyzing leadership • Personality Types and Leadership • Five factor model of personality Great Man Theory • Trait theory • Behavioral Theories: Michigan studies, Ohio State University studies, Leadership Grid, Role theory • Contingency Theories: Casual model of Leadership, Normative Decision model, Hersey Blanchard situational model, Vroom & Jago's model,House's Path Goal theory • Contemporary leadership styles
Module 2 (Credit 1) - Leadership Development Strategies	
Learning Outcomes	After learning the module, learners will be able to, 1. Identify characteristics, types, and methods for evaluating Leadership Development and Leadership Succession. 2. Select appropriate successors, considering emotional aspects and strategies for developing a pool of successors.

	3. Assess essential qualities of effective followership and promote collaboration between leaders and followers
Content Outline	• Characteristics, types and evaluation of Leadership Development • Leadership Succession • Choosing a successor, Emotional aspects of leadership succession, developing pool of successors, Follower ship • Essential qualities of effective followers, Collaboration between leaders and followers.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Project 1: Leadership Traits Analysis

Students will select a historical or contemporary leader and analyze their traits, styles, and behaviors. They will apply relevant leadership theories and models learned in the course to interpret the leader's effectiveness. The project will involve presenting findings on how different leadership traits and styles contribute to organizational success. Through this project, students will enhance their understanding of leadership dynamics and their applicability in real-world scenarios.

Project 2: Personality Impact Assessment

Students will conduct a survey or interview to assess how different personality types influence leadership effectiveness. They will explore the impact of personality traits, as per the Five Factor Model, on leadership styles and behaviors. The project will involve analyzing the data collected to draw conclusions about the relationship between personality and leadership. Through this project, students will gain insights into the complexities of leadership and the role of personality in shaping leadership effectiveness.

Project 3: Leadership Theory Application

Students will choose a specific organizational context and apply diverse leadership theories, such as Trait, Behavioral, and Contingency theories, to analyze leadership challenges. They will identify relevant theories and models to address leadership issues and propose solutions. The project will involve presenting recommendations based on the applicability and effectiveness of selected leadership theories. Through this project, students will develop critical thinking skills and practical problem-solving abilities in the field of leadership.

Project 4: Succession Planning Simulation

Students will simulate a leadership succession scenario within a hypothetical organization. They will develop personalized leadership development and succession plans, considering essential qualities of effective leaders and followers. The project will involve role-playing exercises to evaluate emotional aspects of leadership succession and foster collaboration between leaders and followers. Through this project, students will gain hands-on experience in succession planning and develop strategies for ensuring long-term organizational success.

Reference Books:

1. Northouse, P. G. (2015). Leadership (6th ed.). Sage Publications.

2. Lussier, R. N., & Achua, C. F. (2016). Effective Leadership (3rd ed.). Cengage Learning.
3. Daft, R. L. (2015). Leadership. Cengage Learning.
4. Yukl, G. (2016). Leadership in Organizations (6th ed.). Pearson Education

Semester-II

2.1 Major (Core)

Course Title	Aromatic Chemistry
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. Apply principles of hybridization and VSEPR theory to predict covalent molecule geometry, distinguishing polar and no polar structures.
	2. Analyze covalent bond polarization factors, including polarizing power and ion polarizability, to understand bond characteristics as per Fajan's rule.
	3. Evaluate dipole moment data to interpret percentage ionic character and deduce molecular structure, assessing characteristics of coordinate covalent compounds and metallic bonds.
	4. Design experiments to investigate preparation methods, structural properties, and reactivity of benzene and aromatic compounds, applying Huckel's rule to discern aromaticity and orientation in substitution reactions.
Module 1 (Credit 1) - Molecular Geometry & Polarity	
Learning Outcomes	After learning the module, learners will be able to
	1. Implement principles of hybridization and VSEPR theory to construct models depicting the geometry of covalent molecules and discern between polar and nonpolar structures.
	2. Formulate experiments to explore covalent bond polarization, considering factors like polarizing power and ion polarizability, to analyze bond characteristics and determine the percentage of ionic character using dipole moment measurements.
Content Outline	• Hybridization and geometry of covalent molecules, including VSEPR theory and differentiation between polar and nonpolar molecules. • Covalent bonds, polarization of covalent bonds, polarizing power, polarizability of ions, Fajan's rule, dipole moment, determination of percentage ionic character from dipole moment, relationship between dipole moment and molecular structure. • Coordinate covalent compounds and their characteristics, metallic bond, free electron model, valence bond theory, band theory, weak chemical bonds including intermolecular and intramolecular hydrogen bonds, and van der Waals

	forces.
Module 2 (Credit 1) - Aromatic Reactivity & Aromaticity Analysis	
Learning Outcomes	After learning the module, learners will be able to
	1. Examine the structure of benzene, the nomenclature of aromatic compounds, and general methods of preparation, alongside their physical and chemical properties.
	2. Scrutinize the reactivity of aromatic compounds through electrophilic and nucleophilic substitution reactions, analyzing orientation in aromatic disubstitution, and determining aromaticity based on Huckel's rule.
Content Outline	• Structure, nomenclature, and general methods of preparation of aromatic compounds. • Physical and chemical properties, including electrophilic and nucleophilic substitution reactions, and orientation in aromatic disubstitution. • Aromaticity, including Huckel's rule, anisotropic ring current, and differentiation of aromatic, nonaromatic, and antiaromatic compounds.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

No Internal Assessment for this course

Reference Books:

1. F. A. Cotton, G. Wilkinson and P. L. Gaus, „Basic Inorganic Chemistry", 5th edition, John Wiley,1987.
2. C. N. R. Rao, ,University General Chemistry", Macmillan, India, 2000.
3. Manas Chanda, „Atomic Structure and Chemical Bond", 4th edition, Tata McGraw-Hill, New Delhi, 2000.

2.6 Open Elective Courses/ Generic (OEC)

Course Title	Science Café
Course Credits	4
Course Outcomes	After going through the course, learners will be able to, 1. Apply principles of nutrition to promote good health. 2. Analyze the composition and properties of nutrients. 3. Evaluate the significance of macro and micro elements. 4. Design balanced dietary plans for optimal health.
Module 1 (Credit 1) - Fundamentals of Nutrition	
Learning Outcomes	After learning the module, learners will be able to, 1. Utilize insights into food functions, nutrition, and nutrients to discern different levels of nutrition and recognize signs of malnutrition. 2. Explore the correlation between nutrition and health, identifying visible signs of well-being and understanding the significance of adhering to food guides for optimal nutrient utilization
Content Outline	• Functions of foods, definition of nutrition, nutrients, adequate optimum and good nutrition, malnutrition. Food as a source of nutrients. • Interrelationship between nutrition and health, visible symptoms of good health. • Food guide-basic five food groups and usage of food guide. Use of food in body-digestion, absorption, transport, and utilization of nutrients in the body.
Module 2 (Credit 1) Water and Energy in Nutrition	
Learning Outcomes	After learning the module, learners will be able to, 1. Examine the role of moisture in food, including concepts like hydrogen bonding, bound water, free water, water activity, and their influence on food stability. 2. Assess the concept of energy, encompassing its unit, food as an energy source, the energy value of food, the body's energy requirements, and the utilization of food for energy needs.
Content Outline	• Water as a nutrient, function, sources, requirement, structure, water balance – effect of deficiency. Introduction to chemistry of water and ice. • Moisture in food: Hydrogen bonding, Bound water, Free water, Water activity and Food stability. • Energy – UNIT of energy, food as a source of energy, energy value of food, the body's need for energy, B.M.R.

	activities. Utilization of food for energy requirements. Acid – base balance.
Module 3 (Credit 1) - Carbohydrates and Lipids in Food Science	
Learning Outcomes	After learning the module, learners will be able to, 1. Apply knowledge of carbohydrates for dietary analysis. 2. Investigate the role of sweetening agents in food. 3. Assess the properties of lipids for physiological understanding. 4. Develop processes for handling fats and oils in food processing.
Content Outline	• Carbohydrates- composition, classification, sources, functions, structure, physical & chemical properties. • Other sweetening agents, functions of sugar in food (Browning reaction), changes during cooking and processing. • Lipids – composition, nomenclature, saturated, unsaturated fatty acids, classification, food sources, functions of fats. Physical and chemical properties, emulsions, chemistry & technology of fat and oil processing. Role of food lipids in flavour
Module 4 (Credit 1) - Minerals and Pigments in Nutrition	
Learning Outcomes	After learning the module, learners will be able to, 1. Utilize knowledge of mineral functions, sources, bio availability, and deficiencies to evaluate the importance of calcium, iron, iodine, fluorine, sodium, and potassium in human health. 2. Examine the pigments indigenous to food, including their structure, chemical and physical properties, and analyze the effects of processing and storage on these pigments. 3. Explore the diversity of flavors present in vegetables, fruits, spices, fermented foods, meats, and seafood, discerning their sensory attributes and culinary applications.
Content Outline	• Mineral functions, sources, Bio-availability, and deficiency of following minerals – calcium, Iron,Iodine, Fluorine, sodium, potassium. • Pigments indigenous to food, structure, chemical and physical properties. Effect of processing and storage. • Flavors – Vegetables, fruit and spice flavour, fermented food, Meat and sea food.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1 - Fundamentals of Nutrition

Project: Nutritional Analysis of Daily Diet

Description: Students will conduct a nutritional analysis of their daily diet using readily available online tools or smartphone applications. They will record their food intake for a week and input the data into the software to calculate the intake of macronutrients (carbohydrates, proteins, and fats), micronutrients (vitamins and minerals), and total energy intake. Through analysis, students will identify any deficiencies or excesses in their diet and make recommendations for dietary improvements. This project not only reinforces classroom learning but also equips students with practical skills to make informed dietary choices in their personal and professional lives.

Module 2 - Water and Energy in Nutrition

Project: Water Activity in Common Foods

Description: Students will investigate the concept of water activity in various common food items using easily accessible materials and equipment. They will collect samples of fresh fruits, bread, dried snacks, and other foods from their local grocery store or kitchen. Using a simple homemade water activity meter or by measuring relative humidity, students will determine the water activity of each food sample. Through this hands-on experiment, students will gain insights into the relationship between water activity and food stability, which is crucial for food preservation and safety. This project allows students to apply theoretical knowledge to practical scenarios and enhances their understanding of food science concepts.

Module 3 - Carbohydrates and Lipids in Food Science

Project: Investigating Carbohydrate Content in Everyday Foods

Description: Students will analyze the carbohydrate content of everyday food items using basic qualitative tests that can be performed at home or in a school laboratory. They will select a variety of food samples such as fruits, vegetables, grains, and processed foods from their kitchen or local grocery store. Using simple tests like Benedict's test for reducing sugars and iodine test for starch, students will qualitatively assess the presence of carbohydrates in each food sample. Through this hands-on activity, students will deepen their understanding of carbohydrate composition in foods and its significance in human nutrition. This project fosters practical skills and encourages students to make informed dietary choices based on carbohydrate content.

Module 4 - Minerals and Pigments in Nutrition

Project: Exploring Minerals and Pigments in Everyday Foods

Description: Students will investigate the presence of minerals and pigments in everyday foods through a simple kitchen-based experiment. They will select a variety of fruits, vegetables, grains, and dairy products from their kitchen or local market. Using basic household items like vinegar, iodine solution, and pH paper, students will test for the presence of minerals such as calcium, iron, and potassium, as well as natural pigments like anthocyanins and carotenoids. Through this hands-on exploration, students will gain practical experience in identifying essential nutrients and bioactive compounds in foods. This project not only reinforces classroom learning but also empowers students to make healthier food choices for themselves and others.

References Books:

1. Damodaran, S., Parkin, K. L., & Fennema, D. R. (2007). Fennema’s Food Chemistry (4th ed.). CRC Press.
2. Guthrie, H. A. (1983). Introductory Nutrition (5th ed.). Mosby.
3. Meyer, L. H. (2004). Food Chemistry. Textbook Publishers. ISBN: 0758149204.

4. Mudambi, S. R., Rao, S. M., & Rajagopal, M. V. (2006). Food Science (2nd ed.). New Age International.

5. Mudambi, S. R., & Rajgopal, M. V. (2001). Fundamentals of Foods and Nutrition (4th ed.). New Age International Publishers.

6. Shakuntla, M. N., & Shadaksharaswamy, M. (2013). Food Facts and Principles. New Age International.

2.7 Skill Enhancement Courses (SEC)

Course Title	Personality And Communication
Course Credits	2
Course Outcomes	After going through the course, learners will be able to, 1. Critically analyze Personality constructs, elucidate Determinants of Development, and examine Perception dynamics. 2. Evaluate Factors impacting Association, delineate Personality Traits, and foster Effective Habit formation.] 3. Explore Motivation theories, engage in rigorous Self-Assessment, and implement Emotional Intelligence strategies. 4. Proficiently navigate Effective Communication channels, demonstrate Assertiveness, and exhibit proficient Decision-making prowess
Module 1 (Credit 1) - Leadership and Effective Decision Making	
Learning Outcomes	After learning the module, learners will be able to, 1. Define Personality, explore Determinants of Personality Development, and examine the Perception process to comprehend individual behavior and interactions. 2. Investigate Factors of Association, including Relationship dynamics, Personality Traits, and the development of Effective Habits and Emotional Intelligence for interpersonal effectiveness
Content Outline	• Define Personality, Determinants of Personality Development, Perception- Definition,Perceptual Process • Factors of Association –Relationship, Personality Traits, Developing Effective Habits, Emotional Intelligence, Motivation, Introspection, Self-Assessment, Self-Appraisal & Self-development, Sigmund Freud Id, Ego & SuperEgo • Self Esteem and Maslow, Self Esteem & Erik Erikson, Mind Mapping, Competency Mapping & 360 Degree Assessment, Types of Personalities – Introvert, Extrovert & Ambivert person, Effective Communication & Its key aspects, Assertiveness, Decision making skills, Conflict: Process & Resolution, • Leadership & Qualities of Successful Leader
Module 2 (Credit 1) - Attitude and Stress Management	

Learning Outcomes	After learning the module, learners will be able to, 1. Implement strategies for developing a positive attitude, drawing insights from Carl Jung's contributions to personality development theory. 2. Delve into Stress Management, including an introduction to stress, its causes, and techniques for managing stress effectively. 3. Examine the importance of Time Management, learning various techniques and styles to optimize productivity and efficiency.
Content Outline	• Interpersonal Relationship, Personality – Spiritual journey beyond management of change,Good manners & Etiquettes,Effective Speech, Understanding Body language, projective positive body language. • Attitude - Concept -Significance -Factors affecting attitudes – Positive attitude–Advantages–Negative attitude-Disadvantages –Ways to develop positive attitude • Carl Jung 's contribution to personality development theory • Stress Management: Introduction, Causes, stress management techniques • Time management: Importance of time management, Techniques of time management, Time management styles.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Project 1: Personality Development Analysis

Students will critically analyze the constructs of personality and determine the factors influencing personality development. They will conduct a survey to gather data on how different determinants, such as genetics, environment, and experiences, shape personality. The project will also involve an in-depth study of the perception process and how it affects individual behavior and interactions. Students will compile their findings into a detailed report, presenting insights and implications for personal growth.

Project 2: Habit Formation and Emotional Intelligence

Students will evaluate the factors affecting relationships and personality traits to develop effective habits and emotional intelligence. They will create a habit formation plan that incorporates strategies for building positive habits and enhancing emotional intelligence. The project will involve monitoring their progress over a set period and documenting changes in their interpersonal effectiveness. Students will present their results and reflections in a comprehensive report, highlighting the role of emotional intelligence in personal and professional settings.

Project 3: Motivation and Self-Assessment

Students will explore various motivation theories and engage in self-assessment exercises to understand their motivations and strengths. They will conduct a self-appraisal using tools like mind mapping, competency mapping, and 360-degree feedback to identify areas for self-development. The project will include creating a personal development plan that outlines specific goals and strategies for improving self-esteem and achieving personal growth. Students will present their development plans and the rationale behind their strategies.

Project 4: Communication and Decision-Making Skills

Students will develop and demonstrate effective communication channels and decision-making skills. They will design and implement a communication plan that includes assertive communication techniques and strategies for conflict resolution. The project will involve role-playing scenarios to practice these skills in various contexts, such as workplace settings and personal relationships. Students will document their experiences and evaluate the effectiveness of their communication and decision-making strategies, presenting their findings and reflections in a report.

References Books:

1. Trotter, J. (2022). Perfect Communication: How to Improve Your Communication Skills. Jeffrey Trotter.
2. Dubey, A., & Shukla, A. (2023). Personality Development and Communication Skills. Laxmi Publications Pvt. Ltd.

SNDT Women's University, Mumbai

Bachelor of Science (Mathematics)

B.Sc. (Mathematics)

As Per NEP - 2020

Syllabus

(2024-2025)

Credit structure For Under Graduate Programmes in Humanities, Science and Technology and Interdisciplinary Studies Faculties
(2024 May as per GR dated 13/03/2024)

	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
Subject No 1 (to be treated as Major)	4		12	12	8	10	**46**
Subject No 2 (A and B), so minor	2	2	2		4	4	**14**
Subject No 3		4					**4**
VSC S1	2				2		**4**
VSC S2		2					**2**
VSC S3		2					**2**
Major (Elective)					4	4	**8**
OEC	4	4	2	2			**12**
SEC	2	2		2			**6**
AEC (English)	2	2	2	2			**8**
AEC (Modern Indian Language)			2	2			**4**
VEC	2	2					**4**
CC	2	2	2	2			**8**
IKS (Generic)	2						**2**
IKS (Major-Specific)					2		**2**
FP					2		**2**
OJT						4	**4**
	22	**22**	**22**	**22**	**22**	**22**	**132**

Terminologies

Abbreviation	Full-form	Remarks	Related to Major and Minor Courses
Major (Core)	Main Discipline		
Major (Elective)	Elective Options		related to the Major Discipline
Minor Stream	Other Disciplines (Inter/ Multidisciplinary) not related to the Major	either from the same Faculty or any other faculty	
OEC	Open Elective Courses/ Generic		Not Related to the Major and Minor
VSC	Vocational Skill Courses		Related to the Major and Minor
SEC	Skill Enhancement Courses		Not Related to the Major and Minor
AEC	Ability Enhancement Courses	Communication skills, critical reading, academic writing, etc.	Not Related to the Major and Minor
VEC	Value Education Courses	Understanding India, Environmental science/education, Digital and technological solutions, Health & Wellness, Yoga education, sports, and fitness	Not Related to the Major and Minor
IKS	Indian Knowledge System	I. Generic IKS Course: basic knowledge of the IKS II. II. Subject-Specific IKS Courses: advanced information about the subject: part of the major credit	Subject Specific IKS related to Major
OJT	On-Job Training (Internship/Apprenticeship)	corresponding to the Major Subject	Related to the Major
FP	Field projects	corresponding to the Major Subject	Related to the Major
CC	Co-curricular Courses	Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts	Not Related to the Major and Minor
CE	Community Engagement and service		Not Related to the Major and Minor
RP	Research Project	corresponding to the Major Subject	Related to the Major

Programme Template:

Degree		B.A. / B.Sc. (Honours / Honours with Research)
Major/ Program		Mathematics (2024 Pattern)
Preamble		This program's distinctive approach provides fundamental, high-quality knowledge in all significant fields of both pure and applied mathematics. In addition, it offers a comprehensive instructional programme with thoughtfully thought-out credit distribution. Fifty percent of the credits are made up of the major core courses, major specific elective courses, and relevant skill courses. Interdisciplinary minors, open electives, and major-specific IKS courses are added to this course to enhance the curriculum and promote flexibility. Vocational skill courses and skill enhancement courses are designed to enhance practical skills, whereas ability enhancement courses, IKS, and value education courses emphasize overall growth. Managing our daily lives and minimizing chaos using the help of mathematics is a powerful instrument that not just helps us understand the world around us but also serves as an efficient means of cultivating mental discipline. It is anticipated that students will acquire life skills including communication, argumentation, and general social values—all of which are essential for leading a fulfilling, wealthy, and successful life. Additionally, the students are in high demand due to their computational expertise and mathematical modeling models.
Programme Specific Outcomes (PSOs)		After completing this program, the learner will be able to,
	1	Demonstrating basic knowledge of mathematical skills, programming, and computational techniques required for employment.
	2	Applying the foundational understanding of mathematical concepts and programming techniques to solve real-life problems effectively.
	3	Designing mathematical models for real-life situations by utilizing Programming and computational techniques as required.

	4	Critically analyzing results obtained from mathematical models and problem-solving processes, evaluating their effectiveness, and identifying areas for improvement.
	5	Applying acquired knowledge and skills to solve complex problems, demonstrating the potential to contribute as a researcher in mathematics and related fields.
	6	Demonstrating effective communication skills in both written and verbal forms to convey mathematical concepts, research findings, and problem-solving methodologies clearly and effectively.
Eligibility Criteria for Programme		H.S.C. / (10+2) with mathematics or equivalent from a recognized board **or** 10+3 Diploma (any stream) awarded by any state board of technical education.
Intake		

Structure with Course Titles

B. Sc Mathematics

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester I					
1.1	Algeba - I	Major (Core)	2	50	50	00
1.2		Major (Core)	2	50	0	50
1.3		Major (Core)	2	50	50	00
1.4	Mathematics for Business and Management -I OR Bio-Mathematics-I OR Basic Mathematics for competitive examination	OEC	4	100	50	50
1.5	Foundation Course in Mathematics-I	VSC	2	50	50	0
1.6	Basic Course in Excel	SEC	2	50	50	0
1.7	English - I	AEC (English)	2	50	0	50
1.8	Inception of India Knowledge System	IKS (Generic)	2	50	0	50
1.9		VEC	2	50	0	50
1.10	Co-curricular activity	CC	2	50	50	0
			22	**550**	**300**	**250**
	Semester II					
2.1	Calculus –I	Major (Core)	2	50	0	50
2.2		Major (Core)	2	50	50	00
2.3		Major (Core)	2	50	00	50
2.4		VSC	2	50	50	0
2.5		VSC	2	50	50	0
2.6	Mathematics for Business and Management II OR Bio Mathematics II OR Advanced Mathematics For Competitive Exam	OEC	4	100	50	50
2.7	Advanced Course in Excel	SEC	2	50	50	0
2.8	English -II	AEC (English)	2	50	00	50
2.9		VEC	2	50	0	50
2.10	Co-curricular activity	CC	2	50	0	50
			22	**550**	**250**	**300**

Exit with UG Certificate with 4 extra credits (44 + 4 credits)

Course Syllabus

Semester I

1.1 Major (Core) - Algebra : I

Course Title	Algebra: I
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. **Recognize** prime numbers, apply Euclid's Lemma, and understand basic properties of divisibility in integers.
	2. **Demonstrating** a deep understanding of Well-Ordering Principle, First Principle of Finite Induction and their implications in number theory.
	3. **Demonstrate** the application of equivalence relations in understanding the concept of partitions.
	4. **Analyze** the properties and relationships between different types of functions, evaluating the conditions for injectivity, subjectivity, and bijectivity.
Module1(Credit1) - Integers and Divisibility	
Learning Outcomes	After learning the module, learners will be able to
	1. **Construct:** rigorous mathematical proofs for advanced concepts, such as the Well-ordering principle, Euclid's lemma, and the infinite primes.
	2. **Develop:** advanced problem-solving skills in number theory, show casing proficiency in applying the division algorithm, Euclidean algorithm, and binomial theorem.
Content Outline	• Well-ordering principle, First principle of finite induction, Binomial theorem for non-negative exponents, Pascal Triangle. • Divisibility in integers, division algorithm, greatest common divisor (G.C.D.) and least common multiple (L. C. M.) of two non-zero integers, basic properties of G.C.D., Euclidean algorithm. • Primes, Euclid's lemma, Fundamental Theorem of arithmetic. • Theorems: The set of primes is infinite; there are arbitrarily large gaps between primes. • Congruence, definition, and elementary properties with examples.
Module2(Credit1) – Relations and Functions	
Learning	After learning the module, learners will be able to

Outcomes	1. **Achieve** mastery in function theory and application, show casing the ability to evaluate, apply, and create functions.
	2. **Apply** the properties of equivalence relations, such as the concept of equivalence classes and the relationship between partitions and equivalence relations.
Content Outline	• Definition of relation, types of relations, Equivalence relation, Equivalence classes. • Properties such as two equivalence classes are either identical or disjoint, Definition of partition, every partition gives an equivalence relation and vice versa. • Congruence is an equivalence relation on Z, Residue classes and partition of Z, Addition modulo n, Multiplication modulo n, examples • Definition of function, domain, co-domain and range of a function, composite functions, examples, inverse image of a function, injective, surjective, bijective functions. • Composite of injective, surjective, bijective functions, invertible functions, bijective functions are invertible and conversely.

Assignment/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Students are instructed to choose any five statements associated with the natural number system. Use the principle of finite induction to construct a detailed proof for it. Make a detailed record of the proof. Submit the report to the course instructor. (CO1)

2. Students are suggested to create their own five equivalence relations using everyday life examples. This could involve identifying relationships between peoples (e.g. friends, siblings) or any other relevant category. Also, determine the equivalence classes. Make the note of all equivalence classes of all five relations. Submit the report to the course instructor. (CO3)

References:

1. Burton D. M., Elementary Number Theory, Seventh Edition, Mc-Graw Hill Education (India) Private Ltd.

2. Norman L. (1989) Discrete Mathematics. Revised Edition. Clarendon Press, Oxford.

3. NivenI, Zuckerman. S.(1972). Introduction to the theory of numbers. Third Edition. Wiley Eastern New Delhi.

4. Herstein I. N. (2006). Topics in Algebra. John Wiley.

5. Bhattacharya P. B., Jain S. K. and Nagpaul S. R. (1994) Basic Abstract Algebra. New Age International.

6. Anton H., Bivens I. and Davis S. (2016). Calculus. (10 th edition). Wiley India.

1.4 Open Elective Courses/ Generic (OEC)

A- OEC: Mathematics for Business and Management -I

Course Title	Mathematics for Business and Management –I
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. **Define** and explain basic concepts of averages, ratio, proportion, percentages, profit, and loss.
	2. **Analyze** and solve real-world problems involving advanced applications of averages, ratio, proportion, percentages, profit, and loss.
	3. Explain the significance and applications of simple and compound interest, annuity, present value, future value, and EMI calculations.
	4. **Analyze** and apply financial calculations involving simple and compound interest, annuity, present value, future value, and EMI in real-world scenarios.
Module1(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** basic mathematical concepts of averages, ratio, proportion, percentages, profit, and loss in problem-solving.
	2. **Analyze** and interpret advanced scenarios involving ratios, percentages, and financial calculations.
Content Outline	• Averages • Ratio and proportion • Percentages • Profit and loss
Module2(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** financial formulae to compute and interpret basic financial calculations.
	2. **Evaluate** and strategize complex financial scenarios using advanced financial concepts.
Content Outline	• Simple and compound interest • Annuity • Present Value and Future Value • EMI (Equated Monthly Installments)

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. **Educational Videos Creation**

   Student groups will collaborate to create educational videos explaining basic concepts in averages, ratio, proportion, percentages, profit, and loss. They will share these videos for peer learning and discussions, enhancing understanding through engaging multimedia content. (CO1)

2. **Complex Problem Solving in Finance**

   Groups will solve complex real-world problems related to advanced financial calculations and present their solutions. They will discuss their problem-solving methods, offer critical evaluations, and engage in discussions to showcase proficiency in applying advanced financial concepts. (CO2)

3. **Interactive Quizzes/ Games**

   Students will collaborate in groups to create interactive quizzes or games explaining concepts of simple and compound interest, annuity, present/future value, and EMIs. They will engage peers in learning through these interactive activities, fostering a deeper understanding of financial concepts.(CO3)

4. **Financial Modeling**

   Groups will analyze and apply advanced financial calculations to real-world scenarios involving interest, annuity, present/future value, and EMIs. They will present their models, interpretations, and evaluate the reliability and relevance of their solutions.(CO4)

References:

1. Dikshit A., and Jain J. K. *Business Mathematics*.
2. Hazarika P.. *Business Mathematics*. Delhi: Sultan Chand and Sons.
3. Bari. *Business Mathematics*. Mumbai: New Literature Publishing Company.
4. Gupta, J. D., Gupta, P. K., and Mohan, M. (1987). *Mathematics for Business Economics*. Tata Mc Graw Hill Publishing Co. Ltd.

B - OEC:-Bio-Mathematics-I

Course Title	**Bio-Mathematics-I**
Course Credits	**2**
Course Outcomes	After going through the course, learners will be able to
	1. **Describe** the basic principles of exponential functions, outlining their fundamental properties and how they differ from other types of functions.
	2. **Analyze** and evaluate the behavior and characteristics of exponential functions in various contexts, comparing them with other function types and demonstrating their applications in real-world scenarios.
	3. **Define** and explain the foundational concepts of calculus, including limits, derivatives, and identify the differentiation rules for basic functions.
	4. **Analyze** and apply differentiation techniques to solve complex problems involving various functions and their derivatives.
Module1(Credit1)	
Learning Outcomes	After learning the module, learners will be able to
	1. **Analyze** and apply fundamental functions and their properties.
	2. **Solve** equations involving exponential and logarithmic functions.
Content Outline	•Introduction to exponentials •Functions and graphs •Logarithm, Functions •Constant function, linear function, Quadratic functions, and equations.
Module2(Credit1)	
Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** differentiation rules to various functions.

	2. **Analyze** and interpret derivatives as rates of change.
Content Outline	•Introduction to Calculus •Limits •Derivative, Derivatives as a Rate of Change, •Derivatives of function: Constant function, x^n, e^x, logx, trigonometric functions •Differentiation rules: Scalar multiplication, addition, subtraction, product and quotient, simple examples.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. **Comparative Analysis Presentation (CO1)**

   Students will form groups to research and present a comparative analysis illustrating the unique properties of exponential functions compared to linear or polynomial functions. They will show case graphical representations and real-world examples to highlight the distinctions in behavior and characteristics.

2. **Real-life Case Studies (CO2)**

   Groups will create case studies demonstrating the behavior and real-world applications of exponential functions in diverse contexts like finance, biology, or physics. They will detail scenariosandexplainhowexponentialfunctionsbehavedifferentlyandtheirsignificancein practical applications.

3. **Tutorial Creation(CO3)**

   Students will collaborate in groups to create tutorials or video presentations explaining calculus concepts such as limits, derivatives and differentiation rules. The tutorials will aim for comprehensive coverage and clarity to aid fellow students' understanding.

4. **Complex Problem Solving (CO4)**

   Groups will solve complex problems involving differentiation techniques applied to functions and their derivatives. They will present their solutions, discussing problem-solving strategies and interpretations of results to showcase their comprehensive understanding.

References:

1. Waner S. and Constenoble S. *Applied Calculus* (2nd ed.).Brooks/ Cole Thomson Learning. Anthony M. and Biggs N. (2000). *Mathematics for Economics and Finance: Methods and Modelling* (Cambridge low-priced edition).Cambridge University Press.

2. Dikshit, A. and Jain, J. K. *Business Mathematics*.

3. Hazarika P.. *Business Mathematics*. Delhi: Sultan Chand & Sons.

C. - OEC: Basic Mathematics for competitive examination

Course Title	Basic Mathematics for competitive examination
Course Credits	2
Course Outcomes	After completing this course , learner will be able to
	1. **Understand** and apply foundational concepts of the number system, including numerals, place value, basic operations, number series, H. C. F. and L. C. M., as well as simple and decimal fractions, proficiently at a foundational level.
	2. **Analyze**, evaluate, and apply advanced techniques in number manipulation, fraction operations and fast track formulae effectively, demonstrating critical thinking and proficiency in solving complex mathematical problems at an advanced level.
	3. **Apply** fundamental arithmetic operations involving squares, cube roots, indices, VBODMAS rule, and simplification techniques in solving basic numerical problems.
	4. **Analyze** complex mathematical problem-solving strategies integrating squares, surds, word problems, and advanced mathematical concepts to devise innovative solutions.
Module1(Credit1) - Numbers	
Learning Outcomes	After learning this module , learner will be able to
	1. **Demonstrate** a comprehensive understanding of the number system, including numerals, place value, face value, basic arithmetic operations, divisibility rules, number series, and types of series.
	2. **Apply** advanced techniques to compute H. C. F. and L. C. M. for larger numbers and polynomials, manipulate complex fractions and decimal operations, and employ sophisticated problem-solving strategies for challenging mathematical questions.

Content Outline	• Number system, Numerals, Face value and place value of the digit in a number, Operations on numbers, Divisibility of numbers • Number Series, Types of series of numbers • H. C. F. and L. C. M. • Simple and decimal fractions, operations on fractions • Fast track formulae to solve the questions.
Module2(Credit1) - Numerical Aptitude	
Learning Outcomes	After learning this module , learner will be able to
	1. **Demonstrate** proficiency in performing arithmetic operations involving squares, square roots, cubes, cube roots, indices, surds and applying the VBODMAS rule, enabling them to solve mathematical problems accurately.
	2. **Develop** the ability to analyze complex word problems, apply appropriate mathematical techniques involving approximation, simplification by rule, and properties of numbers, there by devising solutions to real-world scenarios integrating numerical concepts effectively.
Content Outline	• Square and Square roots, Cube and Cube roots • Indices, surds: Properties and operations • VBODMAS rule, simplification by rule • Approximation • Word problems based on numbers

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Students have to solve questions based on above topic from banking examinations

2. VBODMAS rule application

Reference Books:

1. Verma R. Fast Track Objective Arithmetic (Complete revised edition).Arihant Publications (India) Limited.

2. Aggarwal R. S. Quantitative Aptitude for Competitive Examinations.

3. Aggarwal R. S. Objective Arithmetic (SSC and Railway Exam Special).

4. Sharma A. Teach Yourself Quantitative Aptitude.

1.5 Vocational Skill Courses (VSC)

Course Title	Foundation Course in Mathematics I
Course Credits	2
Course Outcomes	After completing this course , learner will be able to
	1. **Explain** the fundamental concepts of sets, set operations and basic operations related to complex numbers.
	2. **Demonstrate** advanced analytical skills by critically evaluating complex number theories, including geometric representations, polar forms, and applying sophisticated theorems such as De-Moivre's theorem.
	3. **Grasp** the introductory concepts of geometry, understanding equations and the geometrical structures of lines, planes, spheres, and cones
	4. **Analyze** and evaluate the properties and interrelations among various number systems, such as natural, integer, rational, irrational, and real numbers
Module1(Credit1) - Sets and Complex Numbers	
Learning Outcomes	After learning this module , learner will be able to
	1. **Articulate** and elucidate the fundamental principles underlying sets, set operations and the basic operations associated with complex numbers, showcasing a clear and comprehensive understanding of these core mathematical concepts.
	2. **Demonstrate** advanced analytical skills by critically evaluating And synthesizing complex number theories, including intricate geometric representations, polar forms, and the application of sophisticated theorems such as De-Moivre's theorem, showcasing a high-level understanding and application of complex mathematical concepts.
Content Outline	• Sets; describing a set, Subsets, Set operations, Indexed collection of sets, Partition, Cartesian product, numerically equivalent sets, Denumerable sets, Uncountable sets • Cartesian form of complex numbers, Geometrical representation, Sum, Subtraction, Multiplication and Division of complex numbers, Basic algebraic properties, Polar form of complex number, Properties of modulus and argument, Complex conjugate, De-Moivre's theorem.

Module2(Credit1) - Number system and Geometry	
Learning Outcomes	After learning this module , learner will be able to
	1. **Differentiate** and apply the properties of natural numbers, integers, rational and irrational numbers, and real numbers.
	2. **Evaluate** the fundamental concepts of geometry, including equations and the geometrical structures of lines, planes, spheres, and cones, showcasing an in-depth understanding and the ability to analyze and interpret complex mathematical properties.
Content Outline	• Natural numbers and properties of natural numbers • Integers, Rational and irrational numbers • Real numbers, properties of real numbers • Geometry: Introduction to equation and geometrical structure of line, Plane, Sphere and Cone.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Applications of De-Moivres theorem

2. Various equations of geometrical structures are to be given to the students and ask to find their structure.

Reference Books:

1. Chartrand, G., Polimeni, A. D.,& Zhang, P. *Mathematical Proofs: A Transition to Advanced Mathematics* (3rd ed.). Pearson.

2. Brown J. W. and Churchill R. V. *Complex Variables and Applications* (7^{th} ed.). McGraw Hill.

3. Stewart I. and Tall, D. *The Foundations of Mathematics* (2^{nd} ed.). Oxford.

4. Joshi M. *Proof Patterns*. Springer.

5. Shantinarayan. *Analytical Solid Geometry*. New Delhi: S. Chand and Company Ltd.

1.6 Skill Enhancement Courses (SEC)

Course Title	Basic Course in Excel
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. **Exhibit** an understanding of creating basic charts and graphs and utilizing Excel functions to sort data in ascending and descending order.
	2. **Apply** analytical skills to sort data efficiently in ascending and descending orders using Excel functions.
	3. **Exhibit** knowledge in basic Excel functions such as MIN, MAX, COUNT, and demonstrate competency in utilizing Excel tools like sorting, filtering, and auto fill for efficient data management.
	4. **Evaluate** Excel functions beyond basic levels, exploringand integrating advanced features like Cell Comments, Find and Replace, and Page Layout tools
Module1(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. **Utilize** basic Excel functionalities, including performing fundamental arithmetic operations (addition, subtraction, multiplication, division) on varied cell values.
	2. **Demonstrate** expertise in creating visually appealing charts and graphs to interpret intricate data patterns
Content Outline	•Introduction to Excel •Addition, Subtraction, Multiplication, Division of values in different cells [Basic Arithmetic Operators] •To prepare basic Charts and Graphs •To create visually appealing charts and graphs to represent data trends and patterns. •To sort the data in increasing and decreasing order
Module2(Credit1) -	

Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** basic Excel functions (e.g., MIN, MAX, COUNT) and utilize essential Excel tools like sorting, filtering, auto fill, and Fill Handle for efficient data management.
	2. **Display advanced** proficiency in utilizing Excel functions and tools such as Cell Comments, Find and Replace, and Page Layout, employing them strategically for advanced data analysis and manipulation.
Content Outline	• Cell Comments, Find and Replace and Page Layout • Various Functions in Excel like MIN, MAX, COUNT • Use of Sorting and Filtering to display the content from specific group • Use AutoFill to populate a series of numbers or dates • Create a series of months or days using the Fill Handle.

Assignment/Activities towards Comprehensive Continuous Evaluation (CCE):

References:

1. Microsoft Excel Bible: The Comprehensive Tutorial Resource.
2. Excel: Quick Start Guide from Beginner to Expert (Excel, Microsoft Office)
3. Thompson, M.(2021).*Excel 2021*.

Semester-II

2.1 Major (Core)

Course Title	**Calculus-I**
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. **Demonstrate** an understanding of the sequence of real numbers and their limits through examples. Explain the concept to absolute value and its role in real numbers.
	2. **Evaluate** the convergence and divergence of sequences. Assess the significance of monotone and bounded sequence in mathematical analysis and real world applications.
	3. **Apply** basic algebraic operations to continuous functions and demonstrate understanding of boundedness.
	4. **Apply** theorems to determine the existence of maximum and minimum values for continuous functions on closed intervals.
Module1(Credit1)- Sequences of Real Numbers	
Learning Outcomes	After learning the module, learners will be able to
	1. **Articulate** a comprehensive understanding of the algebraic and order properties of real numbers including the completeness and Archimedean property of real numbers.
	2. **Synthesize** knowledge of limit theorems to formulate and prove statements related to the behavior of sequences. Develop proofs independently for advanced limit theorems.
Content Outline	• Algebraic and order properties of real numbers, absolute value, completeness property, Archimedean property, density of rational numbers , • Sequences of real numbers and their limits examples , • Limit theorems (only statements), Limit of some standard sequences • $\frac{1}{1+nx}\ \forall\ x > 0\ ;\ (x^n)\ \forall\ x\ 0 < x < 1; \left(x^{\frac{1}{n}}\right)\ \forall\ x > 0$ • Monotone and bounded sequences, Subsequences
Module2(Credit1) – Limits and Continuity	

Learning Outcomes	After learning the module, learners will be able to
	1. **Demonstrate** a comprehensive understanding of limits and continuity in real-valued functions.
	2. **Apply** advanced limit theorems to analyze and solve real-world problems involving functions.
Content Outline	• Limit of a real-valued function and Limit theorems • Right hand limit, Left hand limit , Sequential criteria for limit • Continuous functions • Algebra of continuous functions, discontinuous functions • Boundedness theorem (statement), Maximum-Minimum theorem for continuous functions (statement), Intermediate value theorem (statement), examples

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Students are suggested to create five examples of convergent sequence and five examples of divergent sequence. Make the detail note for the solutions of convergence and divergence of the sequences. Submit the report to course instructor.(CO2)

2. Consider the function

$$f(x) = \frac{|x-b|}{x-b}, x \in R; b \in [0, 100] \cap N$$

Discuss the continuity of the function at x = b. List all natural values of **b** for which function f is discontinuous in the prescribed domain. Make the record of detail calculation for any five values of b. Submit the report to the course instructor. (CO3)

References:

1. Goldberg, R. R. (1915) Methods of Real Analysis, Oxford and IBH.

2. Ghorpade S., Limaye B. (2000). A course in Calculus and Real Analysis, Springer International Ltd.

3. Binmore, K. G. (1982). Mathematical Analysis. Cambridge University Press.

4. Bartle R., Sherbert D. Introduction to Real Analysis. Third Edition. John Wiley and Sons Inc.

5. Apostol T. M., Calculus Vol. I, John Wiley, New York. Antonn H. Bivens I., Davis .S. (2016). Calculus (10 th edition). Wiley India.

2.6 Open Elective Courses/ Generic (OEC)

A - OEC: Mathematics for Business and Management II

Course Title	Mathematics for Business and Management II
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. **Define** and explain basic concepts in preliminary descriptive statistics, such as frequency tables, histograms and measures of central tendency (mean, mode, median).
	2. **Apply** and critically analyze preliminary descriptive statistics techniques to interpret and analyze data.
	3. **Define** and explain fundamental concepts in basic probability theory, including sample space, events, axioms of probability, conditional probability.
	4. **Analyze** and apply fundamental probability concepts to solve complex real-world problems.
Module1(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** basic descriptive statistical tools to summarize data.
	2. **Analyze** and interpret data using preliminary descriptive statistics.
Content Outline	• Preliminary Descriptive Statistics • Introduction • Frequency Tables, • Histograms, • Measures of Central Tendency: Mean, Modeand and Median.
Module2(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** basic probability concepts to analyze simple scenarios.
	2. **Analyze** and solve complex problems using fundamental probability principles.

Content Outline	• Basic Probability theory, • Introduction, • Sample space and events, • Axioms of Probability • Conditional Probability • Addition and Multiplication theorem (without proof) • simple examples.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Descriptive Statistics Fair: Divide students into groups, and assign each group one fundamental concept from descriptive statistics: frequency tables, histograms, mean, mode, or median. The goal is for each group to prepare an engaging and interactive booth or station at a "Descriptive Statistics Fair" to educate others about their assigned concept.

2. Data Analysis Showcase: Students will form groups and be provided with a dataset related to a specific industry or real-world scenario (e.g., finance, healthcare, marketing).The objective is for each group to analyze the dataset using descriptive statistics techniques and present their findings in a showcase.

3. Visual Guides Creation: Student groups will create collaborative posters or visual guides detailing basic descriptive statisticsconcepts.Theywillpresentthesevisualstotheclasstofacilitategroupdiscussions and deepen understanding.

4. Complex Data Analysis: Groups will analyze complex datasets using preliminary descriptive statistics techniques. They'll present their analyses, discuss implications , limitations, and critically evaluate interpretations to showcase proficiency in applying and analyzing statistical methods.

References

1. Elhance D. N. *Fundamentals of Statistics*.

2. Gupta S. G. *Statistical Methods*. S. Chand & Co.

3. Aggarwal B. *Business Mathematics & Statistics*. An e-Book Pvt. Limited.

4. Schaum Series. *Statistics*.

B - OEC: - Bio Mathematics II

Course Title	Bio-Mathematics-II
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. **Define** and explain the foundational concepts of probability theory, including sample space, events and basic axioms of probability.
	2. **Apply** conditional probability and probability theorems to solve complex problems in various scenarios.
	3. **Define** and explain the basic concepts of probability distributions and random variables, including discrete and continuous variables.
	4. **Apply** probability distributions and mathematical expectation to model and analyze real-world problems.
Module1(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** basic probability concepts to analyze events.
	2. **Utilize** conditional probability and theorems in probability calculations.
Content Outline	• Basic Probability Theory • Introduction, • Sample space and events, • Axioms of probability, • conditional probability , • addition and multiplication theorem.
Module2(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. **Apply** probability distributions to model random phenomena.

	2. **Calculate** and interpret mathematical expectations in probability distributions.
Content Outline	• Probability Distribution • Random variable, • continuous and discrete variables, • mathematical expectation, • Binomial distribution, • Poisson distribution, • Normal distribution

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. **Interactive Presentations (CO1)**

   Student groups will create interactive presentations or info-graphics explaining fundamental probability theory concepts. They will design interactive elements to engage the audience, ensuring a comprehensive understanding of these concepts.

2. **Complex Probability Problem Solving (CO2)**

   Students will work collaboratively in groups to tackle complex probability problems involving conditional probability and theorems. They will present solutions, discuss problem-solving strategies , and critically evaluate their approaches for diverse scenarios.

3. **Educational Visuals Creation(CO3)**

   Groups will collaboratively create educational posters or visual aids explaining probability distributionsandrandomvariables.Theywillpresentthesevisuals,encouraging interactive discussions to ensure a comprehensive grasp of these concepts.

4. **Real-world Modeling (CO4)**

   Students will analyze real-world scenarios and model them using probability distributions and mathematical expectation. They will present their models, interpretations, and implications of findings to demonstrate the application of these concepts in practical scenarios.

References:

1. Walpole R. E. and Myers R. H. *Probability and Statistics for Engineers and Scientists*.

2. Veerarajan T.(2002).*Probability, Statistics and Random Process*. Tata Mc Graw-Hill Education.

3. Grinstead C. and Snell J.(1997). *Introduction to Probability*. American Mathematical Society.

4. Yates, R. D.,& Goodman, D.J.(1998).*Probability and Stochastic Processes*. John Wiley and Sons.

C - OEC: - Advanced Mathematics for Competitive Exam

Course Title	Advanced Mathematics for competitive examination
Course Credits	2
Course Outcomes	After completing this course , learner will be able to
	1. **Demonstrate** a foundational understanding of basic mathematical concepts including Average, Percentage, Profit and Loss, Commission and Discount, Simple and Compound Interest, and Ratio and Proportion.
	2. **Analyze** and evaluate the intricacies of mathematical concepts such as Average, Percentage, Profit and Loss, Commission and Discount, Simple and Compound Interest, and Ratio and Proportion.
	3. **Demonstrate** a foundational understanding of mathematical concepts including Mixture and Alligation, Partnership, Problems based on ages, Work and Time, Work and wages problems.
	4. **Analyze** and evaluate the intricacies of mathematical principles such as Mixture and Alligation, Partnership, Problems based on ages, Work and Time, and Work and wages problems.
Module1(Credit1) - Numerical Aptitude I	
Learning Outcomes	After learning this module , learner will be able to
	1. **Demonstrate** a proficient understanding of fundamental mathematical concepts such as Average, Percentage, Profit and Loss, Commission and Discount, Simple and Compound Interest, and Ratio and Proportion.
	2. Critically **analyze** and synthesize the intricacies of mathematical principles including Average, Percentage, Profit and Loss, Commission and Discount, Simple and Compound Interest, and Ratio and Proportion

Content Outline	• Average, Percentage • Profit and Loss • Commission and Discount • Simple and compound interest • Ratio and proportion
Module2(Credit1) - Numerical Aptitude II	
Learning Outcomes	After learning this module , learner will be able to
	1. **Demonstrate** a proficient understanding of fundamental mathematical concepts such as Mixture and Alligation, Partnership, Problems based on ages, Work and Time, Work and wages problems.
	2. Critically **analyze** and synthesize the intricacies of mathematical principles including Mixture and Alligation, Partnership, Problems based on ages, Work and Time, and Work and wages problems.
Content Outline	• Mixture and Alligation • Partnership • Problems based on ages • Work and Time • Work and wages

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE)

1. Problems from banking examinations are to be asked to be solved to the students.
2. Various quantitative aptitude tests can be solved by students.

Reference Books:

1. Verma R. *Fast Track Objective Arithmetic* (Complete revised edition). Arihant Publications (India) Limited.
2. Aggarwal R. S. *Quantitative Aptitude for Competitive Examinations*.
3. Aggarwal R. S..*Objective Arithmetic (SSC and Railway Exam Special)*.
4. Sharma A.. *Teach Yourself Quantitative Aptitude*.

2.7 Skill Enhancement Courses (SEC)

Course Title	Advanced Course in Excel
Course Credits	2
Course Outcomes	After going through the course, learners will be able to
	1. **Grasp** the concepts of Power Query and Power Pivot, comprehending their applications within Excel for data manipulation and analysis.
	2. **Grasp** the concepts of Power Query and Power Pivot, comprehending their applications within Excel for data manipulation and analysis.
	3. **Create** combo charts with multiple chart types on a single graph and utilize Sparklines for miniature chart representations within individual cells.
	4. **Apply** critical thinking to explore advanced features of Hyperlinks, showcasing their understanding and aptitude for utilizing interactivity within Excel for sophisticated data representation and navigation."
Module1(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. Perform calculations on arrays of data using functions like SUM PRODUCT or array constants, showcasing and understanding of fundamental data manipulation techniques
	2. Apply Power Query and Power Pivot, demonstrating a high level of understanding and skill in utilizing the tools for complex data analysis and manipulation within the Excel environment.

Content Outline	• Introduction, Basic Arithmetic Operators • Perform calculations on arrays of data using functions like SUM PRODUCT or array constants • Power Query and its applications in Excel • Power Pivot and its applications in Excel
Module2(Credit1) -	
Learning Outcomes	After learning the module, learners will be able to
	1. Demonstrate a proficient understanding of Dynamic Arrays in Excel, showcasing the ability to effectively apply them in various scenarios
	2. Create combo charts combining multiple chart types and implement Spark lines to represent data concisely.
Content Outline	• Dynamic Arrays and its applications in Excel • Create combo charts with multiple chart types on the same graph • Use Spark lines for miniaturized charts within individual cells • Hyperlinks and Interactivity and its Applications

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Collect data from bank, industry , hospitals or shops and apply the functions you learn on that data and conclude.

References:

1. Microsoft Excel Bible: The Comprehensive Tutorial Resource.
2. Excel: Quick Start Guide from Beginner to Expert (Excel, Microsoft Office)
3. Thompson M.(2021).*Excel 2021*.

SNDT Women's University, Mumbai

Bachelor of Science (Physics)

B.Sc. (Physics)

As Per NEP - 2020

Syllabus

(2024-2025)

Credit structure For Under Graduate Programmes in Humanities, Science and Technology and Interdisciplinary Studies Faculties
(2024 May as per GR dated 13/03/2024)

	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total
Subject No 1 (to be treated as Major)	4		12	12	8	10	**46**
Subject No 2 (A and B), so minor	2	2	2		4	4	**14**
Subject No 3		4					**4**
VSC S1	2				2		**4**
VSC S2		2					**2**
VSC S3		2					**2**
Major (Elective)					4	4	**8**
OEC	4	4	2	2			**12**
SEC	2	2		2			**6**
AEC (English)	2	2	2	2			**8**
AEC (Modern Indian Language)			2	2			**4**
VEC	2	2					**4**
CC	2	2	2	2			**8**
IKS (Generic)	2						**2**
IKS (Major-Specific)					2		**2**
FP					2		**2**
OJT						4	**4**
	22	**22**	**22**	**22**	**22**	**22**	**132**

Terminologies

Abbreviation	Full-form	Remarks	Related to Major and Minor Courses
Major (Core)	Main Discipline		
Major (Elective)	Elective Options		related to the Major Discipline
Minor Stream	Other Disciplines (Inter/ Multidisciplinary) not related to the Major	either from the same Faculty or any other faculty	
OEC	Open Elective Courses/ Generic		Not Related to the Major and Minor
VSC	Vocational Skill Courses		Related to the Major and Minor
SEC	Skill Enhancement Courses		Not Related to the Major and Minor
AEC	Ability Enhancement Courses	Communication skills, critical reading, academic writing, etc.	Not Related to the Major and Minor
VEC	Value Education Courses	Understanding India, Environmental science/education, Digital and technological solutions, Health & Wellness, Yoga education, sports, and fitness	Not Related to the Major and Minor
IKS	Indian Knowledge System	I. Generic IKS Course: basic knowledge of the IKS II. II. Subject-Specific IKS Courses: advanced information about the subject: part of the major credit	Subject Specific IKS related to Major
OJT	On-Job Training (Internship/Apprenticeship)	corresponding to the Major Subject	Related to the Major
FP	Field projects	corresponding to the Major Subject	Related to the Major
CC	Co-curricular Courses	Health and Wellness, Yoga education sports, and fitness, Cultural Activities, NSS/NCC and Fine/ Applied/Visual/ Performing Arts	Not Related to the Major and Minor
CE	Community Engagement and service		Not Related to the Major and Minor
RP	Research Project	corresponding to the Major Subject	Related to the Major

Programme Template:

Degree		B.Sc.
Programme		Physics
Preamble (Brief Introduction to the programme)		The B.Sc. Physics program, structured under the National Education Policy (NEP) 2020, is designed to provide students with a comprehensive understanding of fundamental and advanced concepts in physics. This program emphasizes a blend of theoretical knowledge and practical skills, ensuring that graduates are well-prepared for both academic pursuits and professional careers. By fostering critical thinking, analytical skills, and a strong foundation in scientific principles, the program aims to cultivate a deep appreciation for the physical sciences and their applications in various technological and interdisciplinary fields. Aligned with the NEP 2020's vision for holistic and multidisciplinary education, the B.Sc. Physics program offers flexibility through multiple entry and exit options, integration of vocational education, and opportunities for research and innovation. The curriculum is designed to be inclusive and equitable, catering to diverse learning needs and promoting the use of regional languages alongside English to enhance comprehension. Graduates of this program will find diverse employment opportunities in fields such as research and development, education, healthcare, engineering, data science, and information technology. Emphasizing ethical scientific practices and social responsibility, the program seeks to produce graduates who are not only proficient in physics but also capable of contributing to societal and global challenges through scientific inquiry and innovation.
Programme Specific Outcomes (PSOs)		After completing this programme, Learners will be able to
	1.	Synthesize core principles across physics disciplines to develop a profound understanding, laying the foundation for specialization.
	2.	Apply theoretical and experimental knowledge of physics in diverse contexts, fostering adaptability and innovative problem-solving skills.
	3.	Evaluate complex physics problems critically, employing creative thinking to generate effective solutions.
	4.	Communicate findings and ideas clearly and logically, demonstrating proficiency in conveying complex physics concepts.
	5.	Demonstrate analytical prowess in data analysis and hypothesis formulation, facilitating proficient research conduct across physics domains.
	6.	Lead and collaborate effectively in interdisciplinary teams, exhibiting adaptability and readiness for leadership roles while fostering a culture of continuous learning.

	7.	Construct a framework for promoting multicultural competence and ethical values, fostering sustainability and responsible citizenship in the global physics community.
Eligibility Criteria for Programme		10+2 certificate preferably with Physics as one of the major subjects
Intake		120

Structure with Course Titles

B. Sc Physics

SN	Courses	Type of Course	Credits	Marks	Int	Ext
	Semester I					
1.1	Modern Physics	Major (Core)	2	50	50	00
1.2		Major (Core)	2	50	0	50
1.3		Major (Core)	2	50	50	00
1.4	Electrical and Electronic gadgets for all	OEC	4	100	50	50
1.5	Performing Physics Experiments	VSC	2	50	50	0
1.6	Basic Measurements and Calculations	SEC	2	50	50	0
1.7	English - I	AEC (English)	2	50	0	50
1.8	Inception of Indian Knowledge System	IKS (Generic)	2	50	0	50
1.9		VEC	2	50	0	50
1.10	Co-curricular Activity	CC	2	50	50	0
			22	**550**	**300**	**250**
	Semester II					
2.1	Basic Electronics	Major (Core)	2	50	0	50
2.2		Major (Core)	2	50	50	00
2.3		Major (Core)	2	50	00	50
2.4		VSC S2	2	50	50	0
2.5		VSC S3	2	50	50	0
2.6	Physics in Daily Life	OEC	4	100	50	50
2.7	Physicists Exploring through Experiments	SEC	2	50	50	0
2.8	English -II	AEC (English)	2	50	00	50
2.9		VEC	2	50	0	50
2.10	Co-curricular Activity	CC	2	50	0	50
			22	**550**	**250**	**300**

Exit with UG Certificate with 4 extra credits (44 + 4 credits)

Course Syllabus

Semester I

1.1 Major (Core)

Course Title	Modern Physics
Course Credits	2
Course Outcomes	After Completion of this course the learners will be able to, 1. Apply knowledge of black body radiation, photoelectric effect, Compton Effect to solve physics problems. 2. Analyze scientific articles on phenomena to understand their implications in physics. 3. Evaluate experimental results and theoretical models to refine fundamental physical processes. 4. Design experiments to explore principles underlying X-rays, aiming to advance physics knowledge
Module 1 (Credit1) - Quantum Physics	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply concepts of ultraviolet catastrophe and annihilation in theoretical and experimental physics
	2. Analyze phenomena like black body radiation and gravitational red shift.
Content Outline	• Black body radiation • Ultraviolet catastrophe Photoelectric effect, • Compton Effect, • Pair production and annihilation, • Gravitational red shift.
Module 2 (Credit1) – Radiant Dynamics	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply the principles underlying the discovery and production of X-rays.
	2. Analyze characteristic X-ray spectra and their applications in various fields
Content Outline	•Discovery of X-ray, •X-ray production, •characteristic x-ray spectra, •applications of X-ray, •X-ray diffraction

Assignment/Activities towards Comprehensive Continuous Evaluation (CCE):

Module - 1

Project 1: DIY Photoelectric Effect Experiment

Students construct a simple photoelectric setup using a shoebox, aluminum foil, and a light source. They measure generated voltage as light hits a metal plate, varying intensity and frequency. They present findings, using scientific terms to explain phenomena and relate to research.

Project 2: Gravity Red Shift Simulation

Using household materials, students create a model to simulate gravitational red shift. They demonstrate how light shifts in wavelength near a massive object. Presenting to the teacher, they utilize precise scientific language, referencing relevant research to support their conclusions.

Module - 2

Project 3: DIY X-ray Diffraction Simulation

Students use a laser pointer, a ruler, and various objects (like CDs or DVDs) to simulate X-ray diffraction. They observe diffraction patterns by shining the laser on the objects and measuring angles. Presenting findings, they employ precise scientific language, relating observations to X-ray diffraction principles and applications, referencing scientific literature.

Project 4: X-ray Diffraction Simulation

Using household materials, students create a model to simulate X-ray diffraction. They explore how X-rays interact with crystal lattices, observing diffraction patterns. Presenting findings, they employ accurate scientific language, explaining the principles and applications of X-ray diffraction with reference to scientific literature.

References:

1. Beiser, A., Mahajan, S., & Choudhury, S. R. (2017). Concepts of modern physics (SIE) (7th ed.). McGraw Hill Education.
2. Thornton, S., & Rex, A. (2012). Modern physics for scientists and engineers (International ed., 4th ed.). Brooks/Cole
3. Murugeshan, R., & Sivaprasath, K. (2019). Modern physics (18th ed.). S Chand Publishing
4. Theraja, B. L. (2002). Modern physics (5th ed.). S Chand & Company

1.4 Open Elective Courses/ Generic (OEC)

Course Title	Electrical and Electronic gadgets for all
Course Credits	4
Course Outcomes	After Completion of this course the learners will be able to,
	1. Identify conducting and non-conducting materials, and estimate electricity bills accurately.
	2. Apply principles of electricity to understand lighting sources and cooling devices effectively.
	3. Apply knowledge to effectively use digital devices and analyze differences between digital and analog data.
	4. Design strategies for safe online interactions considering AI advancements and transactions.
Module 1 (Credit 1) - Basics of Electricity	
Learning Outcomes	After learning the module, learners will be able to,
	1. Identify conducting and non-conducting material
	2. Estimate the Electricity bill of any user based on rating and usage pattern
Content Outline	• Concept of electricity, voltage, current, power, energy. Types of • Conducting materials. Electrical ratings of various appliances, and • Electrical billing calculations.
Module 2 (Credit 1) - Basic Home devices	
Learning Outcomes	After learning the module, learners will be able to,
	1. Apply principles of electricity to understand LED, CFL, tube lights, and halogen lamps
	2. Analyze the efficiency of dry ice storage, coolers, air-conditioning, and refrigerators
Content Outline	• Understanding light sources and units – LED, CFL, tube lights, halogen lamps, • Understanding cooling devices – dry ice storage, coolers, air-conditioning, refrigerator
Module 3 (Credit 3) - Digital devices and circuits	
Learning Outcomes	After learning the module, learners will be able to

	1. Apply knowledge to effectively use mobile phones, PCs, laptops, tablets, and smart TVs
	2. Analyze the differences between digital and analog data and various communication media.
Content Outline	• Mobile phone, PC, laptop, tablets, smart TV, Digital camera: – DSLR/Mirrorless/Mobile camera • Digital and analog data. Electronic signals and communication media - wired and wireless communications. Wi-Fi, Bluetooth, satellite communication. LAN, WAN, and larger networks. Internet and World Wide Web.
Module 4 (Credit 4) - Mobile networks and AI tools	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply understanding of bandwidth, data compression, and file formats in 4G/5G networks
	2. Design strategies for safe online interactions considering AI advancements and transaction
Content Outline	• Concept of bandwidth and data compression, various file formats, 4G/5G networks. • Various Social media platforms and online communication etiquette • Artificial intelligence, AI tools Online transactions and safety issues

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1: Energy Consumption Analysis

Students will calculate the energy consumption for different settings such as houses, offices, and public places. They will analyze various heating technologies to understand their advantages and disadvantages. Through practical exercises and research, students will explore concepts of electricity, voltage, current, power, and energy. They will also learn about different types of conducting materials and electrical ratings of appliances, gaining insights into electrical billing calculations and energy-efficient practices.

Module 2: Photography and Networking

In this workshop, students will learn to use digital cameras and mobile cameras effectively to capture high-quality images and videos. They will also probe into various network parameters to understand their functions and implications in digital communication. Through hands-on activities and demonstrations, students will explore wired and wireless technologies such as Wi-Fi, Bluetooth, and satellite communication. Additionally, they will gain knowledge about bandwidth, data compression methods, and file formats, optimizing data transmission efficiency for 4G/5G networks.

Module 3: Online Communication

Students will design strategies for engaging in online communication and social media platforms while adhering to proper etiquette. They will explore various social media platforms and learn about online communication etiquette to ensure respectful and effective interactions. Through case studies and role-playing exercises, students will develop skills for navigating online environments responsibly, understanding the importance of privacy, security, and digital citizenship.

Module 4: Introduction to Artificial Intelligence

In this project, students will gain an understanding of the fundamentals of artificial intelligence (AI) tools and their applications. They will explore different AI technologies and their impact on various industries, including online transactions and safety issues. Through discussions, presentations, and hands-on activities, students will develop insights into the capabilities and limitations of AI, learning how to leverage these technologies effectively in the digital age.

References:

1. Theraja, B. L., & Theraja, A. K. (1959). Electrical technology -i (23rd ed.). S Chand.
2. Hoerner, T. (2007). Basic electricity & practical wiring (4th ed.). Hobar Publications.
3. Davidson, H. (2004). Troubleshooting & repairing consumer electronics without a schematic (3rd ed.). McGraw-Hill Education

1.5 Vocational Skill Courses (VSC)

Course Title	Performing Physics Experiments
Course Credits	2
Course Outcomes	After completion of this course, the learner will be able to,
	1. Analyze electronic circuits including bridge rectifiers, L-R, and C-R circuits for rectification and impedance characteristics
	2. Evaluate the maximum power transfer theorem for optimizing circuit efficiency and performance
	3. Investigate the characteristics and applications of Zener diodes in voltage regulation circuits.
	4. Experimentally verify fundamental physics principles such as black body radiation, photoelectric effect, Compton scattering, and gravitational red shift.
Module 1 (Credit 1) Rectification	
Learning Outcomes	After learning this module , learner will be able to
	1. Analyze rectification, load regulation, and ripple factor in circuits.
	2. Optimize circuit designs for efficient power transfer
	3. Apply Zener diodes in voltage regulation and protection circuits."
Content Outline	• Bridge Rectifier, rectification, load regulation, ripple factor. • Maximum power transfer theorem • Zener Diode Characteristics. • L- R circuit C-R circuit
Module 2 (Credit 1) - Number system and Geometry	
Learning Outcomes	After learning this module, learner will be able to
	1. Analyze spectral data to verify Planck's Law in black body radiation experiments.
	2. Verify gravitational redshift by observing wavelength changes in a gravitational field.
Content Outline	• Black Body Radiation: Spectral Analysis and Planck's Law Verification • Photoelectric Effect: Frequency Dependence of Photoelectron Emission • Compton Scattering: Wavelength Shift of X-rays in Target

	Materials • Experimental Verification of Gravitational Red Shift: Observing Wavelength Changes in a Gravitational Field

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Project 1: Measuring Instruments Workshop

Hands-on sessions for using basic measuring tools. Skills include component identification and DMM usage. Graph plotting proficiency emphasized.

Project 2: Electronics Experiment Showcase

Demonstrate understanding of Bridge Rectifier, Zener Diode, and more. Presentations highlight practical applications.

Project 3: Logic Gates and Transistors

Explore logic gates, De-Morgan's Theorem, and transistor characteristics. Build digital circuits like Half Adders and Full Adders.

Project 4: Scientific Article Analysis

Analyze articles on electronics. Enhance research skills and apply knowledge to real-world scenarios

Reference Books:

1. Beiser, A., Mahajan, S., & Choudhury, S. R. (2017). Concepts of modern physics (SIE) (7th ed.). McGraw Hill Education.
2. Thornton, S., & Rex, A. (2012). Modern physics for scientists and engineers (International ed., 4th ed.). Brooks/Cole.
3. Murugeshan, R., & Sivaprasath, K. (2019). Modern physics (18th ed.). S Chand Publishing.
4. Theraja, B. L. (2002). Modern physics (5th ed.). S Chand & Company.
5. Theraja, B. L. (2006). Basic electronics (solid state) in multicolor ed. (Multicolor ed.). S Chand.
6. Kothari, D. P., & Nagrath, I. J. (2017). Basic electronics (2nd ed.). McGraw Hill Education.
7. Bhagyashree, S. R., Guruprasad, K. N., & Kumar, P. Y. (2021). Basic electronics (1st ed.). Notion Press.

1.6 Skill Enhancement Courses (SEC)

Course Title	Basic Measurements and Calculations
Course Credits	2
Course Outcomes	After Completion of this course, the learner will be able to,
	1. Apply various measuring instruments for precise measurements.
	2. Analyze measurement uncertainties, enabling effective data evaluation.
	3. Construct and interpret graphs, determining slopes and converting non-linear relationships.
	4. Evaluate experimental data, making informed decisions in scientific investigations.
Module 1 (Credit 1) - Electronic Meters	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply techniques to analyze data, making inferences and interpretations.
	2. Create solutions and recommendations, utilizing their analytical and evaluative skills.
Content Outline	• Measuring size: travelling microscope, micrometer screw, Vernier calipers • Time measurement: using stop-watch • Mass measurement: single pan balance • Use of Digital multimeter for measurement of various electrical parameters • Measurement of internal resistance of voltmeter, current-meter and loading effect • Measurement of output impedance of signal generator • Constant voltage source: current capacity and internal resistance • Constant current source: internal resistance
Module 2 (Credit 1) - Measurement Errors	
Learning Outcomes	After learning the module, learners will be able to
	1. Analyze uncertainties, identifying sources and types, and propagate uncertainties effectively.
	2. Plot linear graphs, mastering slope determination, interpolation, and extrapolation techniques.

Content Outline	• Uncertainty analysis: sources of uncertainties, types of uncertainties • Propagation of uncertainties • Graph plotting I: linear (slope, interpolation, extrapolation) • Graph plotting II: Non-linear graphs (slope at given point, interpolation), converting non-linear to linear from known equation • Statistical analysis of data

Assignment/Activities towards Comprehensive Continuous Evaluation (CCE):

Project 1: Parameter Exploration

Create a comprehensive list of parameters for various measuring instruments, including size, time, and mass measurements. Discuss their importance and applications.

Project 2: Hands-on Measurement

Utilize basic measuring instruments to measure physical quantities such as size, time, and mass. Document measurements and compare with theoretical values.

Project 3: Digital Multimeter Workshop

Hands-on session using digital millimeter for electrical parameter measurements. Explore techniques for measuring internal resistance and loading effect.

Project 4: Uncertainty Analysis and Graph Plotting

Explore types of uncertainties in measurements and learn to plot graphs accurately. Perform statistical analysis of data to understand uncertainties better

Reference books:

1. Sawhney, A. K. (2021). A course in electrical and electronic measurements and instrumentation. Shree Hari Publications.

2. Venkateshan, S. P. (2015). Mechanical measurements (2nd ed.). VISIONIAS.

Semester-II

1.2 Major (Core)

Course Title	Basic Electronics
Course Credits	2
Course Outcomes	After Completion of this course the learners will be able to
	1. Apply binary and Boolean algebra logic to design digital circuits.
	2. Analyze diode circuits and filter for effective voltage regulation.
	3. Evaluate Zener diode applications in voltage stabilization and circuit design
	4. Design voltage regulation systems and digital circuits
Module 1(Credit 1) – Zener Diode	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply the principles of Zener diodes as voltage stabilizers in electronic circuits
	2. Analyze different types of diode biasing and their applications in bridge rectifier circuits
Content Outline	• Types of diode biasing (review), Bridge rectifier-ripple factor • Types of filter circuits • Zener diode-Zener diode as a voltage stabilizer • Zener diode circuits.
Module 2 (Credit 1) – Digital logics	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply binary, octal, and hexadecimal number systems for data representation and conversion.
	2. Analyze and interpret boolean algebra rules to construct digital circuits effectively.
Content Outline	• Binary number system- Decimal to binary conversion- • Binary to decimal conversion-octal number system-hexadecimal number system- binary coded decimal code (BCD)-binary addition and binary subtraction using 2's complement.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

No Internal Examination.

Reference Books:

1. Theraja, B. L. (2006). Basic electronics (solid state) in multicolor ed. (Multicolor ed.). S Chand.

2. Kothari, D. P., & Nagrath, I. J. (2017). Basic electronics (2nd ed.). McGraw Hill Education.

3. Bhagyashree, S. R., Guruprasad, K. N., & Kumar, P. Y. (2021). Basic electronics (1st ed.). Notion Press.

2.6 Open Elective Courses/ Generic (OEC)

Course Title	Physics in Daily Life
Course Credits	4
Course Outcomes	After Completion of this course the learner will be able to
	1. Analyze renewable energy sources for addressing global energy challenges.
	2. Evaluate energy consumption patterns and their climate change implications.
	3. Apply energy use quantification and carbon footprint concepts.
	4. Design strategies for minimizing energy use and adopting electric vehicles.
Module 1 (Credit 1) - Energy basics	
Learning Outcomes	After learning the module, learners will be able to
	1. Analyze renewable energy sources like solar, wind, thermal, and hydroelectric power.
	2. Connect some daily life Conduct analysis of energy bills to understand consumption patterns and conservation measures
Content Outline	• Basics of renewable energy solar, wind, thermal, and hydroelectric power. • Energy consumption patterns and global energy challenges. • Importance of energy conservation in addressing climate change and sustainability goals, Analysis of energy bills
Module 2 (Credit 1) - Energy and Climate change	
Learning Outcomes	After learning the module, learners will be able to
	1. Quantify energy use in easily understandable terms
	2. Assess carbon footprint implications.
Content Outline	• Quantifying energy use in simple terms • carbon footprint • Climate change has happened
Module 3 (Credit 1) - Energy use and Carbon emission	
Learning Outcomes	After learning the module, learners will be able to
	1. Recognize energy as both a challenge and a solution.
	2. Develop strategies to achieve a one-third reduction in energy usage and produce the remaining energy locally through solar power

Course Content	• Energy as a problem and as a solution • energy use minimization by 1/3rd • Minimizing energy use by 1/3rd • Generating the remaining 1/3rd of energy locally by solar
Module 4 (Credit 1) - Introduction to Eclectic Vehicle	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply knowledge of electric vehicle components for practical understanding
	2. Analyze environmental differences between battery electric and conventional vehicles.
Course Outcomes	• Electric vehicles: battery electric vehicles (BEVs) • Basic components and functionality of electric vehicles: electric motors, batteries, power electronics, and charging infrastructure. • Comparison of environmental impacts between conventional vehicles and electric vehicles

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

Module 1

In the first project, students embark on a Renewable Energy Showcase. Armed with materials like models or diagrams representing solar panels, wind turbines, thermal power plants, and hydroelectric dams, they delve into the analysis of renewable energy sources. Through meticulous data collection and analysis, they evaluate the feasibility and advantages of each source in different geographical contexts. Following thorough research and experimentation, students compile their findings into a comprehensive report detailing the potential contributions of renewable energy to the global energy mix, providing valuable insights for sustainable energy planning.

Module 2

The second project entails a Carbon Footprint Audit. Equipped with energy consumption data such as electricity bills and carbon footprint calculators or spreadsheets, students conduct a meticulous examination of their own energy usage patterns. Through diligent data collection and analysis, they quantify their carbon footprint and identify areas of high energy consumption. Armed with these findings, students devise strategies for reducing carbon emissions, documenting their journey and insights in a detailed report. This hands-on experience empowers students to take ownership of their energy consumption and contribute to climate change mitigation efforts.

Module 3

In the third module focused on Energy Use and Carbon Emission, students undertake an Energy Reduction Challenge. Armed with energy consumption data and simulation tools, they develop strategies to achieve a one-third reduction in energy usage while promoting local solar energy generation. Through data-driven analysis and simulation, students explore the feasibility of

integrating energy-efficient technologies and solar power solutions into their daily lives. Their efforts culminate in a comprehensive report outlining their strategies, findings, and recommendations for achieving sustainable energy consumption patterns and promoting renewable energy adoption within their communities.

Module 4

In this case, students engage in Electric Vehicle Component Analysis. Utilizing electric vehicle components, diagrams, and demonstration models, they delve into the intricacies of electric vehicle technology. Through hands-on exploration and analysis, students dissect the basic components and functionality of electric vehicles, comparing environmental impacts between battery electric vehicles (BEVs) and conventional vehicles. Their findings are meticulously documented in a detailed report, providing valuable insights into the potential of electric vehicles to mitigate climate change and revolutionize the transportation sector. This project empowers students to become informed advocates for sustainable transportation solutions.

References:

1. Solanki, C. S. (2019). Energy Swaraj: My Experiments with Solar Truth (1st ed.). Notion Press.

2. Rasheed, H. (2022). An introduction to energy: Sources, uses, impact and solutions. Lulu.com.

3. Rao, K. M. (2019). An introduction to electric vehicles (1st ed.). Notion

4. Swayam - https://onlinecourses.swayam2.ac.in/aic22_ge31/preview

5. https://www.youtube.com/watch?v=7ihCH0p2oXM&list=PLYklMEpaP9zGIouFBCimG98d7YH4ChKq0

2.7 Skill Enhancement Courses (SEC)

Course Title	Physicists Exploring through Experiments
Course Credits	2
Course Outcomes	1. Analyze lens aberrations using an optical bench setup to understand optical system performance. 2. Apply optimized mobile camera settings across various lighting conditions to improve image quality. 3. Measure illuminance in different environments using a lux meter, demonstrating proficiency in light measurement. 4. Explore different combinations of lenses and optical systems to understand their effects on imaging
Module 1 (Credit 1) - Optical Insight	
Learning Outcomes	After learning the module, learners will be able to
	1. Apply optimal settings across various devices for diverse lighting conditions
	2. Analyze optical aberrations and characterize electronic components in experimental setups.
Content Outline	• Thermocouple: Calibration and Measurement of Temperature using a Thermocouple. • Lens Aberrations: Investigation of Lens Aberrations using an Optical Bench. • Mobile Camera Settings: Optimization of Mobile Camera Settings for Different Lighting Conditions. • Lux Meter: Measurement of Illuminance in Different Environments using a Lux Meter. • Spectrometer (μ): Measurement of Wavelengths in Spectral Lines using a Spectrometer. • Lens Combinations: Exploration of Lens Combinations and Optical Systems. • LASER Divergence: Measurement of LASER Beam Divergence using a Beam Expander. • LDR Characteristics: Characterization of Light Dependent Resistors (LDRs) under Different Lighting Conditions. • Surface Tension of Biological Fluid: Determination of Surface Tension of Biological Fluids using Capillary Rise Method. • Frequency of AC Mains: Measurement of Frequency of AC Mains using a Frequency Counter
Module 2 (Credit 1) - Mechanical Dynamics	
Learning Outcomes	After learning the module, learners will be able to
	1. Analyze fluid viscosity via Stoke's Method, observing sphere terminal velocity in a fluid.
	2. Apply principles of rotational inertia and energy storage, examining the Flywheel's impact.

Content Outline	• Viscosity by Stoke's Method: Measurement of viscosity of a fluid by observing the terminal velocity of a sphere falling through it. • Flywheel: Study of rotational inertia and energy storage in a rotating mass by observing its effect on rotational motion. • Torsional Oscillations: Investigation of the torsional spring constant and damping effects in torsional oscillations. • Bifilar Pendulum: Determination of moment of inertia of a body by observing its oscillations about two perpendicular axes. • Y by Vibrations: Determination of Young's modulus of a material by analyzing its vibrational modes and frequencies. • Thermocouple: Calibration and measurement of temperature using the thermoelectric effect in a thermocouple device.

Assignments/Activities towards Comprehensive Continuous Evaluation (CCE):

1. Thermocouple Calibration: Students calibrate a thermocouple by measuring known temperatures and recording corresponding voltage readings.
2. Lens Aberrations: Students investigate lens aberrations using an optical bench, analyzing distortions and anomalies in optical systems.
3. Mobile Camera Settings: Students optimize mobile camera settings for different lighting conditions, experimenting with exposure, white balance, and ISO settings.
4. Lux Meter: Students measure illuminance in different environments using a lux meter, assessing light intensity for various applications.
5. Spectrometer (μ): Students measure wavelengths in spectral lines using a spectrometer, analyzing the dispersion of light for spectroscopic studies.
6. Lens Combinations: Students explore lens combinations and optical systems, studying the effects of combining different lenses on image formation.
7. Lens Combinations: Students explore lens combinations and optical systems, studying the effects of combining different lenses on image formation.
8. LASER Divergence: Students measure LASER beam divergence using a beam expander, analyzing the spread of the laser beam over distance.
9. LDR Characteristics: Students characterize light-dependent resistors (LDRs) under different lighting conditions, studying their resistance variation with light intensity.
10. Surface Tension of Biological Fluid: Students determine the surface tension of biological fluids using the capillary rise method, exploring fluid dynamics in biological systems.
11. Frequency of AC Mains: Students measure the frequency of AC mains using a frequency counter, analyzing electrical power distribution systems.

References:

1. Sawhney, A. K., & Aakash. (2022). A Course in Electrical and Electronic Measurements and Instrumentation (NVB+++ ed.). VISIONIAS.

2. Purkait, P., Biswas, B., & Koley, C. (2017). Electrical and Electronics Measurements and Instrumentation. McGraw Hill Education.

3. Gupta, J. B. (2013). A Course in Electrical & Electronics Measurement & Instrumentation (Reprint 2013 ed.). S K Kataria and Sons.