Scheme of Instruction & Syllabi

of

Bachelor of Science (Honours)

Mathematics

(Effective from Session 2026-2027)

First Year

Department of Applied Sciences & Humanities

INVERTIS UNIVERSITY

Bareilly-243123 U.P.

B.Sc. Honours (Mathematics)

This programme is designed to develop students' ability to identify, analyse, and solve complex problems across a wide range of application domains by integrating fundamental mathematical knowledge with interdisciplinary concepts. It equips learners with the analytical and computational skills required to apply mathematical principles and related scientific methods to real-world challenges, while fostering a deep understanding of the core areas of Mathematical Sciences. The curriculum also emphasizes the significant role of mathematics in advancing science, technology, and society, thereby contributing to the improvement of the quality of human life. Furthermore, it encourages students to recognize and appreciate the pioneering contributions of eminent mathematicians and scientists whose work has shaped the development of Mathematics and its allied disciplines.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The B.Sc. (Honours) Mathematics program is designed to provide students with a strong foundation in mathematical sciences while developing critical thinking, analytical reasoning, computational proficiency, and problem-solving abilities.

This specialized degree makes the graduates employable in scientific organizations and also to assume expert administrative positions in various types of organizations. Further acquisition of higher-level degrees will help graduates pursue a career in academics or scientific organizations as researchers.

The Program Educational Objectives are to prepare the students to:

1. Work independently or in a team with engineering, medical, ICT professionals and scientists in scientific problem solving.
2. Act as expert administrators in public, private and government organizations, or as business administrators, with further training and education.
3. Pursue masters and doctoral research degrees to work in colleges, universities as professors, or as scientists in research establishments.

PROGRAM OUTCOMES (POs)

After undergoing this programme, a student will be able to execute the following successfully:

1. Scientific knowledge: Apply the knowledge of Mathematics, scientific fundamentals, and scientific specialization to the solution of complex scientific problems.

2. Problem analysis: Identify, formulate, research literature, and analyze scientific problems to arrive at substantiated conclusions using first principles of Mathematical sciences and nature.

3. Design/development of solutions: Design solutions for complex scientific problems and design system components and processes to meet specifications, with consideration for public health and safety, and cultural, societal and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern scientific tools including prediction and modelling to complex activities with an understanding of the limitations.

6. Scientific temper and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the practice.

7. Environment and sustainability: Understand the impact of professional scientific solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for, sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the work practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

10. Communication: Communicate effectively with their community and with society at large. Be able to comprehend and write effective reports and documentation. Make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of scientific and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in, independent and life-long learning and research in the broadest context of scientific and technological change.

B.Sc. (Honours) (Mathematics)
Scheme of Instruction

I Year

I Semester			Teaching Scheme			Marks Distribution			Credits
Paper	**Code**	**Subject**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	
DSC-1	BHP101	Mechanics & Properties of Matter	3	1	0	30	70	100	4
DSC-2	BHP102	Thermodynamics	3	1	0	30	70	100	4
DSC-3	BHC101	General Inorganic Chemistry	3	1	0	30	70	100	4
DSC-4	BHC102	General Organic Chemistry	3	1	0	30	70	100	4
DSC-5	BHM101	Differential Calculus & Matrix	3	1	0	30	70	100	4
DSC-6	BHM102	3-Dimensional Geometry	3	1	0	30	70	100	4
Lab-1	BHP151	Mechanics Lab I	0	0	4	15	35	50	2
Lab-2	BHC151	Organic Chemistry Lab	0	0	4	15	35	50	2
Lab-3	BHM151	MATLAB Programming-I	0	0	4	15	35	50	2
G. Core	EPC001	AI Based English Proficiency Course - I	0	0	0	0	50	50	2
Total			**18**	**6**	**12**	**225**	**575**	**800**	**32**

II Semester			Teaching Scheme			Marks Distribution			Credits
Paper	**Code**	**Subject**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	
DSC-7	BHP201	Optics	3	1	0	30	70	100	4
DSC-8	BHP202	Waves and Oscillations	3	1	0	30	70	100	4
DSC-9	BHC201	General Physical Chemistry	3	1	0	30	70	100	4
DSC-10	BHC202	Inorganic Chemistry of Chemical Bonding	3	1	0	30	70	100	4
DSC-11	BHM201	Real Analysis	3	1	0	30	70	100	4
DSC-12	BHM202	Integral Calculus	3	1	0	30	70	100	4
Lab-4	BHP251	Optics Lab	0	0	4	15	35	50	2
Lab-5	BHC251	Inorganic Chemistry Lab	0	0	4	15	35	50	2
Lab-6	BHM251	Programming with C	0	0	4	15	35	50	2
G. Core	EPC001	AI Based English Proficiency Course - II	0	0	0	0	50	50	2
Total			**18**	**6**	**12**	**225**	**575**	**800**	**32**

L – Lecture
T – Tutorial
P – Practical
MSM – Mid Semester Marks
ESM – End Semester Marks

B.Sc. (Honours) (Mathematics)
Scheme of Instruction

II Year

III Semester			Teaching Scheme			Marks Distribution			Credits
Paper	**Code**	**Subject**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	
DSC-13	BHP301	Electromagnetic Theory	3	1	0	30	70	100	4
DSC-14	BHP302	Semiconductor Physics	3	1	0	30	70	100	4
DSC-15	BHC301	Organic Chemistry of Functional Groups	3	1	0	30	70	100	4
DSC-16	BHC302	Thermodynamics and Chemical Equilibria	3	1	0	30	70	100	4
DSC-17	BHM301	Probability Theory & Statistics	3	1	0	30	70	100	4
DSC-18	BHM302	Differential Equations	3	1	0	30	70	100	4
Lab-7	BHP351	Thermal Physics Lab	0	0	4	15	35	50	2
Lab-8	BHC351	Synthesis in Chemistry Lab	0	0	4	15	35	50	2
Lab-9	BHM351	Aptitude and Reasoning	0	0	4	15	35	50	2
		Total	**18**	**6**	**12**	**225**	**525**	**750**	**30**

IV Semester			Teaching Scheme			Marks Distribution			Credits
Paper	**Code**	**Subject**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	
DSC-19	BHP401	Digital Electronics	3	1	0	30	70	100	4
DSC-20	BHP402	Modern Physics	3	1	0	30	70	100	4
DSC-21	BHC401	Advanced Inorganic Chemistry	3	1	0	30	70	100	4
DSC-22	BHC402	Heterocyclic and Polycyclic Chemistry	3	1	0	30	70	100	4
DSC-23	BHM401	Integral Transform	3	1	0	30	70	100	4
DSC-24	BHM402	Numerical Analysis	3	1	0	30	70	100	4
Lab-10	BHP451	Semiconductor Lab	0	0	4	15	35	50	2
Lab-11	BHC451	Instrumentation in Chemistry Lab	0	0	4	15	35	50	2
Lab-12	BHM451	Numerical Analysis Lab	0	0	4	15	35	50	2
		Total	**18**	**6**	**12**	**225**	**525**	**750**	**30**

L – Lecture
T – Tutorial
P – Practical
MSM – Mid Semester Marks
ESM – End Semester Marks

B.Sc. (Honours) (Mathematics)
Scheme of Instruction

III Year

V Semester			Teaching Scheme			Marks Distribution			Credits
Paper	**Code**	**Subject**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	
DSC-25	BHM501	Discrete Mathematics	3	1	0	30	70	100	4
DSC-26	BHM502	Number theory & Cryptography	3	1	0	30	70	100	4
DSC-27	BHM503	Complex Analysis	3	1	0	30	70	100	4
DSC-28	BHM504	Modern Algebra	3	1	0	30	70	100	4
VAC-1	BHM505	Introduction to Data Science	2	0	0	15	35	50	2
Lab-13	BHM551	Matlab Programming-II	0	0	4	15	35	50	2
Lab-14	BHM552	Data Science Lab	0	0	4	15	35	50	2
FW	BHM553	Internship/Field Work	0	0	0	30	70	100	4
Total			**14**	**4**	**8**	**195**	**455**	**650**	**26**

VI Semester			Teaching Scheme			Marks Distribution			Credits
Paper	**Code**	**Subject**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	
DSC-29	BHM601	Linear Algebra	3	1	0	30	70	100	4
DSC-30	BHM602	Differential Geometry and Tensor Analysis	3	1	0	30	70	100	4
DSC-31	BHM603	Advance Analysis and Metric Spaces	3	1	0	30	70	100	4
DSC-32	BHM604	Optimization Techniques	3	1	0	30	70	100	4
VAC-2	BHM605	Environment and Climate Change	2	0	0	15	35	50	2
Lab-15	BHM651	Python Lab	0	0	4	15	35	50	2
Project	BHM652	Project Work	0	0	0	50	100	150	6
Total			**14**	**4**	**4**	**200**	**450**	**650**	**26**

L – Lecture
T – Tutorial
P – Practical
MSM – Mid Semester Marks
ESM – End Semester Marks

Detailed Syllabus

for

Bachelor of Science (Honours)

in

Mathematics

First Year

(w.e.f. 2026-27)

BHP101: Mechanics and Properties of Matter	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	Class Test -12 Marks Teachers Assessment - 6 Marks Attendance - 12 Marks End Semester Exam - 70 marks

Course Objectives:

1. **Develop a fundamental understanding of classical mechanics**, including Newton's laws, centre of mass, work-energy principles, conservation laws, rotational dynamics and gravitation.
2. **Introduce the mechanical properties of matter**, including elasticity, stress and strain, elastic moduli, torsion and bending of beams, with emphasis on their physical significance and applications.
3. **Familiarize students with the basic principles of fluid mechanics and surface phenomena**, including fluid flow, Bernoulli's theorem, viscosity, Poiseuille's law and surface tension.

Syllabus:

Unit-1: Dynamics of System of Particles
Dynamics, Newton's laws of motion, centre of mass and its equation of motion for discrete and continuous mass distributions; impulse. Work and the work-energy theorem; conservative and non-conservative forces; potential energy and the force as the negative gradient of potential energy; potential-energy diagrams, stable and unstable equilibrium; gravitational potential energy; work done by non-conservative forces; the law of conservation of linear momentum and energy conservation.

Unit-2 Rotational Dynamics
Rotation about a fixed axis, Angular momentum of a particle and of a system of particles; torque and the conservation of angular momentum; moment of inertia, the parallel- and perpendicular-axis theorems; moment of inertia of a uniform rod, rectangular lamina, disc, cylindrical rod, spherical shell and solid sphere; kinetic energy of rotation; rolling motion --- combined translation and rotation on an inclined plane.

Unit-3: Gravitation
Newton's law of gravitation; inertial and gravitational mass; gravitational potential and field due to a spherical shell and a solid sphere; orbital and escape velocity, Kepler's laws of planetary motion.

Unit-4: Elasticity
Elasticity, Hooke's law and the stress-strain diagram; elastic moduli and the relations between elastic constants; Poisson's ratio and its expression in terms of the elastic constants; work done in stretching and in twisting a wire; twisting couple on a cylinder; torsional pendulum,

Unit-5: Surface Tension and Viscosity
Bernoulli's Theorem, Molecular theory of surface tension; excess of pressure across a liquid surface of drops and bubbles; variation of surface tension with temperature; Streamline and turbulent flow of fluids; the ideal fluid and the equation of continuity; rate of flow of a liquid through a capillary tube; Poiseuille's formula for viscous flow through a capillary tube; coefficient of viscosity of a liquid.

Textbooks:

1. Daniel Kleppner and Robert J. Kolenkow, An Introduction to Mechanics, McGraw-Hill, 1973.

2. F. W. Sears, M. W. Zemansky and H. D. Young, University Physics, Narosa Publishing House, 1982.

3. David Halliday, Robert Resnick and Jearl Walker, Principles of Physics, 10th edition, ISV Paperback, 2015.

4. R. Murugeshan, Properties of Matter, S. Chand & Co. Pvt. Ltd., New Delhi

Reference Books:

1. H. C. Verma, Concepts of Physics, Volume I, Bharati Bhawan Publishers.

2. Charles Kittel, Walter Knight, Malvin Ruderman, Carl Helmholz and Burton Moyer, Mechanics --- Berkeley Physics Course, Vol. 1, Tata McGraw-Hill, 2007.

3. Keith R. Symon, Mechanics, 3rd edition, Addison-Wesley, 1971.

4. D. S. Mathur, Mechanics, S. Chand & Company Limited, 2000.

5. Brij Lal and N. Subrahmanyam, Properties of Matter, S. Chand & Co./Eurasia Publishing House, New Delhi, 1989.

Course Outcomes:

After completing the course, students will be able to:

CO1.	Apply Newton's laws of motion, work-energy theorem and conservation principles to analyse the dynamics of particles and systems of particles.
CO2.	Determine the centre of mass, angular momentum, torque and moment of inertia of mechanical systems and analyse rotational and rolling motion.
CO3.	Explain the fundamental principles of gravitation and apply them to calculate gravitational potential, field, orbital velocity, escape velocity and planetary motion.
CO4.	Explain the mechanical properties of solids using stress, strain, elastic moduli, Poisson's ratio, torsion and bending of beams.
CO5.	Apply the principles of fluid mechanics to understand streamline and turbulent flow, continuity equation, Bernoulli's theorem, viscosity and fluid flow through capillaries.
CO6.	Explain surface tension and related surface phenomena and apply relevant physical principles to solve basic quantitative and conceptual problems.

BHP102: Thermodynamics	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	Class Test -12Marks Teachers Assessment - 6Marks Attendance - 12 Marks End Semester Exam - 70 marks

Course Objectives:

1. **Develop a fundamental understanding of the laws and principles of thermodynamics**, including thermodynamic systems, temperature, heat, work, internal energy, and the first and second laws of thermodynamics.
2. **Familiarize students with the concepts of entropy, thermodynamic potentials, and Maxwell's relations**, and their applications to reversible and irreversible processes and thermodynamic systems.
3. **Develop the ability to apply thermodynamic principles to practical physical processes**, including heat engines, refrigerators, phase transitions, real gases, and the Joule-Thomson effect.

Detailed Syllabus:

Unit-1: Fundamentals of Thermodynamics
Thermodynamic system, thermodynamic equilibrium, Zeroth law of thermodynamics and concept of temperature, Heat and work, State functions, First law of thermodynamics, Differential form of first law, Internal energy, Applications of first law, Relation between *Cp* and*Cv*, Work done during isothermal and adiabatic processes.

Unit-2: Second Law of Thermodynamics and Heat Engines
Reversible and irreversible processes, Conversion of heat into work and work into heat, Heat engines, Carnot cycle, Carnot engine and its efficiency, Refrigerator and coefficient of performance (COP), Kelvin-Planck and Clausius statements.

Unit-3: Entropy and Thermodynamic Applications
Concept of entropy, Change in entropy, Clausius theorem, Clausius inequality, Entropy of a perfect gas, Entropy change in reversible and irreversible processes, Entropy of the universe, Principle of increase of entropy, Third law of thermodynamics and unattainability of absolute zero, Temperature-entropy (T-S) diagrams.

Unit-4: Thermodynamic Potentials and Maxwell's Relations
Thermodynamic variables, Thermodynamic potentials (Internal Energy, Enthalpy, Helmholtz Free Energy and Gibbs Free Energy): definitions, properties and applications, Maxwell's thermodynamic relations, Clausius-Clapeyron equation, Joule-Thomson effect and Joule-Thomson coefficient for ideal and real gases.

Textbooks:

1. Mark W. Zemansky & Richard H. Dittman, *Heat and Thermodynamics*, McGraw-Hill Education.
2. D.S. Mathur, *Heat and Thermodynamics*, S. Chand Publishing.

Reference Books:

1. Garg, Bansal & Ghosh, *Thermal Physics*, Tata McGraw-Hill.

2. Francis W. Sears & Gerhard L. Salinger, *Thermodynamics, Kinetic Theory and Statistical Thermodynamics*, Narosa Publishing House.

Course Outcomes:

After completing the course, students will be able to:

CO1.	Explain the fundamental concepts of thermodynamics, including thermodynamic systems, equilibrium, temperature, heat, work, state functions, and the first law of thermodynamics.
CO2.	Apply the laws of thermodynamics to analyse reversible and irreversible processes, heat engines, Carnot cycles, refrigerators, and their efficiencies and coefficients of performance.
CO3.	Explain the concept of entropy and analyse entropy changes in reversible and irreversible processes using the Clausius theorem, Clausius inequality, and the principle of increase of entropy.
CO4.	Describe the third law of thermodynamics and apply the concept of entropy to thermodynamic systems, including the entropy of an ideal gas and the unattainability of absolute zero.
CO5.	Understand and apply thermodynamic potentials, including internal energy, enthalpy, Helmholtz free energy, and Gibbs free energy, along with Maxwell's thermodynamic relations.
CO6.	Apply thermodynamic principles to phase transitions and real-gas behaviour, including the Clausius-Clapeyron equation and Joule-Thomson effect, and interpret their physical significance.

BHC101: General Inorganic Chemistry	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks III Semester Exam – 70 marks

Course Objectives:

1. To give an overview of complete knowledge of atomic structure.
2. To explain periodic table and general properties.
3. To describe the structure of solids.
4. To explain about hydrogen.

Detailed Syllabus

Unit-1 Concepts of Atomic Structure Rutherford's nuclear model of the atom, Planck's quantum theory and photoelectric effect, Bohr's Model of the atom, Hydrogen spectrum, Summerfield's extension of Bohr's theory, Particle and wave character of electron, The de Broglie equation, Davisson and Germer experiment, Heisenberg's uncertainty principle, Compton effect, Quantum numbers, Zeeman effect, Aufbau's principle, Pauli's exclusion principle, Hund's rule of maximum multiplicity, Effective nuclear charge, Slater's rule and its applications.
Unit-2 Periodic Table and Atomic Properties The long form periodic table, Cause of periodicity, Division of elements into s, p, d and f blocks, atomic properties, Covalent, ionic radii and their periodic trends, Ionization energy and factors affecting ionization energy, Variation of ionization energy in the periodic table, Electron affinity, electronegativity and their variations in the periodic table, Determination of electronegativity by Pauling and Mulliken's approach, Factors determining electronegativity.
Unit-3 The Structure of Solids Crystalline and amorphous solids, Size and Shape of crystals, Space lattice and unit cell, Bravais lattices, Seven basic crystal systems, Miller indices, Types of crystals, Close packing in crystalline solids, Types of cubic close packing, Limiting radius ratio, Radius ratio rule and shape of an ionic crystal, Structure of different ionic crystals: NaCl, ZnS, CsCl, CaF_2, TiO_2, CaC_2, CdI_2, Lattice energy of ionic crystals and its calculation, The Born-Haber Cycle, Defects in crystalline solids.
Unit-4 Hydrogen Position of hydrogen in periodic table, Resemblance with alkali metals, Resemblance with halogens, Preparation, properties and uses of hydrogen, Nascent hydrogen, Active hydrogen, Atomic hydrogen, Ortho and para hydrogen, Hydrides, Heavy hydrogen or deuterium, Tritium, Heavy water.

Text and Reference Books

1. *Basic Inorganic Chemistry* Cotton, G.Wilkinson, and Paul L.Gauss, 3rd Edition (1995), John Wiley & Sons, New York.
2. *Principles of Inorganic Chemistry by* Puri, Sharma and Kalia, 32nd Edition, Milestone publications.

Course Outcomes (COs)

After completing the course, students will be able to

CO1	Describe the Atomic structure.
CO2	Summarize Periodic and atomic properties in detail.
CO3	Solve the problems based on quantum numbers
CO4	Basic study of structure of solids and hydrogen atom.

BHC102: General Organic Chemistry	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks III Semester Exam – 70 marks

Course Objectives:

1. To give an overview of complete knowledge of structure of organic molecules.
2. To describe the nomenclature and classification of organic compounds.
3. To explain the isomerism in organic compounds.
4. To explain about reaction intermediates of organic reaction.
5. To explain aromatic compounds.

Detailed Syllabus

Unit-1 Structure of Organic Molecules Classical concept of bonding, Bond length and bond energies, Modern concept of bonding, sp^3 hybridization of carbon, sp^2 hybridization of carbon, sp hybridization of carbon, Hybridization of nitrogen, Hybridization of oxygen, Polar and non-polar molecules, Resonance concept, Hydrogen bonding, Representation of organic compounds, General methods of Purification of organic compounds: crystallization, sublimation, distillation, extraction with a solvent and chromatography.
Unit-2 Nomenclature and Classification of Organic Compounds Types of organic compounds, Functional groups, Homologous series, IUPAC system of nomenclature, IUPAC names from structural formulas, Nomenclature of polyfunctional compounds, Orbital structure and nomenclature of alkanes, Orbital structure and nomenclature of alkenes, Orbital structure and nomenclature of alkynes.
Unit-3 Isomerism in Organic Compounds Constitutional (structural) isomerism, Geometrical isomerism, Optical isomerism and optical activity, Optical isomerism of lactic and tartaric acids, Enantiomers, Diastereomers, Meso-compounds, Optical activity without chiral carbons, Resolution of racemic mixtures, Walden inversion, Cahn-Ingold R-S system of specifying configurations, Conformations of alkanes and cycloalkanes, E-Z system of specifying configurations.
Unit-4 Organic Reactions and Reaction Intermediates Inductive effect, Mesomeric effect, Electromeric effect, Homolytic and heterolytic fission, Carbonium ions (carbocations), Carbanions, Carbon free radicals, Carbenes, Hyperconjugation, Electrophiles and nucleophiles, Types of organic reactions, Types of reaction mechanisms, Exothermic and endothermic reactions, Some basic organic reactions: nucleophilic and electrophilic addition reactions, Markonikov and anti-markonikov rule, Diels-Alder reaction.
Unit-5 Aromatic Compounds Structure of benzene, Resonance energy of benzene, Aromaticity, Huckel rule of aromaticity, Halogenation, nitration and sulfonation of benzene, Mechanisms of Friedel Craft alkylation and acylation.

Text and Reference Books

1. *Organic Chemistry*, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
2. *Organic Chemistry*, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
3. *Organic Chemistry*, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).

Course Outcomes (COs)

After completing the course, students will be able to

CO1	To learn Chemical bonding and hybridization
CO2	Understand the IUPAC nomenclature and classification of organic compounds.
CO3	Understand Geometrical and optical isomerism in organic compounds.
CO4	Understand homolytic and heterolytic fissions along with different types of reaction intermediates in organic reactions.
CO5	Understand Huckel's rule of aromaticity and different reactions of aromatic compounds.

BHM 101: Differential Calculus and Matrices	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** Class Test-12Marks Teachers Assessment - 6 Marks Attendance – 12Marks End Semester Exam–70marks

Course Objectives:

1. Understand the concepts and applications of differential calculus for functions of one and several variables.
2. Apply multivariable calculus techniques to solve optimization and approximation problems.
3. Develop proficiency in matrix operations and analyze systems of linear equations
4. Apply Eigen value methods and the Cayley–Hamilton theorem to solve matrix-related problems.
1. Analyse the properties and applications of special matrices in mathematical aspects

Detailed Syllabus

Unit 1: Differential Calculus-I: Differentiation of different functions, successive differentiation, Leibnitz theorem, Partial differentiation, Euler's theorem, Change of variables, Expansion of function of several variables, Curve tracing.
Unit 2: Differential Calculus-II: Jacobian, approximation of errors, Extrema of functions of several variables, Lagrange's method of multipliers (Simple applications).
Unit 3: Matrices: Matrices and types of Matrices, Elementary row and column transformation, Echelon form of a matrix, Normal form of a matrix, Rank of a matrix, Linear dependent and Independent vectors, Consistency of linear system of equations, Solution of homogeneous and non-homogeneous linear equations, Gauss elimination method.
Unit 4: Eigen Values, Eigen Vector and Cayley-Hamilton Theorem: Characteristic equation, Cayley-Hamilton theorem, Inverse of a matrix using Cayley-Hamilton, Eigen values and Eigen vectors of a matrix, Diagonalization of a matrix.

Textbooks:

1. H. K. Dass, Higher Engineering Mathematics, S.Chand Publications.
2. B. S. Grewal, Engineering Mathematics, Khanna Publishers, 2004.

Reference Books:

1. R. K. Jain& S. R. K.Iyenger, Advance Engineering Mathematics, Narosa Publishing House, 2002.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
3. Peter V. O"Neil, Advanced Engineering Mathematics, Thomson (Cengage) Learning, 2007.

Course Outcomes:

At the end of the course, the student should be able to:

1. Apply differential calculus techniques to analyze and solve problems involving functions of one and several variables.
2. Solve optimization, approximation, and transformation problems using multivariable calculus concepts
3. Perform matrix operations and solve systems of linear equations using appropriate matrix methods.
4. Apply the Cayley–Hamilton theorem to find Eigen values, and eigenvectors..
5. To diagonalize the matrix

BHM 102: 3-Dimensional Geometry	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** Class Test-12Marks Teachers Assessment - 6 Marks Attendance – 12Marks End Semester Exam–70marks

Course Objectives:

1. To understand about and planes
2. To understand about straight line.
3. To understand about sphere and to describe methods for problem solving of three-dimensional shapes like sphere, plane.
4. To develop an understanding of cone
5. To develop an understanding of cylinder.

Detailed Syllabus

Unit 1: Direction cosines & direction ratio: Direction cosines, Direction Ratios, their properties, relation between direction cosines and direction ratio, Direction cosines and direction ratios of a line joining two points **Plane:** Definition, Equation of a plane, Angle between two planes, planes through two planes, Distance of a point from a plane, Area of a triangle, Volume of Tetrahedron.
Unit 2: Straight lines: Introduction, Equations of coordinate axes, Cartesian equation and vector equation of a line, skew line, Symmetrical form & non-symmetrical form, Angle between two lines, Angle between a line and a plane, Perpendicular distance, Intersecting lines, Skew lines, shortest distance and equation of line of shortest distance, Intersection of three planes.
Unit 3: Sphere: Definition, Equation of a sphere, General equation of a sphere, Centre and radius of a sphere, Great circle, Diameter form of the equation of a sphere, Tangent line and tangent plane of a sphere, Condition of tangency for a line and equation of tangent plane, Angle of intersection of two spheres, Condition of orthogonality of two spheres.
Unit 4: Cone: Cone, Quadratic Cone, Equation of a cone, Enveloping cone, Condition for general equation of second degree to represent a cone, Intersection with a line, Tangent plane, Reciprocal Cone, Right Circular Cone.
Unit 5: Cylinder: Definition, Equation of a cylinder, Enveloping cylinder, Equation of enveloping cylinder, right circular cylinder, Equation of right circular cylinder.

Textbooks:

1. N. Saran and R. S. Gupta, Analytical Geometry of Three Dimensions, Pothisala Pvt. Ltd, Allahabad, 2001.
2. Gorakh Prasad and H. C. Gupta, Textbook on Coordinate Geometry, Pothisala Pvt. Ltd., Allahabad, 2004.

Reference Books:

1. P. K. Jain and Khalil Ahmad, A textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd, 2008.
2. S. L. Loney, The Elements of Coordinate Geometry, Macmillan and Co., London, 2001.

3. R.J.T. Bell, Elementary Treatise on Coordinate Geometry of Three Dimensions, Macmillan India Ltd, 1998
4. Gorakh Prasad and H. C. Gupta: Text Book on Coordinate Geometry, Pothishala Pvt. Ltd.,Allahabad.
5. P.N. Pandey, Polar Coordinate Geometry, Sharda Academic Publishing House, Allahabad.
6. Sharma & Jain, Co-ordinate Geometry, Galgotia Publication, Dariyaganj, New Delhi, 1998.

Course Outcomes:

At the end of the course, the student should be able to:

1. Understanding about direction cosines and ratios of a line
2. Understanding about three dimensions shapes.
3. Develop an understanding of straight line.
4. Develop an understanding of sphere.
5. Methods for problem solving of cone and cylinder.

BHP151: Mechanics Lab I	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Attendance - 5 Marks Teachers Assessment - 10 Marks End Semester Exam - 35 Marks

Course Objectives:

1. **Develop practical skills** in measuring mechanical properties such as moment of inertia, viscosity, surface tension, Young's modulus, and modulus of rigidity.
2. **Familiarize students with experimental techniques** for determining physical constants such as acceleration due to gravity and elastic constants using standard laboratory apparatus.
3. **Develop proficiency in experimental data analysis**, including observation, measurement, error estimation, graphical analysis, and interpretation of experimental results.

List of Experiments:

Student has to perform any eight of the following experiments:

1. To determine the Moment of Inertia of a Flywheel.
2. To determine the coefficient of viscosity of water by the capillary flow method (Poiseuille's method).
3. To determine the surface tension of a liquid by Jaeger's method.
4. To determine the modulus of rigidity of a wire by the horizontal (static torsion) apparatus.
5. To determine the modulus of rigidity of a wire by the vertical (dynamic torsion) apparatus.
6. To determine the acceleration due to gravity (g) using a Bar Pendulum.
7. To determine the acceleration due to gravity (g) using a Kater's Pendulum.
8. To determine Young's modulus of a material by the bending of beam method.
9. To determine the elastic constants of a wire by Searle's method.
10. To determine the modulus of rigidity of a wire by Maxwell's needle.
11. To study the motion of a loaded spring and determine (a) the spring constant, (b) the value of g, and (c) the modulus of rigidity.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, 1st Edition (2007), R. Chand & Co.

2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

Reference Books:

1. Indu Prakash and Ramakrishna, A Textbook of Practical Physics, Vol. 1 & Vol. 2, Kitab Mahal, New Delhi.

2. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Course Outcomes:

After completing the course, students will be able to:

CO1.	Determine mechanical and material properties such as moment of inertia,

	viscosity, surface tension, Young's modulus, and modulus of rigidity using standard experimental methods.
CO2.	Measure the acceleration due to gravity using different types of pendulums and compare the experimental results.
CO3.	Perform experiments involving rotational, torsional, oscillatory, and bending motion and analyse their physical behaviour.
CO4.	Handle standard laboratory instruments and experimental setups safely and systematically for accurate measurements.
CO5.	Analyse experimental observations using appropriate calculations, graphs, and error estimation techniques.
CO6.	Interpret experimental results and relate them to the underlying principles of mechanics and properties of matter.

BHC151: Organic Chemistry Lab	
Teaching Scheme	**Examination Scheme**
Practical's: 4 hrs/Week	External marks- 35
Credits: 2	Internal marks- 15

Course Objectives:

1. To give an overview of qualitative analysis of organic compounds.

2. To give a brief idea of single step organic synthesis.

3. To introduce students with paper chromatography technique.

Detailed Syllabus

LIST OF EXPERIMENTS

- **Qualitative Analysis of Organic Compounds**
- Detection of Elements (Nitrogen, Sulphur, Halogens) in organic compounds by Lassaigne's test.
- Identification of Functional Groups: Preliminary tests to detect the nature of an unknown organic compound (saturation/unsaturation, solubility behavior).
- Detection of Carbohydrates: Tests for identification of reducing/non-reducing sugars (e.g., glucose, sucrose, starch) using Fehling's, Benedict's, and Molisch's tests.
- Detection of Carboxylic Acids:Identification of an unknown carboxylic acid (e.g., oxalic acid, benzoic acid, salicylic acid) through systematic qualitative analysis.
- Detection of Phenols: Identification of phenolic compounds using $FeCl_3$ test and bromine water test.
- Detection of Carbonyl Compounds: Distinguishing between aldehydes and ketones using Tollens', Fehling's, and 2,4-DNP tests.
- Detection of Esters: Identification of an unknown ester through hydrolysis and functional group tests.
- **Organic Preparations (Simple One-Step Reactions)**
- Preparation of Acetanilide from aniline (acetylation reaction) via recrystallization.
- Preparation of p-Bromoacetanilide from acetanilide and yield calculation.
- Preparation of Iodoform from ethanol/acetone (haloform reaction) via crystallization.

Chromatographic Separation

- Separation of a mixture of two amino acids or two sugars using paper chromatography.
- Separation of a mixture of o- and p-nitrophenol, or o- and p-aminophenol using paper chromatography.

Course Outcomes (COs)

After completing the course, students will be able to

CO1	Understand detection of elements
CO2	Understand the separation of compounds via chromatographic technique.
CO3	Understand and identification of functional groups in organic compounds

BHM151-Matlab Programming - I	
Teaching Scheme Lab: 4 Hrs/Week Tutorials: 0 Hrs./Week Credits: 2	**Examination Scheme** Internal-15Marks External- 35 Marks

Course Objectives:

The main objectives of this course are to:

1. Understand the MATLAB environment, including its interface and syntax.
2. Understand commands and programming fundamentals.
3. Develop MATLAB programs using variables, operators.
4. Develop MATLAB programs using input/output statements, conditional statements, and looping constructs.
5. Utilize built-in mathematical functions and user-defined functions to solve scientific and engineering problems.

List of Experiments/Programs

Program 1	Write a program to perform basic arithmetic operations on two numbers.
Program 2	Write a program to find the roots of a quadratic equation.
Program 3	Write a program to find the largest number among three numbers.
Program 4	Write a program to convert temperature between Celsius and Fahrenheit.
Program 5	Write a program to calculate Simple Interest and Compound Interest.
Program 6	Write a program to check whether a given year is a leap year..
Program 7	Write a program to reverse a number.
Program 8	Write a program to check whether a number is palindrome or not.
Program 9	Write a program to find the factorial of a number.
Program 10	Write a program to perform addition, subtraction, and multiplication of two matrices.
Program 11	Write a program to find the transpose, determinant, inverse, and rank of a matrix.
Program 12	Write a program to program to find the eigenvalues and eigenvectors of a matrix.
Program 13	Write a program to sort the elements of a vector in ascending and descending order.
Program 14	Write a program to solve a system of linear equations using the Gaussian Elimination method.

Course Outcomes:

On the successful completion of the course, student will be able:

1. Demonstrate proficiency in using the MATLAB environment, including the Command Window, Editor, Workspace, and Help system for program development.
2. Develop MATLAB programs using variables, operators, built-in functions
3. Develop MATLAB programs using control structures to solve computational problems.
4. Apply arrays, vectors, and matrices in MATLAB to perform mathematical computations..
5. Apply matrices in MATLAB to solve systems of linear equations.

Paper	Code	Subject	L	T	P	MSM	ESM	Total	Credits
G.Core	EPC001	AI Based English Proficiency Course - I	0	0	0	0	50	50	2

[Course objectives, detailed syllabus, text/reference books and course outcomes to be provided by the concerned Board of Studies.]

BHP201: Optics	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	Class Test -12 Marks Teachers Assessment - 6 Marks Attendance - 12 Marks End Semester Exam - 70 marks

Course Objectives:

1. **Develop a fundamental understanding of geometrical and physical optics**, including image formation, interference, diffraction, resolving power, and polarization of light.
2. **Familiarize students with important optical phenomena and principles**, including Young's interference, thin-film interference, Fraunhofer diffraction, Rayleigh's criterion, and double refraction.
3. **Develop the ability to apply optical principles to practical systems and instruments**, including optical interferometers, diffraction gratings, polarimeters, and optical resolving systems.

Detailed Syllabus:

Unit-1: Geometrical Optics and Resolving Power

Introduction to ray optics; sign conventions; general theory of image formation; cardinal points; Newton's formula; equivalent focal length of a combination of two thin lenses; resolving power and Rayleigh's criterion; limit of resolution of the eye; limit of resolution of a convex lens; resolving power of optical instruments; resolving power of a grating

Unit-2: Interference

Theory of interference; conditions for sustained interference; division of wavefront and division of amplitude; Young's double-slit experiment; Fresnel's biprism; phase change on reflection and Stokes' treatment; interference in thin films; interference in parallel and wedge-shaped films; Newton's rings and determination of wavelength and refractive index; Michelson's interferometer.

Unit-3: Fraunhofer Diffraction

Introduction to diffraction; types of diffraction; difference between interference and diffraction; Fraunhofer diffraction due to a single slit; diffraction due to a double slit; diffraction due to N-slits; plane transmission grating and its applications.

Unit-4: Polarization

Introduction to polarized light; polarization by reflection and refraction; Brewster's law; Malus' law; double refraction; uniaxial and biaxial crystals; ordinary and extraordinary

rays; quarter-wave plate and half-wave plate; analysis of plane, circular and elliptical polarized light; optical activity; Fresnel's theory of optical activity; specific rotation; polarimeter.

Text Books:

1. Ajoy Ghatak, Optics, 6th Edition, McGraw-Hill Education, 2017.
2. Eugene Hecht, Optics, 5th Edition, Pearson Education, 2016.
3. D. P. Khandelwal, A Text Book of Optics, Vani Publishing House, New Delhi.
4. Brij Lal, N. Subrahmanyam and M. N. Avadhanulu, A Text Book of Optics, S. Chand & Company, New Delhi.

Reference Books:

1. F. A. Jenkins and H. E. White, Fundamentals of Optics, 4th Edition, McGraw-Hill.
2. M. Born and E. Wolf, Principles of Optics, 7th Edition, Cambridge University Press.
3. R. K. Ghatak, Optics and Optoelectronics, Prentice-Hall of India.

Course Outcomes:

After completing the course, students will be able to:

CO1.	Explain the principles of geometrical optics and analyse image formation using cardinal points, Newton's formula, and combinations of thin lenses.
CO2.	Explain and analyse interference phenomena using division of wavefront and amplitude, and apply these principles to Young's experiment, thin films, Newton's rings, and Michelson's interferometer.
CO3.	Understand Fraunhofer diffraction and analyse diffraction patterns produced by single slits, double slits, and plane transmission gratings.
CO4.	Explain the concept of resolving power and apply Rayleigh's criterion to analyse the resolution limits of optical instruments and diffraction gratings.
CO5.	Explain the principles of polarization, double refraction, wave plates, and optical activity, and analyse different states of polarized light.
CO6.	Apply the principles of optics to understand and interpret the working of optical instruments and experimental techniques used for the determination of wavelength, refractive index, resolving power, and specific rotation.

BHP202: Waves and Oscillations	
Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	Class Test -12 Marks Teachers Assessment - 6 Marks Attendance - 12 Marks End Semester Exam - 70 marks

Course Objectives:

1. **Develop a fundamental understanding of wave motion and oscillations**, including progressive waves, wave equations, simple harmonic motion, and the propagation of sound.
2. **Familiarize students with free, damped, and forced oscillatory systems**, including their mathematical formulation, energy characteristics, resonance, damping, and quality factor.
3. **Develop the ability to apply the principles of waves and oscillations** to mechanical and electrical systems, including mass-spring systems, pendulums, LC and LCR circuits, and sound propagation.

Detailed Syllabus:

Unit-1: Wave Motion

Plane and spherical waves; longitudinal and transverse waves; plane progressive (travelling) waves; wave equation; particle velocity and wave velocity; differential equation of wave motion; pressure associated with longitudinal waves; energy transport by waves; intensity of waves.

Unit-2: Velocity of Waves and Propagation of Sound

Velocity of longitudinal waves in a fluid-filled pipe; Newton's formula for the velocity of sound; Laplace's correction; factors affecting the velocity of sound; dependence of velocity of sound on temperature, pressure, density and humidity; shock waves and their basic characteristics.

Unit-3: Free Oscillations and Simple Harmonic Motion

Simple harmonic motion (SHM); differential equation of SHM and its solution; amplitude, angular frequency, frequency, time period and phase; velocity and acceleration in SHM; kinetic, potential and total energy and their time-average values; free oscillations of systems with one degree of freedom; mass-spring system; simple pendulum; torsional pendulum; electrical oscillator (LC circuit); analogy between mechanical and electrical oscillators.

Unit-4: Damped and Forced Oscillations

Damped harmonic oscillator and its mathematical formulation; underdamped, critically damped and overdamped motion; power dissipation; relaxation time; quality factor; forced harmonic oscillator; transient and steady-state solutions; amplitude and phase of forced oscillations; resonance and sharpness of resonance; power dissipation; bandwidth and quality factor; forced electrical oscillations and LCR circuit.

Textbooks:

1. K. Uno Ingard, *Fundamentals of Waves & Oscillations* (Cambridge University Press, 1988)
2. Daniel Kleppner, Robert J. Kolenkow, *An Introduction to Mechanics* (McGraw-Hill, 1973)

Reference Books:

1. A. P. French, *Vibrations and Waves* (CBS Pub. & Dist., 1987)
2. N. K. Bajaj, *The Physics of Waves and Oscillations* (Tata McGraw-Hill, 1988)
3. Franks Crawford, *Waves: Berkeley Physics Course (SIE)* (Tata McGraw Hill, 2007)
4. N. Subrahmanyam & Brijlal, *Waves & Oscillation* (S. Chand Publications, 2010)

Course Outcomes:

After completing the course, students will be able to:

CO1.	Explain the fundamental properties of longitudinal and transverse waves and analyse plane and spherical wave propagation using appropriate wave equations.
CO2.	Derive and apply the principles governing the velocity of sound in fluids and explain the effects of various physical factors and the formation of shock waves.
CO3.	Understand Fraunhofer diffraction and analyse diffraction patterns produced by single slits, double slits, and plane transmission gratings.
CO4.	Explain the concept of resolving power and apply Rayleigh's criterion to analyse the resolution limits of optical instruments and diffraction gratings.
CO5.	Explain the principles of polarization, double refraction, wave plates, and optical activity, and analyse different states of polarized light.
CO6.	Apply the principles of optics to understand and interpret the working of optical instruments and experimental techniques used for the determination of wavelength, refractive index, resolving power, and specific rotation.

BHC201: General Physical Chemistry	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks Semester Exam – 70 marks

Course Objectives:

1. To give an overview of complete knowledge of kinetic theory of gases.
2. To describe the electrolytic conductance and transference.
3. To explain about thermodynamics and its laws.
4. To explain different types of colloids and their characteristic properties.

Detailed Syllabus

Unit-1 The Gaseous State Kinetic molecular theory of gaseous, Derivation of gas laws, Ideal gas equation, Kinetic energy and temperature, Maxwell distribution of molecular velocities and energies, Types of molecular velocities, Expansivity and compressibility, Collision parameters: collision diameter, collision cross-section, collision number, collision frequency, Mean free path. Transport properties: Thermal conductivity, viscosity, diffusion. Degrees of freedom of a gaseous molecule. The principle of equipartition of energy.
Unit-2 Electrochemistry: Electrolytic Conductance and Transference Electrolytic conductance, Specific conductance, Equivalent conductance, Molar conductance, Variation of molar conductance with dilution, Ionic mobility, Transport number, Determination of transport numbers by moving boundary method, Kohlrausch's law, Calculation of molar ionic conductance, Relation between molar ionic conductance and ionic mobility, Determination of ionic mobility, Applications of Kohlrausch law, Diffusion and ionic mobility, Ostwald's dilution law, Debye Huckel theory of strong electrolytes.
Unit-3 The First Law of Thermodynamics Thermodynamic equilibrium, Extensive and intensive properties, Thermodynamic processes, Nature of work and heat, The first law of thermodynamics, Internal energy, State functions, Path functions, Exact and inexact differentials, Euler reciprocal relation, The cyclic rule, Enthalpy, Heat capacity, Relation between C_p and C_v, Isothermal and adiabatic expansion of an ideal gas and their comparison, Carnot cycle, Joule Thomson effect, Zeroeth law of thermodynamics.
Unit-4 The Colloidal State Colloidal systems, Lyophillic and lyophobic colloids, Properties of colloidal systems, Electrical properties: Charge on colloidal particles, the electrical double layer, DLVO theory, Coagulation of colloids. Electrokinetic properties: Electrophoresis, electro-osmosis.

Text and Reference Books

1. *Physical Chemistry*: P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
2. *Physical Chemistry*: B. R. Puri, L. R. Sharma, and M. S. Pathania.37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
3. *Physical Chemistry*: P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.

Course Outcomes (COs)

After completing the course, students will be able to

CO1	State kinetic theory of gaseous and different gaseous laws.
CO2	Understand different types of conductance and various laws of electrochemistry.
CO3	Explain First law of thermodynamics and its applications.
CO4	Explain different types of colloids and their properties.

BHC202: Inorganic Chemistry of Chemical Bonding	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12 Marks Teachers Assessment – 6 Marks Attendance – 12 Marks Semester Exam – 70 marks

Course Objectives:

1. To give an overview of General characteristics of main group elements.
2. To describe chemical bonding and different theories of bonding.
3. To explain hybridization and geometry of molecules.
4. To explain properties of acids and bases.

Detailed Syllabus

Unit-1 The Main Group Elements General characteristics of main group elements, metallic character, Polarizing power and polarizability, oxidizing and reducing properties, Electropositive character, Oxidation states, Diagonal relationship, Compounds of main group elements, Some special characteristics of p block elements, Reluctance of heavier p block elements to show maximum oxidation state and to involve p orbitals for pi bonding, Participation of d orbitals in sigma bonding, Participation of d orbitals in pi bonding, Electronegativities of main group elements.
Unit-2 Chemical Bonding and Theories of Bonding Ionic bond, Covalent bond, Atomic orbital overlap concept of covalency, Variable covalency, Maximum covalency, Coordinate covalent bond, Polarity in covalent bond, Covalent character of ionic bond, Fajan's rule, Effect of polarization, Percent ionic character of a polar covalent bond, Bond length, Bond angle, bond energy, Valence bond theory, Molecular orbital theory of homonuclear and heteronuclear diatomic molecules, Metallic bonding, Hydrogen bonding and its consequences.
Unit-3 Hybridization and Shapes of Covalent Molecules Hybridization, Salient features of hybridization, Orientation of hybrid orbitals in space, VSEPR theory, Geometry and shape of covalent molecules, Geometry of molecules containing only bond pair of electrons, Geometry of molecules containing bond pair as well as lone pair of electrons, Structure of CO_2 molecule, Geometry of some ions.
Unit-4 Acids and Bases Arrhenius concept, Concept of Lowry and Bronsted, Lux-Flood concept, Solvent-system concept, Lewis concept, Relative strengths of acids and bases, Effect of solvent, Levelling effect, Effect of polarity and dielectric constant, effect of substituents, Hard and soft acids and bases, Pearson's concept, Bonding in hard-hard and soft-soft combinations, HSAB principle and its applications, Basis for hard-hard and soft-soft interactions.

Text and Reference Books

1. *Inorganic Chemistry*, Huhey, J.E. Prentice Hall 1993
2. *Concepts & Models of Inorganic Chemistry*, Douglas, B.E. and Mc Daniel, D.H., Oxford 1970
3. *Concise Inorganic Chemistry*, Lee, J.D., ELBS (1991)
4. *Inorganic Chemistry*, Shriver & Atkins,Third Edition, Oxford Press 1994.
5. *Inorganic Chemistry*, H.W. Porterfield,Second Edition, Academic Press, 2005

Course Outcomes (COs)

After completing the course, students will be able to

CO1	Explain general characteristics and compounds of main group elements.
CO2	Understand chemical bonding in inorganic compounds.
CO3	Explain geometry and shape of inorganic molecules.
CO4	Explain different theory of acids and bases.

BHM201-Real Analysis	
Teaching Scheme	**Examination Scheme**
Lectures:3hrs/Week	ClassTest-12Marks
Tutorials:1hr/Week	Teachers Assessment-6 Marks Attendance– 12Marks
Credits:4	End Semester Exam–70marks

Course Objectives:

1. To understand the algebraic and order properties of the real number system, including the completeness property of real numbers.
2. To understand the concept of sequences of real numbers and study their convergence, boundedness, and related properties.
3. To understand the concept of infinite series of real numbers and the various tests for determining their convergence.
4. To understand the concept of Riemann integration and determine the integrability of functions using partitions, upper sums, and lower sums

Detailed Syllabus

Unit 1: Real Number System: Algebraic and order properties of R, Absolute value of a real number; Bounded sets, Supremum and infimum, Archimedean property, Definition and types of intervals, Open and closed sets in R, Nested intervals, The completeness property of R,
Unit 2: Sequences in R: Sequence, Limit of a sequence, Bounded sequence, Limit theorems, Convergent sequence, Monotone sequences, Monotone convergence theorem, Subsequence's, Bolzano-Weierstrass theorem for sequences, Cauchy sequence, Cauchy's convergence criterion.
Unit 3: Infinite Series: Convergence and divergence of infinite series of real numbers, Necessary condition for convergence, Cauchy criterion for convergence; Tests for convergence of positive term series: Basic comparison test, Limit comparison test, D'Alembert's ratio test, Cauchy's nth root test, Integral test; Alternating series, Leibniz test, Absolute and conditional convergence.
Unit 4: Reimann Integrations: Bounded functions on closed intervals; partitions and refinements; upper and lower sums (Darboux sums); upper and lower integrals; definition of Riemann integrability; criteria for integrability; integrability of continuous, monotone, and piecewise continuous functions; properties of the Riemann integral (linearity, additivity, monotonicity, and comparison theorems); Fundamental Theorem of Calculus; Mean Value Theorem for integrals; applications to area under curves, area between curves.

Textbooks:

1. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
2. T. Apostol, Mathematical Analysis, Narosa Publishing House.

Reference Books:

1. W. Rudin, Principles of Mathematical Analysis, Tata McGraw-Hill.
2. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
3. S. Narayan and M.D. Raisinghania, Elements of Real analysis, S. Chand & Company Ltd.
4. S.C. Malik, Principle of Real analysis, New Age International Publisher, New Delhi.

Course Outcomes:

At the end of the course, the student should be able to:

1. Apply the properties of the real number system to analyze sequences, limits, and fundamental concepts in real analysis.
2. Determine the convergence or divergence of real sequences and apply sequence theorems to solve problems in mathematical analysis.
3. Develop an understanding of sphere and straight line.
4. Test the Riemann integrability of functions and evaluate definite integrals using the fundamental properties and theorems of Riemann integration.

BHM202-INTEGRAL CALCULUS	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** ClassTest-12Marks TeachersAssessment-6 Marks Attendance– 12Marks EndSemesterExam–70marks

Course Objectives:

1. To understand about principles of reduction formulae for simplifying higher-order algebraic, trigonometric, and logarithmic integrals.
2. To understand about Bernoulli's formula.
3. Establish mathematical relationships between Beta and Gamma representations.
4. To understand about integration and to describe methods from two dimensions into three dimensions using triple integrals.
5. To compute geometric metrics such as lengths, curved surface areas, and bounded volumes of revolution.

Detailed Syllabus

Unit 1: Reduction formulae, integration of product of powers of algebraic and trigonometric functions, integration of product of powers of algebraic and logarithmic functions - Bernoulli's formula.
Unit 2: Beta and Gamma functions, infinite integral – definitions, recurrence formula of Gamma functions, properties of Beta and Gamma functions, relation between Beta and Gamma functions, Applications.
Unit 3: Multiple Integrals, definition of double integrals, evaluation of double integrals, Jacobian, double integrals in polar coordinates, change of order of integration.
Unit 4: Triple integrals, applications of multiple integrals, volumes of solids of revolution, areas of curved surfaces, change of variables,
Unit 5: Areas under plane curves, Cartesian co-ordinates, area of a closed curve, areas in polar co-ordinates.

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2010.
2. Shanti Narayan & Dr. P.K. Mittal, Integral Calculus, S.Chand, 2005.

Reference Books:

1. Dass, H. K. (2014). *Advanced engineering mathematics* (21st ed.). S. Chand Publishing.
2. Stewart, J. (2020). *Calculus: Early transcendentals* (9th ed.). Cengage Learning.
3. Kaplan, W. (2002). *Advanced calculus* (5th ed.). Addison-Wesley.
4. Edwards, J. (1921). *A treatise on the integral calculus: With applications, examples and problems* (Vol. 1 & 2). Macmillan and Co.
5. Zill, D. G. (2016). *Advanced engineering mathematics* (6th ed.). Jones & Bartlett Learning.
6. Das, P. S., & Vijayakumari, C. (2014). *Engineering mathematics*. Pearson Education India.
7. Aggarwal, B. D. (2012). *Integral evaluations using the Gamma and Beta functions: With special integrals in engineering and science*. Science Publishers.

Course Outcomes:

At the end of the course, the student should be able to:

1. Understanding the integration limits of a double integral effectively involves dynamically reversing the order of integration.

2. Compute triple integrals over complex three-dimensional spaces.
3. Methods for the Beta & Gamma forms and recurrence identities.
4. Calculate the surface areas of curved geometries and the volumes of solids generated through mathematical revolution.

BHP251: Optics Lab	
Teaching Scheme	**Examination Scheme**
Practical: 4 hrs/Week Credits: 2	Attendance - 5 Marks Teachers Assessment - 10 Marks End Semester Exam - 35 Marks

Course Objectives:

1. **Develop practical skills** in performing optical, wave, and oscillation experiments using standard laboratory instruments and experimental techniques.
2. **Familiarize students with experimental methods** for determining physical quantities such as wavelength, focal length, refractive index, frequency, angular spread, and resolving optical parameters.
3. **Develop proficiency in experimental data analysis**, including accurate measurement, observation, graphical representation, error estimation, and interpretation of experimental results.

List of Experiments:

Student has to perform any eight of the following experiments:

1. To determine the wavelength of monochromatic light using Newton's rings.
2. To determine the focal length of two lenses by the nodal-slide method and to locate the position of the cardinal points.
3. To determine the height of a tower using a sextant.
4. To determine the refractive index of a prism using white light.
5. To determine the wavelength of the prominent spectral lines of mercury light using a plane transmission grating (normal incidence method).
6. To verify Malus's law using a polarizer-analyzer arrangement.
7. To determine the frequency of an electrically maintained tuning fork using Melde's experiment.
8. To determine the frequency of A.C. mains using a sonometer.
9. To determine the wavelength of a laser using a diffraction grating.
10. To determine the wavelength and angular spread of a laser beam.

Text Books:

1. Geeta Sanon, B.Sc. Practical Physics, 1st Edition (2007), R. Chand & Co.

2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.

Reference Books:

1. Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.

2. D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

Course Outcomes:

After completing the course, students will be able to:

CO1.	**Apply** standard experimental techniques to determine optical parameters such as wavelength, focal length, refractive index, cardinal points, and angular

	spread.
CO2.	**Perform and analyse** experiments based on interference, diffraction, and polarization to verify fundamental laws and determine relevant physical quantities.
CO3.	**Determine and interpret** frequencies and wavelengths associated with mechanical and electrical oscillations using appropriate experimental methods.
CO4.	**Operate** standard optical and laboratory instruments, including spectrometers, polarizers, gratings, sextants, sonometers, and laser-based experimental setups, systematically and safely.
CO5.	**Analyse** experimental observations using appropriate calculations, graphs, uncertainty/error estimation, and data interpretation techniques.
CO6.	**Evaluate and interpret** experimental results and relate them to the underlying principles of optics, wave motion, interference, diffraction, polarization, and oscillations.

BHC251: Inorganic Chemistry Lab	
Teaching Scheme	**Examination Scheme**
Practical's: 4 hrs/Week	External marks- 35
Credits: 2	Internal marks- 15

Course Objectives:

1. To give an overview of qualitative analysis of organic compounds.

2. To give a brief idea of single step organic synthesis.

3. To introduce students with paper chromatography technique.

Detailed Syllabus

LIST OF EXPERIMENTS

- **Basic Titrimetric Skills and acid-base titrations**

1. Preparation of standard solutions of different Molarity/Normality (e.g., NaOH, HCl, $KMnO_4$ oxalic acid).
2. Estimation of concentration of unknown HCl using standardized NaOH solution.
3. Estimation of oxalic acid concentration using standardized NaOH solution.
4. Estimation of sodium carbonate concentration using standardized HCl solution.
5. Estimation of carbonate and hydroxide present together in a mixture (double titration method).
6. Estimation of carbonate and bicarbonate present together in a mixture (double titration method).

- **Redox Titrations**

7. Estimation of oxalic acid concentration using standardized $KMnO_4$ solution.
8. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
9. Estimation of oxalic acid and sodium oxalate present together in a given mixture.
10. Estimation of Fe^{2+} using standardized $K_2Cr_2O_7$ solution (with internal/external indicator) via redox titration.
11. Iodometric titration: estimation of an oxidizing agent (e.g., $K_2Cr_2O_7$) using standardized sodium thiosulphate solution.

Course Outcomes (COs)

After completing the course, students will be able to

CO1	Prepare solutions of different molarity and normality.
CO2	Understand the practical knowledge of acid base titrations.
CO3	Understand the theory behind redox titrations.

BHM251-PROGRAMMING IN C

Teaching Scheme	Examination Scheme
Lab: 4 Hrs/Week Tutorials: 0 Hrs./Week Credits: 2	Internal-15Marks External- 35 Marks

Course Objectives:

The main objectives of this course are to:

1. To give an overview of recapitulation of computer basics.
2. To describe the computer programming.
3. To explain BASIC concepts of C programming.
4. To explain basic commands in C programming.
5. To explain loops in C programming.

List of Experiments/Programs

Note: Complete any 15 programs out of twenty programs**.**

Program 1	Write a program to check whether a number is even or odd.
Program 2	Write a program to check whether a character is vowel or consonant.
Program 3	Write a program to find the largest number among three numbers.
Program 4	Write a function to check whether a number is positive or negative.
Program 5	Write a program to generate multiple tables.
Program 6	Write a program to display Fibonacci sequence.
Program 7	Write a program to reverse a number.
Program 8	Write a program to check whether a number is palindrome or not.
Program 9	Write a program to find LCM of two numbers.
Program 10	Write a program to find simple interest.
Program 11	Write a program to swap two numbers
Program 12	Write a program to find roots of a Quadratic Equation.
Program 13	Write a program to check Leap Year.
Program 14	Write a program to check whether a number is positive or negative.
Program 15	Write a program to calculate the sum of natural numbers.
Program 16	Write a program to check whether a number can be expressed as sum of two prime numbers.
Program 17	Write a program to find factorial of a number using Recursion.
Program 18	Write a program to to find average of numbers.
Program 19	Write a program to unt numbers of digits in a number.
Program 20	Write a program to find perfect number between 1 to n.

Course Outcomes:

On the successful completion of the course, student will be able:

1. To explain c programming.
2. To use c commands in programming
3. To Write, edit, compile a c program
4. Execute standard basic programs in C.
5. To apply loop in c programming.

Paper	Code	Subject	L	T	P	MSM	ESM	Total	Credits
G.Core	EPC001	AI Based English Proficiency Course - II	0	0	0	0	50	50	2

[Course objectives, detailed syllabus, text/reference books and course outcomes to be provided by the concerned Board of Studies.]

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AI English Proficiency

Adaptive Syllabus — Bands 1 to 9

Listening·Speaking·Reading·Writing

1-Year Programme·2 Semesters·Powered by AI FluentEdge

How to Read This Syllabus

Each band section lists **5 units per skill**. The first **2 units are mandated** — these form the assessed curriculum (120 lessonspersemester).Units3–5areoptionalenrichmentthatstudentsareencouragedtocompletebutcarrynomarks.

✓ Mandated	Assessed · contributes to 10-mark Course Completion component
Optional	Encouraged enrichment · no marks attached · unlocked on platform

Programme Overview — All Bands

BETBaselinedetermineseachstudent'sstartingbandindependentlyforeachskill.Studentsbeginfromtheirdiagnosed band and complete the 2 mandated units of that level each semester.

Band	CEFR	Platform Level	MandatedUnits(per skill)	Lessons / Skill	Total Lessons
Bands 1–3	A1	Beginner	Unit 1 &2	30	120
Band 4	A2	Elementary	Unit 1 &2	30	120
Band 5	B1	Intermediate	Unit 1 &2	30	120
Bands 6–7	B2	Upper-Intermediate	Unit 1 &2	30	120
Band 8	C1	Advanced	Unit 1 &2	30	120
Band 9	C2	Proficient	Unit 1 &2	30	120

Note:StudentsatBands1,2,and3allbeginatBeginnerlevel.StudentsatBands6and7beginatUpper-Intermediate.Platform unlocks adaptive progression within and across levels.

Bands 1, 2 &3

CEFR: A1 · Beginner

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Bands1,2,and3aregroupedtogetherattheBeginnerlevel(CEFRA1).Studentsareplacedwithinthislevelatdifferentstartingpoints by the BET Baseline — Band 1 at the earliest point, Band 3 slightly further in — but all cover the same mandated units.

Listening	Unit Name	Lessons	Status	Sub-topics
1	Workplace Greetings	15	✓ Mandated	15
2	Basic Instructions	15	✓ Mandated	15
3	Office Objects	15	Optional	15
4	Simple Schedules	15	Optional	15
5	Basic Requests &Medication	15	Optional	14

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Introducing Yourself	15	✓ Mandated	13
2	Talking About Daily Tasks	15	✓ Mandated	12
3	Asking for Directions	15	Optional	8
4	Making Simple Requests & IT Support	15	Optional	29
5	Following Up	15	Optional	2

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reading Simple Emails	15	✓ Mandated	15
2	Following Return Policy Instructions	15	✓ Mandated	15
3	Following Simple Financial Documents	15	Optional	15
4	Understanding Office Signs & Workplace Etiquette	15	Optional	22
5	Regulatory Documents	15	Optional	2

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing a Short Job Description	15	✓ Mandated	5
2	Writing a Simple Email	15	✓ Mandated	10
3	Writing Basic Instructions	15	Optional	10
4	Taking Simple Work Notes	15	Optional	8
5	Meeting Follow-up	15	Optional	6

Band 4

CEFR: A2 · Elementary

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Listening	Unit Name	Lessons	Status	Sub-topics
1	Scheduling Meetings	15	✓ Mandated	15
2	Email Follow-ups	15	✓ Mandated	15
3	Work Routines	15	Optional	15
4	Office Roles	15	Optional	10
5	Basic Phone Calls & Handling Complaints	15	Optional	12

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Scheduling Meetings	15	✓ Mandated	15
2	Writing and Responding to Emails	15	✓ Mandated	12
3	Work Roles and Responsibilities	15	Optional	12
4	Giving Feedback on Tasks	15	Optional	8
5	Talking About Company Policies	15	Optional	9

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reading Company Policies	15	✓ Mandated	15
2	Understanding Meeting Agendas	15	✓ Mandated	15
3	Reading Customer Inquiries	15	Optional	15
4	Internal Office Communication	15	Optional	15
5	Understanding Workflow Charts	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing Follow-Up Emails	15	✓ Mandated	15
2	Summarizing Workplace Tasks	15	✓ Mandated	15
3	Creating Short Reports	15	Optional	15
4	Writing Formal Meeting Invitations	15	Optional	15
5	Describing Company Policies	15	Optional	15

Band 5

CEFR: B1 · Intermediate

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Listening	Unit Name	Lessons	Status	Sub-topics
1	Client Calls	15	✓ Mandated	15
2	Daily Briefings	15	✓ Mandated	15
3	Handling Complaints	15	Optional	15
4	Meeting Agendas	15	Optional	15
5	Team Discussions	15	Optional	15

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Team Discussions	15	✓ Mandated	15
2	Handling Client Communication	15	✓ Mandated	15
3	Managing Workplace Challenges	15	Optional	15
4	Giving Performance Feedback	15	Optional	15
5	Handling Workplace Negotiations	15	Optional	15

Reading	Unit Name	Lessons	Status	Sub-topics
1	Analyzing Business Reports	15	✓ Mandated	15
2	Reading Project Proposals	15	✓ Mandated	15
3	Understanding Corporate Emails	15	Optional	15
4	Reviewing Meeting Minutes	15	Optional	15
5	Handling Client Requests	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing Business Proposals	15	✓ Mandated	15
2	Composing Structured Workplace Emails	15	✓ Mandated	15
3	Drafting Performance Reviews	15	Optional	15
4	Summarizing Client Feedback	15	Optional	15
5	Writing Detailed Project Updates	15	Optional	15

Bands 6 &7

CEFR: B2 · Upper-Intermediate

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Bands6and7aregroupedtogetherattheUpper-Intermediatelevel(CEFRB2).Studentsareplacedatdifferentstartingpointswithin this level based on their BET score, but both cover the same mandated units.

Listening	Unit Name	Lessons	Status	Sub-topics
1	Strategy Meetings	15	✓ Mandated	15
2	Budget Discussions	15	✓ Mandated	15
3	Project Feedback	15	Optional	15
4	Performance Reviews	15	Optional	15
5	Internal Memos	15	Optional	15

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Strategy Meetings	15	✓ Mandated	15
2	Budget Discussions	15	✓ Mandated	15
3	Handling Corporate Presentations	15	Optional	15
4	Reviewing Project Proposals	15	Optional	15
5	Discussing Market Trends	15	Optional	15

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reading Financial Reports	15	✓ Mandated	15
2	Understanding Competitive Analysis	15	✓ Mandated	15
3	Reviewing Business Strategies	15	Optional	15
4	Evaluating Employee Performance Reports	15	Optional	15
5	Reading Corporate Case Studies	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Drafting Strategic Plans	15	✓ Mandated	15
2	Writing Executive Summaries	15	✓ Mandated	15
3	Composing High-Level Business Reports	15	Optional	15
4	Writing Structured Financial Forecasts	15	Optional	15
5	Preparing Official Corporate Documentation	15	Optional	15

Band 8

CEFR: C1 · Advanced

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

Listening	Unit Name	Lessons	Status	Sub-topics
1	Negotiation Strategies	15	✓ Mandated	14
2	Financial Analysis	15	✓ Mandated	15
3	Business Development	15	Optional	15
4	Policy Changes	15	Optional	15
5	Crisis Management	15	Optional	15

Speaking	Unit Name	Lessons	Status	Sub-topics
1	Negotiation Strategies	15	✓ Mandated	15
2	Financial Analysis Discussions	15	✓ Mandated	15
3	Business Development Talks	15	Optional	15
4	Crisis Communication	15	Optional	15
5	Discussing Global Business Policies	15	Optional	15

Reading	Unit Name	Lessons	Status	Sub-topics
1	Reviewing Investment Proposals	15	✓ Mandated	15
2	Analyzing Global Business Trends	15	✓ Mandated	15
3	Understanding Market Research Reports	15	Optional	15
4	Reading International Trade Agreements	15	Optional	15
5	Corporate Risk Assessments	15	Optional	15

Writing	Unit Name	Lessons	Status	Sub-topics
1	Writing Complex Business Case Studies	15	✓ Mandated	15
2	Preparing International Trade Analysis	15	✓ Mandated	15
3	Drafting Industry Regulatory Reports	15	Optional	15
4	Writing Professional Negotiation Scripts	15	Optional	15
5	Composing Thought Leadership Articles	15	Optional	15

Band 9

CEFR: C2 · Proficient

✓ **Mandated:** Units 1 & 2 per skill · 30 lessons/skill · 120 lessons total per semester

Optional: Units 3, 4 & 5 per skill (encouraged, ungraded)

List eni ng	Unit Name	Lessons	Status	Sub-topics
1	Boardroom Debates	15	✓ Mandated	15
2	Industry Forecasts	15	✓ Mandated	15
3	Investor Meetings	15	Optional	15
4	Competitive Analysis	15	Optional	15
5	International Mergers	15	Optional	15

Spe aking	Unit Name	Lessons	Status	Sub-topics
1	Boardroom Debates	15	✓ Mandated	15
2	Industry Forecasts	15	✓ Mandated	15
3	Investor Meetings	15	Optional	15
4	Competitive Analysis	15	Optional	15
5	International Mergers	15	Optional	15

Rea ding	Unit Name	Lessons	Status	Sub-topics
1	Reading Boardroom Briefings	15	✓ Mandated	15
2	Analyzing International Mergers	15	✓ Mandated	15
3	Reviewing High-Stakes Legal Contracts	15	Optional	15
4	Reading Complex Financial Audits	15	Optional	15
5	Understanding Multinational Business Strategies	15	Optional	15

Writ ing	Unit Name	Lessons	Status	Sub-topics
1	Writing Global Business Transformation Whitepapers	15	✓ Mandated	15
2	Composing Investment Proposals	15	✓ Mandated	15
3	Drafting Multinational Expansion Strategies	15	Optional	15
4	Preparing High-Impact Financial Reports	15	Optional	15
5	Writing Regulatory Compliance Case Studies	15	Optional	15