Scheme of Instruction & Syllabi

For

Master of Science

in

Physics

Two Years CBCS M.Sc. Course in Physics

(Academic Session: 2026-27)

First Year

Department of Applied Sciences & Humanities

INVERTIS UNIVERSITY

Invertis Village

Bareilly-Lucknow NH-24, Bareilly-243123, India

M.Sc. (Physics)

This program provides an ability to identify and solve significant problems across a broad range of application areas, to develop the aptitude to apply the principles of Physics and to articulate an in-depth understanding of advanced knowledge on various areas of Physics. It is designed to help students understand the importance of physical advancements in industry and the role of these in improving the quality of human life.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The program acts as the advanced degree and helps to develop critical, analytical and problem-solving skills at an advanced level. The foundation degree makes the students employable in scientific organizations and also to assume administrative positions in various types of organizations. It also helps the students to pursue a career in academics or scientific organizations as a researcher.

The Program Educational Objectives are to prepare the students to:

PEO-1. **Work independently or in a team with engineering, medical, ICT professionals and scientists in scientific problem solving.**

PEO-2. **Act as administrators in public, private and government organizations or business administrators with further training and education.**

PEO-3. **Pursue Doctoral research degrees to work in colleges, universities as professors or as scientists in research establishments.**

Program Outcomes of M.Sc. (Physics)

PO1: Students will have a firm foundation in the fundamentals and application of current scientific theories in different areas of Physics.
PO2: Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.
PO3: Students will be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems.
PO4: Students will be able to clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.
PO5: Students will be able to explore new areas of research in both physics and allied fields of science and technology.
PO6: Students will appreciate the pivotal role of physics in our society and use this as a basis for ethical behavior.
PO7: Students will be able to function as a member of an interdisciplinary problem-solving team.
PO8: Students will have specific skills in planning and conducting advanced experiments and applying structural-physical characterization techniques.
PO9: Students will be able to use modern instrumentation and classical techniques, to design experiments, and to properly record the results of their experiment.
PO10: Students will be able to use modern library searching and retrieval methods to obtain information about a topic, techniques, or an issue relating to physics.
PO11: Students will be able to communicate scientific results in writing and in oral presentation.
PO12: Students will become proficient in their specialized area of physics and acquire the basic tools needed to carry out independent cutting-edge research in physics.

M.Sc. Previous (PHYSICS)
Proposed Course Structure

Semester – I

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 1	MPY-101	Mathematical Physics	3	1	0	30	70	100	4
2	Paper 2	MPY-102	Classical Mechanics	3	1	0	30	70	100	4
3	Paper 3	MPY-103	Quantum Mechanics-I	3	1	0	30	70	100	4
4	Paper 4	MPY-104	Electromagnetic Theory	3	1	0	30	70	100	4
5	Paper 5	EPC-001	AI Based English Proficiency Course - I	0	0	0	0	50	50	2
6	Lab 1	MPY-151	Physics Lab I	0	3	6	50	100	150	6
	Total			**12**	**7**	**6**	**170**	**430**	**600**	**24**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

Semester – II

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 6	MPY-201	Condensed Matter Physics	3	1	0	30	70	100	4
2	Paper 7	MPY-202	Atomic and Molecular Physics	3	1	0	30	70	100	4
3	Paper 8	MPY-203	Nuclear and Particle Physics	3	1	0	30	70	100	4
4	Paper 9	MPY-204	Statistical Physics	3	1	0	30	70	100	4
5	Paper 10	EPC-002	AI Based English Proficiency Course - II	0	0	0	0	50	50	2
6	Lab 2	MPY-251	Physics Lab II	0	3	6	50	100	150	6
	Total			**12**	**7**	**6**	**170**	**430**	**600**	**24**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

M.Sc. Final (PHYSICS)
Proposed Course Structure
FOR SPECIALIZATION IN ELECTRONICS

Semester – III

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 11	MPY301	Advanced Laser Physics	3	1	0	30	70	100	4
2	Paper 12	MPY302	Computational Physics	3	1	0	30	70	100	4
3	Paper 13	MPY303	Semiconductor Devices and Integrated Circuits	3	1	0	30	70	100	4
4	Paper 14	MPY311	Digital Electronics and Microprocessors	3	1	0	30	70	100	4
5	Lab 3	MPY351	Electronics Laboratory	0	3	6	50	100	150	6
6	Lab 4	MPY352	Computational Physics Laboratory-1	0	0	4	15	35	50	2
7	Field Lab	MPY350	Field Project/Internship	–	–	–	30	70	100	4
	SEMESTER TOTAL			**12**	**7**	**10**	**215**	**485**	**700**	**28**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

Semester - IV

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 15	MPY401	Quantum Mechanics - II	3	1	0	30	70	100	4
2	Paper 16	MPY411	Modern Communication Electronics	3	1	0	30	70	100	4
3	Paper 17	MPY412	Semiconductor Devices Fabrication	3	1	0	30	70	100	4
4	Lab 5	MPY451	Advanced Electronics Laboratory	0	3	6	50	100	150	6
5	Lab 6	MPY452	Computational Physics Laboratory-II	0	0	4	15	35	50	2
6	Project	MPY450	Project Work	–	–	–	100	100	200	8
	Total			**9**	**6**	**10**	**255**	**445**	**700**	**28**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

***Student can carry out Field Project/Internship during any semester break of the program**

FOR SPECIALIZATION IN MATERIAL SCIENCES

Semester - III

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 11	MPY301	Advanced Laser Physics	3	1	0	30	70	100	4
2	Paper 12	MPY302	Computational Physics	3	1	0	30	70	100	4
3	Paper 13	MPY303	Semiconductor Devices and Integrated Circuits	3	1	0	30	70	100	4
4	Paper 14	MPY321	Structure of Materials	3	1	0	30	70	100	4
5	Lab 3	MPY353	Material Science Laboratory	0	3	6	50	100	150	6
6	Lab 4	MPY352	Computational Physics Laboratory-1	0	0	4	15	35	50	2
7	Field Lab	MPY350	Field Project/Internship	–	–	–	30	70	100	4
	SEMESTER TOTAL			**12**	**7**	**10**	**215**	**485**	**700**	**28**
L-Lecture, T-Tutorial, P-Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

Semester - IV

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 15	MPY401	Quantum Mechanics - II	3	1	0	30	70	100	4
2	Paper 16	MPY421	Properties of Materials	3	1	0	30	70	100	4
3	Paper 17	MPY422	Nano Materials	3	1	0	30	70	100	4
4	Lab 5	MPY453	Advanced Materials Science Laboratory	0	3	6	50	100	150	6
5	Lab 6	MPY452	Computational Physics Laboratory-II	0	0	4	15	35	50	2
6	Project	MPY450	Project work	–	–	–	100	100	200	8
	Total			**9**	**6**	**10**	**255**	**445**	**700**	**28**
L-Lecture, T-Tutorial, P-Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

***Student can carry out Field Project/Internship during any semester break of the program**

FOR SPECIALIZATION IN QUANTUM COMPUTING

Semester - III

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 11	MPY301	Advanced Laser Physics	3	1	0	30	70	100	4
2	Paper 12	MPY302	Computational Physics	3	1	0	30	70	100	4
3	Paper 13	MPY303	Semiconductor Devices and Integrated Circuits	3	1	0	30	70	100	4
4	Paper 14	MPY331	Quantum Computing-Theory	3	1	0	30	70	100	4
5	Lab 3	MPY354	Quantum Computing Laboratory-I	0	3	6	50	100	150	6
6	Lab 4	MPY352	Computational Physics Laboratory-I	0	0	4	15	35	50	2
7	Field Lab	MPY350	Field Project/Internship	–	–	–	30	70	100	4
	SEMESTER TOTAL			**12**	**7**	**10**	**215**	**485**	**700**	**28**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

Semester – IV

S.No	Paper	Code	Subjects	Teaching Scheme			Marks Distribution			Credit
				L	T	P	CA	EE	Total	
1	Paper 15	MPY401	Quantum Mechanics - II	3	1	0	30	70	100	**4**
2	Paper 16	MPY431	Quantum Algorithms & Complexity	3	1	0	30	70	100	4
3	Paper 17	MPY432	Quantum Hardware, Error Correction & Applications	3	1	0	30	70	100	4
4	Lab 5	MPY454	Quantum Computing Laboratory-II	0	3	6	50	100	150	6
5	Lab 6	MPY452	Computational Physics Laboratory-II	0	0	4	15	35	50	2
6	Project	MPY450	Project work	–	–	–	100	100	200	8
	Total			**9**	**6**	**10**	**255**	**445**	**700**	**28**
L-Lecture, T-Tutorial, P- Practical, CA-Continuous Assessment, EE-Examination Evaluation.										

***Student can carry out Field Project/Internship during any semester break of the program**

Semester-I

MPY-101: Mathematical Physics

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

Prerequisite: - Students should have basic knowledge of:

1. Differential calculus, integral calculus, matrices, and elementary differential equations.
2. Complex numbers, vector algebra, and fundamental concepts of engineering mathematics.

Course Objectives: The objectives of this course are to:

1. Develop fundamental concepts of matrices, differential equations, complex analysis, special functions, and integral transforms with their applications.
2. Provide analytical techniques for solving advanced mathematical problems arising in engineering and physical sciences.
3. Enable students to apply mathematical methods such as Fourier and Laplace transforms, eigenvalue analysis, and special functions in modeling and problem-solving.

Detailed Syllabus:

Unit-1: Matrices
Definitions and types of matrices; Solution of linear algebraic equations, Characteristic equation and diagonal form, Eigen values and Eigen vectors, Cayley - Hamilton theorem, Functions of matrices, Application in solving linear differential equations.

Unit-2: Differential Equations
Linear Differential equation of first order, linear differential equations with constant coefficient, Summary of Frobenius method, Exact equation, Inhomogeneous linear equation, Differential equation with exact solution.

Unit-3: Complex Analysis
Function of complex variables, Cauchy-Riemann differential equations, Cauchy's integral theorem, Cauchy's integral formula, Taylor's Series, Laurent series, Cauchy residue theorem, Singular points of an analytical function, Evaluation of residues & definite integrals.

Unit-4: Special Functions Differential Equations
Differential Equations and Special Functions, Beta and Gamma functions, Second ordered linear differential equations with variable coefficients, Solution of Hyper-geometric, Legendre, Bessel, Hermite and Laguerre equations, Physical applications, Generating functions, Recursion relations.

Unit-5: Fourier series and Transforms Fourier series, Fourier integrals and transform, FT of Delta functions, Convolution theorem, Parseval's identity, Applications to the solution of differential equations, Laplace Transform and its properties, Applications to the solution of differential equations.

Text and Reference Books:

1. Artken & Weber, Mathematical methods for Physicists, Academic Press- N.Y.
2. E. Kreyszig, 7th Edition, Advanced Engineering Mathematics, New Age International.
3. J.W. Brown, R.V. Churchill, Complex Variables and Applications, Mc-Graw Hill.
4. A. W. Joshi, Matrices and Tensors in Physics, New Age International

Course Outcomes:

After completing the course, students will be able to:

CO1.	**Recall** the fundamental concepts of matrices, differential equations, complex variables, special functions, and integral transforms.
CO2.	**Explain** the fundamental concepts of matrices, differential equations, complex variables, special functions, and integral transforms.
CO3.	**Apply** matrix algebra, eigenvalue techniques, and analytical methods to solve systems of linear equations and ordinary differential equations.
CO4.	**Analyze** complex functions using Cauchy–Riemann equations, contour integration, Taylor/Laurent series, and residue theorem to evaluate definite integrals.
CO5.	**Evaluate** the suitability of special functions, Fourier series, Fourier transforms, and Laplace transforms for solving differential equations arising in engineering and physical sciences.
CO6.	**Develop** mathematical models and solution strategies using matrix methods, special functions, and integral transforms to solve engineering and physical science problems.

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MPY-102: Classical Mechanics

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

Prerequisite: Students should have basic knowledge of:

1. Newtonian mechanics, vectors, calculus, and differential equations.
2. Fundamental concepts of force, energy, momentum, and coordinate systems in physics.

Course Objectives: The objectives of this course are to:

1. Develop a comprehensive understanding of classical mechanics using Newtonian, Lagrangian, and Hamiltonian formulations.
2. Provide knowledge of variational principles, canonical transformations, and mathematical techniques used in advanced mechanics.
3. Apply principles of classical mechanics for analyzing particle motion, central force problems, and physical systems.
4. Provide insight into advanced concepts such as Poisson brackets, Kepler motion, and scattering phenomena.

Detailed Syllabus:

Unit-1:Preliminaries of classical mechanics

Newtonian mechanics- single and many particle systems, Conservation principles (laws)-linear momentum, Angular momentum & energy, Constrained motion, constraints, Degree of freedom, Generalised coordinates and notations.

Unit-2: Lagrangian formulation and Variational principles

Principle of virtual work, D' Alembert principle, Lagrange's equation from D'Alembert's principle, Lagrangian for a charge particle in an electromagnetic field, Application of Lagrange equations of motion—linear harmonic oscillator, Simple pendulum, Atwood's Machine, Compound pendulum, L-C Circuit, Particle moving under central force, problems, Superiority of Lagrangian approach over Newtonian approach, Introduction and techniques of calculation of variations, Hamilton's variational principle, deduction of Hamilton's principle from D'Alembert's principle, equation of one dimensional harmonic oscillator using Hamilton's principle, Deduction of Lagrange's equation of motion from Hamilton's principle.

Unit-3: Hamiltonian formulation of mechanics

Phase space and the motion of the system, Hamiltonian with physical significance, Hamiltonian canonical equations of motion, Hamiltonian canonical equations of motion in different coordinate systems, Applications of Hamilton's equation of motion - simple pendulum, compound pendulum, Linear harmonic oscillator, Modified Hamilton's Principle, Deduction of Hamiltonian canonical equations of motion from modified Hamilton's principle, Canonical transformations, Poisson bracket, Poisson's theorem, Poisson brackets in quantum mechanics.

Unit-4: Motion under central forces: two body problem

Equivalent one body problem, General features of central force motion, Motion under inverse square law - kepler problem, Virial theorem, Unbound motion Rutherford scattering, Centre of mass and laboratory coordinates.

Text and Reference Books:

1. H. Goldstein, *Classical Mechanics*, Narosa Publishing Home.
2. L.D. Landau & E.M. Lifschz, Mechanics, Pergamon**:**
3. P.V. Panat, *Classical Mechanics*, Narosa Publishing Home.
4. R. G. Takawale and P.S.Puranik, *Introduction to Classical Mechanics*, TMH
5. J. C. Upadhyaya, *Classical Mechanics*, Himalaya Publishing House.
6. N. C. Rana & P. S. Joag, *Classical Mechanics*, TMH.

Course Outcomes: After completing the course, students will be able to:

CO1.	**Recall** the fundamental concepts of classical mechanics, conservation laws, constraints, generalized coordinates, and central force motion.
CO2.	**Explain** the principles of Lagrangian and Hamiltonian formulations, variational principles, and canonical equations of motion.
CO3.	**Apply** Lagrange's and Hamilton's equations to solve problems involving oscillatory systems, pendulums, charged particles, L–C circuits, and particles under central forces.
CO4.	**Analyze** the dynamics of mechanical systems using phase space, canonical transformations, Poisson brackets, and central force motion.
CO5.	**Evaluate** appropriate formulations and conservation principles for solving two-body problems, Kepler motion, Rutherford scattering, and related physical systems.
CO6.	**Develop** mathematical models and solution strategies for complex mechanical systems using variational methods and Hamiltonian mechanics.

MPY-103: Quantum Mechanics-I

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

Prerequisite: - Students should have basic knowledge of:

1. Quantum mechanics, atomic physics, wave mechanics, linear algebra, and differential equations.
2. Operators, eigenvalues, vector spaces, and mathematical methods used in physics.

Course Objectives: The objectives of this course are to:

1. Develop understanding of the fundamental principles and mathematical formulation of quantum mechanics, including wave functions, operators, and angular momentum.
2. Introduce advanced quantum mechanical techniques such as perturbation theory, variational method, and WKB approximation for solving physical problems.
3. Provide knowledge of scattering theory and its applications in atomic and subatomic systems.

Detailed Syllabus:

Unit 1: Basic Concepts of Quantum Mechanics

Postulates of Quantum Mechanics, Wave function in Coordinate & Momentum Representation, Momentum eigenfunctions, Box normalization, Schroedinger Equation for Spherically Symmetric Potentials, Degeneracy, Hydrogen Atom- Radial equation, Eigenvalues and Eigenfunctions.

Unit 2: Operator Formalism

Linear operators, Hermitian operators, Unitary operators and Unitary Transformations, Matrix representation of operators, Diagonalization of Matrices, Parity operator, Simultaneous measurement and Commuting operators.

Unit-3: Angular Momenta and their Properties

Angular momentum operators and their commutation relations, Ladder operators, Introduction to Dirac"s Bra and Ket notation, Matrices for J^2, J_z , J_x, J_y, J_+, & J_- , Spin angular Momentum, Spin wave functions, Addition of angular momenta: Clabsch-Gordan coefficients.

Unit-4: Approximation Methods:

Time-independent Perturbation theory (non-degenerate and degenerate), Physical applications:cNormal He-atom, Perturbed Harmonic oscillator, Zeeman effect (Normal), Stark effect, Variational (Rayleigh-Ritz) method, Physical applications: Ground state of helium, Zero-point energy of one-dimensional harmonic oscillator, WKB approximation, Connection formulae for penetration of a barrier, Application of W.K.B. method: Probability of penetration of a barrier, Theory of □- decay, Geiger-Nuttel law.

Unit-5: Scattering Theory

Differential and total scattering cross sections, Stationary scattering wave: Scattering amplitude, partial wave analysis and application to simple cases; Green Function, Born

approximation, validity and simple applications.

Text and Reference Books:

1. L. I. Schiff, *Introductory Quantum Mechanics*, Pearson Education Ltd.
2. R. P. Feynman, Feynman Lectures on Physics (Volume 3), Narosa.
3. D.J. Griffiths, Introduction of Quantum Mechanics, Cambridge University Press
4. J. J. Sakurai, Modern Quantum Mechanics, Addison-Wesley.
5. P. M. Mathews and K. Venkatesan, A Text-book of Quantum Mechanics, Tata mcgraw- Hill.
6. A. Ghatak and S. Lokanathan, Quantum mechanics: Theory and Applications, Kluwer Academic.
7. R. Shankar, Principles of Quantum Mechanics, Springer
8. A. Das, Lectures on Quantum Mechanics, Hindustan Book Agency.

Course Outcomes:

After completing the course, students will be able to:

CO1.	**Recall** the fundamental postulates of quantum mechanics, wave functions, operators, angular momentum, approximation methods, and scattering theory.
CO2.	**Explain** the operator formalism, Schrödinger equation, angular momentum algebra, and approximation techniques used in quantum mechanics.
CO3.	**Apply** quantum mechanical principles and mathematical tools to determine eigenvalues, eigenfunctions, matrix representations, and solutions to atomic and scattering problems.
CO4.	**Analyze** quantum systems using operator methods, angular momentum coupling, perturbation theory, variational methods, WKB approximation, and partial wave analysis.
CO5.	**Evaluate** the suitability of approximation and scattering methods for solving quantum mechanical problems and interpreting physical phenomena.
CO6.	**Develop** mathematical models and solution strategies for quantum systems using advanced quantum mechanical formalisms and approximation techniques.

MPY-104: Electromagnetic Theory

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

Prerequisite: Students should have basic knowledge of:

1. Vector calculus, electrostatics, magnetostatics, and differential equations.
2. Fundamental concepts of electric and magnetic fields, waves, and coordinate systems.

Course Objectives: The objectives of this course are to:

1. Develop a comprehensive understanding of Maxwell's equations, electromagnetic waves, and electromagnetic field theory.
2. Provide knowledge of electromagnetic potentials, gauge transformations, radiation phenomena, and wave propagation in different media.
3. Apply electromagnetic principles for analyzing waveguides, transmission lines, antennas, and related engineering applications.

Detailed Syllabus:

Unit-1: Maxwell's Equations

Maxwell's correction to Ampere's law for non-steady currents and concept of Displacement current, Maxwell's Equations in vacuum and matter, Boundary conditions for electromagnetic fields, Electromagnetic energy and momentum, Inhomogeneous wave equation and Green's function solution, Poynting theorem and energy conservation, Poynting vector, Maxwell's stress tensor and conservation of momentum.

Unit-3: Electromagnetic Waves

Electromagnetic wave equation, Plane electromagnetic waves, Wave propagation in free space, Conducting and dielectric media, Reflection and refraction, Fresnel equations, Polarization of electromagnetic waves, Energy density and momentum.

Unit-3: Electromagnetic Potentials and Gauge Transformations, Radiation

Vector and scalar potentials, Maxwell's Equations in terms of Electromagnetic Potentials, Non-uniqueness of Electromagnetic Potentials and Concept of Gauge. Gauge Transformations: Coulomb and Lorenz Gauge, Transformation Properties of Electromagnetic Fields and Sources under Rotation, Spatial Inversion and Time-Reversal, Field and radiation in dipole, Radiation by moving charges, Lienard-Wiechert potentials, Total power radiated by an accelerated charge, Lorentz formula.

Unit-4: Waveguides and Transmission Lines

Basic concept of waveguide, Propagation of Electromagnetic Waves in Rectangular Waveguides, TE and TM Modes, Cut off frequency, Phase and group velocities, Energy Flow and Attenuation. Modal Analysis of guided modes in a cylindrical waveguide, Cavity resonator, Transmission lines, Characteristic impedance, Standing Wave Ratio (SWR), Basic principles of antennas and applications.

Text and Reference Books:

1. J.D. Jackson, *Classical Electrodynamics,* John Wiley & Sons.
2. D. J. Griffiths, *Introduction to Electrodynamics,* Prentice Hall of India.
3. F.J. Milford and R.W. Christy, *Foundations of Electromagnetic Theory,* Narosa publishing house.
4. E.C. Jordon and K.G. Balmain, *Electromagnetic Waves and Radiating Systems*, Prentice-Hall of India.

Course Outcomes:

After completing the course, students will be able to:

CO1.	**Recall** the fundamental concepts of Maxwell's equations, electromagnetic waves, electromagnetic potentials, radiation, waveguides, and transmission lines.
CO2.	**Explain** the principles of electromagnetic field theory, wave propagation, gauge transformations, radiation mechanisms, and guided wave propagation.
CO3.	**Apply** Maxwell's equations and electromagnetic theory to analyze wave propagation, boundary-value problems, radiation, and transmission line characteristics.
CO4.	**Analyze** electromagnetic wave behavior in free space, dielectric and conducting media, waveguides, cavity resonators, and antenna systems using appropriate mathematical formulations.
CO5.	**Evaluate** the performance of electromagnetic systems by selecting appropriate models for wave propagation, radiation, waveguides, and transmission lines.
CO6.	**Develop** analytical models and solution strategies for electromagnetic field, radiation, and guided-wave problems using Maxwell's theory and electromagnetic principles.

MPY-151: Physics Lab I

Teaching Scheme	Examination Scheme
Practicals: 6hrs./Week, T-Tutorial: 3hrs./Week	Internal – 50 marks
Credits: 6	End Semester Exam – 100 marks

Prerequisites:

1. Basic knowledge of undergraduate physics concepts, laboratory measurements, and experimental techniques.
2. Understanding of fundamental principles of optics, electronics, electromagnetism, modern physics, and electrical circuits.

Course Objectives:

1. To provide hands-on experience in experimental techniques related to electronics, optics, electromagnetism, and modern physics.
2. To develop skills in operating laboratory instruments, data acquisition, analysis, and interpretation of experimental results.
3. To demonstrate and verify fundamental physical laws and principles through practical experiments.

List of Experiments:

Note: *Minimum 10 experiments should be performed. (Experiments may be added /deleted subject to availability of time and facilities)*

1. Study of e/m by Magnetron valve method or Bush method.
2. Study of B.H. Curve.
3. To trace V~I characteristic curves of diodes and transistors on a CRO and learn their uses in electronic circuits.
4. Verification of Fresnel's formula for reflection
5. Study of Half wave and Full wave rectifiers.
6. To determine Planck's constant using photocell.
7. To determine the velocity of ultrasonic waves in a given liquid using interferometer.
8. Study of uncertainty principle using Laser.
9. Study of the regulated power supply.
10. Study of IC 555 Timer.
11. Study of G.M. Counter.
12. Michelson's Interferometer.
13. Study of Adders and Substractors.
14. To determine the wavelength of a given light source using bi-prism.
15. Study of the existence of atomic energy levels using Franck – Hertz Experiment.

Text and Reference Books:

1. Experimental Physics: Modern Methods, R.A. Dunlap, Oxford University Press.
2. B.K. Jones, Electronics for Experimentation and Research, Prentice-Hall.
3. Basic Electronics: A Text-Lab Manual, P.B. Zbar and A.P. Malvino, Tata Mc-Graw Hill, New Delhi.

Course Outcome:

After completing the course, students will be able to:

CO1.	**Recall** the operating principles, components, and safety procedures of laboratory instruments and experimental techniques used in modern physics.
CO2.	**Explain** the physical principles underlying experiments related to electromagnetism, optics, electronics, quantum physics, ultrasonics, and nuclear physics.
CO3.	**Perform** laboratory experiments using standard instruments to measure physical parameters and verify fundamental physical laws.
CO4.	**Analyze** experimental observations by processing data, estimating uncertainties, plotting graphs, and interpreting the results.
CO5.	**Evaluate** the accuracy, reliability, and limitations of experimental methods by comparing measured results with theoretical predictions.
CO6.	**Design** and document experimental procedures or simple electronic/optical setups for investigating physical phenomena and solving laboratory problems.

EPC-001: AI Based English Proficiency Course - I

Teaching Scheme	Examination Scheme
Self Study: 4hrs./Week	–
Credits: 2	End Semester Exam – 50 marks

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

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

Semester-II

MPY-201: Condensed Matter Physics

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

Prerequisite: - Students should have:

1. Basic knowledge of quantum mechanics, electromagnetism, thermodynamics, and mathematical methods used in physics.
2. Fundamental understanding of atomic structure, wave phenomena, and introductory solid-state physics concepts.

Course Objectives:

1. To provide fundamental knowledge of crystal structures, diffraction techniques, thermal properties, and electronic behavior of solids.
2. To develop understanding of band theory, superconductivity, and modern quantum materials.
3. To apply concepts of solid-state physics for analyzing material properties and technological applications.

Detailed Syllabus:

Unit 1: Crystal Structure

Lattice points and space lattice, unit cell, primitive cell, Bravais lattices; metallic crystal structures (sc, bcc, fcc, hcp, diamond, zinc blende) and atomic packing fractions; directions, planes and Miller indices; inter-planar spacing in cubic crystals; reciprocal lattice; crystal defects — Schottky and Frenkel defects.

Unit-2: X-rays and Crystal Diffraction

Production and properties of X-rays; X-ray diffraction and Bragg's law; Bragg spectrometer and the powder-crystal method; comparison of X-ray, electron and neutron diffraction techniques for structural analysis.

Unit-3: Thermal properties of solids

Specific heat of solids; Einstein's and Debye's theories of specific heat; thermal expansion; thermal conductivity of solids.

Unit-4: Theory of Conductors

Free-electron theory of metals and electronic heat capacity; Bloch functions and formation of energy bands; Kronig-Penney model and Brillouin zones; effective mass and the concept of holes; Fermi surface; brief introduction to topological band structures, graphene and 2D quantum materials as modern extensions of band theory.

Unit-5: Superconductivity

Concept of superconductivity and the Meissner effect; Type-I and Type-II superconductors; London equations, penetration depth and coherence length; BCS theory; high-temperature and iron-based superconductors; applications, including superconducting qubits used in quantum computing hardware.

Text and Reference Books:

1. Charles Kittel, *Introduction to Solid State Physics*, Wiley Eastern.
2. Neil W. Ashcroft & N. David Mermin, Solid State Physics (Cengage Learning / Brooks-Cole, 1976)
3. A.J. Dekker, *Solid State Physics*, Prentice Hall of India.
4. Ali Omar, *Elementary Solid-State Physics,* Narosa Publishing House.
5. J.S. Blakemore, *Solid State Physics*, Cambridge University Press.
6. S.O. Pillai, *Problems and Solutions in Solid State Physics,* New Age International.

Course Outcomes:

After completing the course, students will be able to:

CO1.	**Recall** the fundamental concepts of crystal structures, lattice systems, defects, diffraction techniques, thermal properties, electronic properties, and superconductivity.
CO2.	**Explain** the principles of crystal geometry, X-ray diffraction, thermal behavior of solids, band theory, and superconducting phenomena.
CO3.	**Apply** concepts of crystallography, Bragg's law, lattice theory, band models, and superconductivity to solve problems related to solid-state materials.
CO4.	**Analyze** crystal structures, diffraction patterns, thermal properties, electronic band structures, and superconducting behavior using appropriate theoretical models.
CO5.	**Evaluate** the suitability of different theoretical models and experimental techniques for studying structural, thermal, electronic, and superconducting properties of materials.
CO6.	**Design** and propose material-based solutions by applying concepts of crystal engineering, electronic properties, and superconducting technologies for modern applications.

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MPY -202: Atomic and Molecular Physics

Teaching Scheme	Examination Scheme
Lectures: 3 hrs./Week	Class Test -12 Marks
Tutorials: 1 hrs./Week	Teachers' Assessment – 6 Marks, Attendance – 12 Marks
Credits: 4	End Semester Exam – 70 marks

Prerequisite: Students should have:

1. Basic knowledge of quantum mechanics, atomic physics, electromagnetism, and mathematical methods in physics.
2. Understanding of wave-particle duality, angular momentum, atomic structure, and fundamental spectroscopy concepts.

Course Objectives: The objectives of this course are to:

1. Provide a comprehensive understanding of atomic and molecular spectra using quantum mechanical principles.
2. Develop knowledge of angular momentum coupling, external field effects, and molecular spectroscopic techniques.
3. Apply spectroscopic concepts for analyzing atomic and molecular structures and their physical properties.

Detailed Syllabus:

Unit-1: Atomic Spectra

Bohr's atomic model, Sommerfeld's quantization rules, Sommerfeld's extension of Bohr's model, Relativistic corrections for energy levels of hydrogen atom, Magnetic dipole moments: Orbital magnetic dipole moment, Bohr magneton, Larmor Precession, Space quantization, Electron spin, Vector model of the atom: coupling of angular momenta, Spectroscopic terms and their notations, Stern-Gerlach experiment.

Unit-2: Coupling Schemes and Effect of External Fields

L-S coupling, Lande interval rule, Selection rules for L-S coupling, j-j coupling, Selection rules for j-j coupling, Normal and Anomalous Zeeman Effect and Paschen Back Effect, Stark effect: Weak field effect and Strong field effect in hydrogen atom.

Unit-3: Molecular Spectra

Rotational spectra of diatomic molecules, Rigid rotor - effect of isotopic substitution, Non-rigid rotor, Isotope effect, Vibrational-rotational spectra: molecule as a harmonic oscillator, Anharmonicity and its effect on vibrational-rotational spectra.

Unit-4: Electronic and Raman Spectra

Electronic spectra, Intensity distribution (vibrational) in band system: Frank-Condon principle, Raman effect, Classical and quantum theory of Raman effect, Rotational and vibrational Raman spectra, Applications of Raman spectroscopy.

Text and Reference Books:

1. G M Barrow, *Introduction to molecular spectroscopy*, Tata McGraw-Hill.
2. Raj Kumar, Atomic and Molecular spectra: Laser, Knrn
3. Arthur Beiser, *Concepts of Modern Physics*, McGraw-Hill.
4. Manas Chanda, *Atomic Structure and Chemical Bond*, Tata McGraw-Hill.

5. G Aruldas, *Molecular Structure and Spectroscopy*, Prentice Hall of India Ltd.
6. H.J. Zeiger and G.W. Pratt, *Magnetic Interactions in Solids*, Oxford University Press.

Course Outcomes:

After completing the course, students will be able to:

CO1.	**Remember** the fundamental concepts of atomic models, quantum numbers, angular momentum, magnetic moments, and spectroscopic terms.
CO2.	**Understand** the principles of atomic spectra, coupling schemes, external field effects, and molecular spectroscopic transitions.
CO3.	**Apply** quantum mechanical concepts and selection rules to analyze atomic spectra, molecular spectra, Zeeman effect, Stark effect, and Raman spectra.
CO4.	**Analyze** atomic and molecular spectra by using coupling schemes, energy level diagrams, rotational-vibrational models, and spectroscopic principles.
CO5.	**Evaluate** the applicability of different spectroscopic techniques and theoretical models for interpreting atomic and molecular structures.
CO6.	**Create** theoretical models and interpretive approaches for studying atomic and molecular systems using advanced spectroscopic concepts.

MPY-203: Nuclear and Particle Physics

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

Prerequisite: Students should have:

1. Basic knowledge of quantum mechanics, atomic physics, and mathematical methods used in physics.
2. Fundamental understanding of electromagnetic interactions, special relativity, and particle concepts.

Course Objectives: The objectives of this course are:

1. To introduce the fundamental properties of nuclei, nuclear forces, and mechanisms of nuclear disintegration.
2. To provide an understanding of nuclear structure through different nuclear models and explain nuclear stability and reactions.
3. To familiarize students with elementary particles, their classification, interactions, and symmetry principles.

Detailed Syllabus:

Unit-1: Structure and properties of Nucleus:

Introduction, Nuclear size and its determination, Binding energy, Semi-empirical mass formula, Spin and parity, nuclear angular momentum, Magnetic dipole moments, Electric quadrupole moments, Statistics of nuclear particles, Isobaric spin, Systematics of stable nuclei.

Unit-2: Nuclear Forces

Nature of the nuclear Force, spin dependence and tensor component of nuclear forces, charge independence, Deuteron: properties and simple theory of the deuteron ground state, Elements of meson theory, Neutron-proton scattering at low energy, Effective range theory of neutron-proton scattering, Proton-proton scattering at low energy, Effective range theory of proton-proton scattering, Neutron-neutron scattering,

Unit-3: Nuclear Models

Evidence of shell structure, Liquid drop model, Single-particle shell model, its validity and limitations, Magic number

Unit-4: Nuclear Reactions

Types of Nuclear reactions, Conservation laws, Nuclear cross section, Classical analysis of cross section, Partial wave analysis of reaction cross section, Compound nucleus, Compound nucleus reaction, Disintegration of compound nucleus, Simple theory of beta decay, properties of the neutrino, non-conservation of parity, electron capture, internal conversion.

Unit-5: Elementary Particle Physics

Introduction; Classification of elementary particles and their anti-particles, Fundamental interaction (Gravitational, Electromagnetic, Strong and Weak), Conservation laws, Invariance; charge and parity, Elementary particle symmetry, Quarks model, Isospin of quarks.

Text and Reference Books:

1. R.R. Roy and B.P. Nigam, Nuclear Physics, New Age International.
2. H. Enge — Introduction to Nuclear Physics, Addison-Wesley.
3. Kenneth S. Krane — Introductory Nuclear Physics, Wiley.
4. D. Griffiths — Introduction to Elementary Particles, Wiley-VCH.
5. Kaplan, Nuclear Physics, Narosa
6. B.L. Cohen, Concepts of Nuclear Physics, Tata McGraw Hill.

Course Outcomes:

After completing the course, students will be able to:

CO1.	**Remember** the basic concepts of nuclear properties, binding energy, nuclear moments, parity, and nuclear stability.
CO2.	**Understand** the principles of nuclear forces, radioactive decay processes, nuclear models, and elementary particle interactions.
CO3.	**Apply** concepts of nuclear physics to calculate binding energy, analyze nuclear reactions, and explain decay processes and conservation laws.
CO4.	**Analyze** nuclear structure, stability, reaction mechanisms, and particle classifications using appropriate theoretical models.
CO5.	**Evaluate** different nuclear models and interaction theories for explaining nuclear properties, reactions, and elementary particle behavior.
CO6.	**Create** theoretical approaches and models for interpreting complex nuclear and particle physics phenomena using fundamental principles.

MPY-204: Statistical Physics

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

Prerequisite: - Students should have:

1. Basic knowledge of thermodynamics, calculus, probability theory, and mathematical methods in physics.
2. Fundamental understanding of classical mechanics and introductory quantum mechanics.

Course Objectives: The objectives of this course are:

1. To provide a comprehensive understanding of thermodynamic principles, statistical ensembles, and their connection with macroscopic properties of matter.
2. To develop knowledge of quantum statistical distributions and their applications to various physical systems.
3. To introduce the concepts of phase transitions, critical phenomena, and theoretical models used to explain collective behavior in matter.

Detailed Syllabus:

Unit-1: Review of Thermodynamics

Extensive and intensive variables, Laws of thermodynamics, Legendre transformations and thermodynamic potentials, Maxwell relations, Applications of Maxwell's relations: (i) Clausius- Clapeyron equation, (ii) values of Cp-Cv, (iii) T-dS equations, (iv) Joule-Thomson coefficient for ideal and Real gases (v) Change of temperature during an adiabatic process.

Unit-2:Formalism of Equilibrium: Statistical Mechanics

Concept of phase space, Liouville's theorem, Basic postulates of statistical mechanics, Ensembles: micro-canonical, Canonical, Grand canonical and isobaric, Connection to thermodynamics, Fluctuations, Applications of various ensembles, Equation of state for a non-ideal gas, Vander Waal's equation of state, Meyer cluster expansion, Virial coefficients, Ising Model.

Unit-3: Quantum Statistics

Fermi Dirac Statistics, Ideal Fermi gas, properties of simple metals, Pauli paramagnetism, Electronic specific heat and white dwarf stars.

Bose-Einstein statistics, Applications of the formalism to: Ideal Bose gas, Debye theory of specific heat, properties of black-body radiation, Bose- Einstein condensation, Experiments on atomic BEC, BEC in a harmonic potential.

Unit -4: Phase Transitions

Phases of matter, Thermodynamic potential, First-order phase transitions, Continuous phase transitions, Ising model-mean field theory, critical exponents, Order parameter, Landau theory of phase transitions.

Text and Reference Books:

1. K. Huang, *Statistical Mechanics*, Wiley
2. R.K. Pathria, *Statistical Mechanics*, Elsevier
3. F. Reif, *Fundamentals of Statistical and Thermal Physics*, Tata McGraw-Hill.
4. Mark Waldo Zemansky, Richard Dittman, Heat and Thermodynamics: An Intermediate Textbook (McGraw-Hill, 1981)
5. Francis W. Sears & Gerhard L. Salinger, Thermodynamics, Kinetic Theory, and Statistical Thermodynamics (Narosa, 1986).
6. B.B.Laud, *Fundamentals of Statistical Mechanics*, New Age International Publication.
7. Lokanathan and Gambhir, *Statistical and Thermal Physics*, Prentice Hall of India Ltd.

Course Outcomes: After completing the course, students will be able to:

CO1.	**Remember** the fundamental concepts of thermodynamics, statistical mechanics, ensembles, quantum statistics, and phase transitions.
CO2.	**Understand** the principles of thermodynamic potentials, statistical ensembles, quantum distributions, and theories of phase transitions.
CO3.	**Apply** thermodynamic relations, statistical methods, and quantum statistical distributions to solve problems related to physical systems.
CO4.	**Analyze** equilibrium properties, fluctuations, quantum gases, phase transitions, and critical phenomena using appropriate theoretical models.
CO5.	**Evaluate** different statistical approaches and theoretical models for explaining macroscopic properties of classical and quantum systems.
CO6.	**Create** theoretical models and solution strategies for complex physical systems using principles of thermodynamics and statistical mechanics.

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MPY 251-Physics Lab II

Teaching Scheme	Examination Scheme
Practicals: 6hrs./Week, Tutorials: 3hrs./Week	Internal – 50 marks
Credits: 6	End Semester Exam – 100 marks

Prerequisite:- Students should have:

1. Basic knowledge of undergraduate-level physics concepts including optics, electromagnetism, electronics, solid-state physics, and quantum physics.
2. Familiarity with laboratory techniques, measurement methods, data analysis, and error estimation.

Course Objectives: The objectives of this course are:

1. To provide hands-on experience in experimental techniques related to modern physics, solid-state physics, electronics, and material characterization.
2. To develop skills in measurement, observation, data analysis, and interpretation of experimental results using scientific instruments.
3. To enable students to understand and verify fundamental physical principles through laboratory experiments.

List of Experiments:

Note: *Minimum 10 experiments should be performed. (Experiments may be added /deleted subject to availability of time and facilities)*

1. Study of Zeeman Effect.
2. Study of Hall Effect.
3. Study of the elastic constant of cubic crystals.
4. Study of Modulation and Demodulation.
5. To determine the conductivity of a semiconductor at various temperatures by four-Probe method.
6. To determine crystal structure of different materials using X-ray diffraction.
7. To determine the Curie temperature of a given ferroelectric material.
8. Study of Susceptibility of paramagnetic material by Gouy method.
9. Study of Characteristics, inverse square law, absorption coefficient by using GM Counter.
10. To determine the wavelength, separation of wavelengths of sodium light and to determine the thickness of thin mica sheet using Michelson interferometer.
11. Study of Electron Spin Resonance (ESR).
12. To demonstrate the wave nature of the electron by Electron Diffraction.
13. Study of Thermionic Emission.
14. Study of transistor biasing.
16. To determine the molecular field in a dielectric and verify Clausius – Mossotti equation.
15. Determination of "e" by Millikan oil drop method.

Reference Books:

1. G.Aruldas, *Molecular structure and Spectroscopy*, Prentice-hall of India Pvt. Ltd.
2. S.O. Pillai (3rd Edition), *Solid State Physics*, New age International Publisher.
3. D.R. Behekar, Dr. S. T. Seman, V.M. Gokhale, P. G. Kale, Practical Physics, (Kitab Mahal Publication

Course Outcomes: After completing the course, students will be able to:

CO1.	**ember** the principles, components, and working methods of experimental ps used in atomic physics, electronics, optics, nuclear physics, and material nce.
CO2.	**erstand** the physical concepts and theoretical principles involved in riments related to Zeeman effect, Hall effect, diffraction, spectroscopy, conductors, and electronic devices.
CO3.	**ly** experimental techniques and measurement methods to determine ical parameters and verify fundamental laws using laboratory instruments.
CO4.	**lyze** experimental observations through data processing, graphical analysis, rtainty estimation, and interpretation of physical phenomena.
CO5.	**luate** the accuracy, reliability, and limitations of experimental results by paring observations with theoretical predictions.
CO6.	**ate** experimental procedures and scientific approaches for investigating ical phenomena using appropriate instruments and measurement niques.

EPC-002: AI Based English Proficiency Course - II

Teaching Scheme	Examination Scheme
Self Study: 4hrs./Week	–
Credits: 2	End Semester Exam – 50 marks

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

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