Scheme of Instruction & Syllabi

Of

Bachelor of Science (Honours)

Physics

(Effective from Session 2026-2027)

First Year

Department of Applied Sciences & Humanities

INVERTIS UNIVERSITY

Bareilly-243123 U.P.

B.Sc. Honours (Physics)

This program provides a specialized ability to identify and solve significant problems across a broad range of application areas concerned chiefly with knowledge of Physics as well as of cross-discipline nature, to develop the aptitude to apply the principles of Physics and related sciences to articulate an in-depth understanding of core knowledge on various areas of Physical Sciences. It is designed to help students understand the importance of the role of this knowledge in improving the quality of human life. It also helps students recognize and appreciate the contribution of great scientists in the field of Physics and related fields.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

This program acts as a specialized degree and helps to develop critical, analytical and problem-solving skills at a first level. 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 Physics, 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 Physical 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 modeling 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) (Physics)
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	0	0	4	15	35	50	2
AECC	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
AECC	EPC002	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) (Physics)
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) (Physics)
Scheme of Instruction

III Year

V Semester			Teaching Scheme			Marks Distribution			Credits
Paper	**Code**	**Subject**	**L**	**T**	**P**	**MSM**	**ESM**	**Total**	
DSC-25	BHP501	Electric and Magnetic Properties	3	1	0	30	70	100	4
DSC-26	BHP502	Atomic and Molecular Physics	3	1	0	30	70	100	4
DSC-27	BHP503	Quantum Mechanics	3	1	0	30	70	100	4
DSC-28	BHP504	Mathematical Physics	3	1	0	30	70	100	4
VAC-1	BHP505	Introduction to Data Science	2	0	0	15	35	50	2
Lab-13	BHP551	Electromagnetics Lab	0	0	4	15	35	50	2
Lab-14	BHP552	Data Science Lab	0	0	4	15	35	50	2
FW	BHP553	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	BHP601	Solid State Physics	3	1	0	30	70	100	4
DSC-30	BHP602	Nuclear & Particle Physics	3	1	0	30	70	100	4
DSC-31	BHP603	Statistical Mechanics	3	1	0	30	70	100	4
DSC-32	BHP604	Nanomaterials and Applications	3	1	0	30	70	100	4
VAC-2	BHP605	Environment and Climate Change	2	0	0	15	35	50	2
Lab-15	BHP651	Material Science Lab	0	0	4	15	35	50	2
Project	BHP652	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
Physics

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.	Describe 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 Germe 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	**Examination Scheme**
Lectures: 3 hrs/Week	Class Test -12 Marks
Tutorials: 1 hr/Week	Teachers Assessment – 6 Marks
	Attendance – 12 Marks
Credits: 4	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 o 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 o nomenclature, IUPAC names from structural formulas, Nomenclature of polyfunctiona 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 optica activity, Optical isomerism of lactic and tartaric acids, Enantiomers, Diastereomers, Meso compounds, Optical activity without chiral carbons, Resolution of racemic mixtures, Walder 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 o 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

BHM102: 3-Dimensional Geometry	
Teaching Scheme Lectures:3hrs/Week Tutorials:1hr/Week Credits:4	**Examination Scheme** ClassTest-12Marks TeachersAssessment-6Marks 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. aran 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 Practicals: 2 hrs/Week Credits: 2	**Examination Scheme** External marks- 35 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.

EPC001 & EPC002 - AI Based English Proficiency Course - I & II	
Self Learning Course Self study: 4 Hrs/Week Credits: 2 (Each semester)	**Examination Scheme** External- 50 Marks (Each semester)

WeXL AI · Invertis University
AI English Proficiency Course
Adaptive Syllabus — Bands 1 to 9
Listening · Speaking · Reading · Writing
1-Year Programme · 2 Semesters · Powered by AI FluentEdge

Each band section lists **5 units per skill**. The first **2 units are mandated** — these form the assessed curriculum (120 lessons per semester). Units 3–5 are optional enrichment that students are encouraged to complete but carry no marks.

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

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AI English Proficiency Course

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 lessons per semester). Units 3–5 are optional enrichment that students are encouraged to complete but carry no marks.

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

Programme Overview — All Bands

BET Baseline determines each student's starting band independently for each skill. Students begin from their diagnosed band and complete the 2 mandated units of that level each semester.

Band	CEFR	Platform Level	Mandated Units (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: Students at Bands 1, 2, and 3 all begin at Beginner level. Students at Bands 6 and 7 begin at Upper-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)

Bands 1, 2, and 3 are grouped together at the Beginner level (CEFR A1). Students are placed within this level at different starting points 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)

Bands 6 and 7 are grouped together at the Upper-Intermediate level (CEFR B2). Students are placed at different starting points within 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)

Listening	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

Speaking	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

Reading	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

Writing	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