NATIONAL UNIVERSITY BANGLADESH



Syllabus

Bachelor of Science (Honours) Second Year

Department of Physics

PROVISIONAL

Effective from the Academic Year: 2024–2025 and onward

Vision of the University

We expect that the hundredth anniversary of the National University, our commitment to "Progress for Everyone" will be evident in all areas of our operations and stakeholder engagements.

We leverage our core strength in education, research, and community engagement to address pressing global issues and foster sustainable development.

By 2042, National University aims to strengthen its positions as Bangladesh's top academic institution and rank among the world's leading universities. Our focus will be on expanding expertise building strategic partnerships, and increasing our global influence. Our services will be measured by the achievements of the individuals and communities we serve.

Mission of the University

To promote "Progress for Everyone" by fostering transformative education, conducting pioneering research, and encouraging meaningful collaboration with individuals, communities, and partners both in Bangladesh and around the world.

Vision of the Program

By the National University's centennial, our Physics Department will be globally recognized for scientific excellence and social impact. We envision leading the advancement of physics in Bangladesh by expanding our academic expertise, pioneering sustainable technologies, and forging international partnerships that measure success through the empowerment of the communities we serve.

Mission of the Program

The academic program is focused on the creation, translation, and dissemination of knowledge on the subject matter. The strategic goals of the department are to:

1. Support the aims and objectives of the University within the capacity of our Departmental program. Curriculum for BSc (Hons) in Physics,

2. Train and produce high-quality graduates to meet up national and international requirements in scientific sectors of the job market.

3. Enhance the teaching-learning and research capacities of the Department by retaining and recruiting outstanding faculty and staff.

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Objectives

To equip students with a solid foundation in theoretical and applied physics, fostering critical thinking, problem-solving, and interdisciplinary collaboration. The program aims to develop technical expertise, soft skills, and ethical responsibility, preparing students for advanced studies, research, and careers that contribute to solving real-world challenges and promoting social well-being and sustainability.

Program Educational Objectives (PEOs):

PEO-1: To prepare physics graduates to exhibit quality of excellence, critical thinking, creativity, inventiveness, and self-motivation for life-long learning to handle all kind of diverse situations in interdisciplinary and multidisciplinary environment.

PEO-2: To produce graduates who are globally acceptable professionals for government, corporate and research organizations along with skills for entrepreneurial pursuits in multidisciplinary areas.

PEO-3: To groom graduates who can demonstrate technical competence in the field of project and technology management.

PEO-4: To produce graduates who can ethically lead and work as a part of team towards the fulfillment of both individual and organizational goals.

Mapping PEOs with the Missions

Ms / **PEOs**	M1	M2	M3
PEO1	√	√	
PEO2	√		√
PEO3	√	√	
PEO4	√	√	

Program Learning Outcomes (PLOs)

On successful completion of these programs a student should able to learn the following outcomes:

Fundamental Skill:

PLO-1: Knowledge: Apply fundamental knowledge of physics along with specializations to solve scientific problems of material science, energy, mechanics, optics, communication, space etc.

PLO-2: Problem analysis: Solve problems in Physics using appropriate mathematical tools.

PLO-3: Experimentation: An ability to execute and analyze the results of an experimental investigation or theoretical modeling and to draw valid conclusions with an estimate of the uncertainty in the result. An ability to compare experimental results with the predictions of relevant theories.

PLO-4: Conduct investigations of problems: Use research based methods including design of experiments, analysis and interpretation of data leading to logical conclusions.

PLO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, software and modern scientific and ICT tools to problem solving in different sectors of Physics.

Social skill:

PLO-6: Communication: An ability to communicate scientific information verbally and in the form of clear and accurate scientific reports.

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

PLO-8: Ethics: Apply ethical principles and commit to professional ethics, responsibilities and norms of scientific practices.

Personal Skill:

PLO-9: Individual and teamwork: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

PLO-10: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Thinking Skill:

PLO-11: Project Management: Demonstrate knowledge and understanding of principles of physics and apply those to one's own work as a member and leader in a team, to manage projects and in multidisciplinary environments.

PLO-12: Technology Management: Competence in using programming languages and in troubleshooting and solving basic problems in electronic equipment and circuits.

Mapping PEO with PLO:

Domain	PLO	PEO-1	PEO-2	PEO-3	PEO-4
Cognitive	PLO-1	√	√		
	PLO-2	√	√		
	PLO-3			√	
	PLO-4		√	√	
	PLO-5		√	√	
	PLO-6		√	√	
Affective	PLO-7				√
	PLO-8				√
	PLO-9				√
	PLO-10				√
Psychomotor	PLO-11			√	
	PLO-12			√	

PROVISIONAL

Physics: Second Year
Courses, Marks and Credit Distribution

Course Code	Course Title	Marks	Credits
Core Courses			
8222751	Electricity and Magnetism	100	4
8222753	Geometrical and Physical Optics	100	4
8222755	Classical Mechanics	100	4
8222758	Physics Practical-II (Electricity and Magnetism, Geometrical and Physical Optics)	100	4
Allied Courses: Any two sets from set A, set B and set C			
Set A			
8223757	Calculus-II and Ordinary Differential Equations	100	4
8223758	Math Lab (Mathematica)	50	2
Set B			
8222859	General Chemistry-II	100	4
8222861	Environmental Chemistry	50	2
Set C			
8223659	Methods of Statistics	100	4
8223660	Statistics Practical-II	50	2
Compulsory Courses			
8221171	Functional English	100	4
8226601	Applied Information and Communication Technology (Applied ICT)	75	3
8226602	Practical: Applied ICT	25	1
8222760	Viva Voce (Physics)	**50**	**2**
Total		**950**	**38**

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Matrix of Courses with Program Learning Outcomes (Curriculum map)

Course N0.	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO10	PLO11	PLO12
8222751	√	√	√	√						√		√
8222753	√	√	√	√						√		√
8222755	√	√	√	√						√		√
8222758	√	√	√	√		√		√	√	√	√	
8223757	√	√								√		
8223758	√			√					√	√		
8222859	√	√	√	√		√	√			√		√
8222861	√						√	√		√		
8223659	√	√			√					√		
8223660	√	√	√	√					√	√		
8221171	√					√				√		
8226601	√				√	√				√	√	√
8226602	√				√	√			√	√	√	√
8222760	√								√	√		

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Detailed Syllabus

Course Code: 8222751	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Electricity and Magnetism			

Course Description

This course develops the fundamental concepts of electricity and magnetism with emphasis on electrostatics, electric potential, capacitance, electric current, magnetic fields, electromagnetic induction, alternating current, and basic electrical circuits. Students will acquire theoretical knowledge and analytical skills to solve practical engineering and scientific problems involving electric and magnetic phenomena.

Course Objectives (CO)

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

- Develop fundamental knowledge of electric and magnetic fields and their governing laws.
- Analyze electrostatic and magneto static systems using mathematical and physical principles.
- Apply network theorems and circuit laws to solve electrical circuit problems.
- Explain electromagnetic induction and alternating current phenomena.
- Develop analytical and problem-solving skills applicable to engineering and physical sciences.

Course Learning Outcomes (CLOs)

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

CLO	Course Learning Outcome	Bloom's Level
CLO1	Explain the fundamental concepts of electric charge, electric field, electric potential, Coulomb's law and Gauss's law.	Understand
CLO2	Apply electrostatic principles to determine electric field, electric potential, capacitance and energy stored in electric fields.	Apply
CLO3	Analyze electric circuits using Ohm's law, Kirchhoff's laws, network theorems and RC circuits.	Analyze
CLO4	Explain magnetic fields produced by electric currents and apply Ampere's law and Biot–Savart law to solve magnetostatic problems.	Apply
CLO5	Analyze electromagnetic induction, inductance, magnetic materials and Maxwell's equations.	Analyze
CLO6	Explain the principles of AC circuits, electromagnetic oscillations and thermoelectric effects and solve related engineering problems.	Analyze

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Mapping of CLOs with PLOs

CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓	✓	✓	✓			✓			✓		
CLO2	✓	✓	✓	✓			✓			✓		✓
CLO3	✓	✓	✓	✓			✓			✓		
CLO4	✓	✓	✓	✓			✓			✓		
CLO5	✓	✓	✓	✓			✓			✓		
CLO6	✓	✓	✓	✓			✓			✓		

Course Contents

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
1-3	**Electric Charge and Field**: Electric Charge, Conductors, Insulators, Coulomb's Law, Quantization and Conservation of Charge, Electric Field, Electric Field due to Point Charge, Charged Disc, Sheet, Long Wire, Electric Dipole, Quadrupole	Lecture, Interactive Discussion, Problem Solving	Quiz Assignment Class Test	CLO1
4	**Gauss' Law:** Gauss's Law, Electric Flux, Applications of Gauss's Law	Lecture, Numerical Problem Solving	Quiz Assignment Class Test	CLO1
5-6	**Electric Potential:** Electric Potential, Potential Energy, Equipotential Surface, Potential due to Charge Distribution, Electric Field from Potential, Electrostatic Generator, Electrical Images	Lecture, Tutorial Demonstration	Quiz Assignment Class Test	CLO2
7-9	**Capacitor and Dielectrics:** Capacitance, Capacitors in Series and Parallel, Parallel Plate, Cylindrical and Spherical Capacitors Dielectrics, Electric Displacement Vector, Energy Stored in Electric Field	Lecture, Problem Solving	Quiz Assignment Class Test	CLO2
10-11	**Current and Resistance:** Electric Current, Current Density, Drift Velocity, Resistance, Resistivity, Conductivity, Ohm's Law, Electrical Energy, Power	Lecture, Discussion	Quiz Assignment Class Test	CLO3
12	**Electric Circuits:** Kirchhoff's Laws, EMF, Wheatstone Bridge, Potentiometer, RC Circuits	Lecture, Numerical Problems	Quiz Assignment Class Test	CLO3

PROVISIONAL

13-14	**Magnetic Field:** Magnetic Field, Magnetic Force, Torque on Current Loop, Galvanometer, Ammeter, Voltmeter, Hall Effect, Motion of Charged Particle, Thomson Experiment	Lecture, Demonstration	Quiz Assignment Class Test	CLO4
15-16	**Ampere's Law and Biot-Savart Law:** Ampere's Law and Applications, Biot–Savart Law and Applications	Lecture, Problem Solving	Quiz	CLO4
17-18	**Electromagnetic Induction:** Faraday's Law, Lenz's Law, Electromagnetic Induction Self and Mutual Inductance, LR Circuits, Magnetic Energy, Magnetization, B-H Curve	Lecture, Numerical Exercises	Assignment Class Test	CLO5
19	**Magnetism of Matter:** Magnetic Materials, Maxwell's Equations, Displacement Current	Lecture, Discussion	Quiz Assignment Class Test	CLO5
20-24	**Alternating and Electromagnetic Oscillations:** Alternating Current, AC through R, L and C, Series and Parallel LCR Circuit, LC Oscillation, RMS Values, Resonance, Quality Factor, Power Factor, AC Measuring Instruments, AC Bridge, AC Generator	Lecture, Problem Solving	Quiz Assignment Class Test	CLO6
25–28	**Thermoelectricity:** Thermoelectric Effects: See-beck, Peltier, Thomson Effects, Thermocouple	Lecture, Problem-Based Learning	Quiz Assignment Class Test	CLO6

Course Assessment Framework

Total Course Marks: 100 Examination Duration: 4 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

PROVISIONAL

List of Books

Brijlal, & Subramaniyam, (1978), *Electricity and Magnetism* (4th ed), S. Chand & Co.

Griffiths, D. J. (2017). *Introduction to electrodynamics* (4th ed.). Cambridge University Press.

Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics* (11th ed.). Wiley.

Jackson, J. D. (1999). *Classical electrodynamics* (3rd ed.). John Wiley & Sons.

Purcell, E. M., & Morin, D. J. (2013). *Electricity and magnetism* (3rd ed.). Cambridge University Press.

Reitz, J. R., Milford, F. J., & Christy, R. W. (2008). *Foundations of electromagnetic theory* (4th ed.). Pearson.

PROVISIONAL

Course Code: 8222753	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Geometrical and Physical Optics			

Course Description

This course introduces the principles of geometrical and physical optics with emphasis on image formation, optical instruments, coherence, interference, diffraction, polarization, dispersion, and scattering of light. Students develop analytical skills to explain optical phenomena and understand the working principles of modern optical instruments used in science and engineering.

Course Objectives

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

- Develop a sound understanding of geometrical and physical optics.
- Explain the formation of images and the operation of optical instruments.
- Apply wave optics principles to analyze interference, diffraction, and polarization phenomena.
- Understand the physical principles underlying modern optical devices and experimental techniques.
- Solve practical problems involving optical systems and real-life applications of optics.

Course Learning Outcomes (CLOs)

After successful completion of the course, the students will be able to:

CLO	Course Learning Outcome	Bloom's Level
CLO1	Explain the principles of geometrical optics including reflection, refraction, image formation, optical aberrations, and ray matrix methods.	Understand
CLO2	Analyze image formation by mirrors, lenses, the human eye, microscope, and telescope.	Analyze
CLO3	Explain the concepts of coherence, superposition, wave propagation, and interference of light.	Understand
CLO4	Apply the principles of interference to analyze optical instruments such as Fresnel bi-prism, Michelson interferometer, Fabry–Perot interferometer, and Newton's rings.	Apply
CLO5	Analyze diffraction phenomena and evaluate the resolving power of optical instruments including diffraction gratings and spectrometers.	Analyze
CLO6	Explain the principles of polarization, optical activity, birefringence, and the operation of polarization devices.	Understand

PROVISIONAL

CLO7	Explain dispersion, scattering of light, and their applications in solving real-world scientific and engineering problems.	Apply

Mapping of CLOs with PLOs

CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓	✓								✓		
CLO2	✓	✓	✓	✓						✓		
CLO3	✓	✓	✓							✓		
CLO4	✓	✓	✓									✓
CLO5	✓	✓	✓							✓		
CLO6	✓	✓	✓							✓		
CLO7	✓	✓	✓							✓		

Course Contents

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
1-5	**Geometrical Optics:** Reflection, Refraction and Total Internal Reflection, Plane Mirrors, Spherical Mirrors, Spherical Refracting Surfaces, Image Formation, Thin Lenses, Lens Power, Microscope, Telescope, Human Eye and Vision Mechanism, Spherical Aberration, Chromatic Aberration, Astigmatism, Ray Matrix Method	Interactive Lecture, Numerical Problem Solving, Tutorial Demonstration	Quiz Assignment Class Test	CLO1 CLO2
6-8	**Coherence:** Spatial and Temporal Coherence, Higher Order Coherence	Lecture, Discussion	Quiz Assignment Class Test	CLO3
9-14	**Interference of waves:** Principle of Superposition of Wave, and Wave Interference, Phase Velocity, Group Velocity, Huygens' Principle, Division of Wavefront and Amplitude, Young's Double Slit Experiment, Fresnel Bi-prism, Fringe Formation, Newton's Rings and Applications, Multiple Beam Interference using Plane Parallel Plate, Michelson Interferometer Fabry–Perot Interferometer	Lecture, Laboratory Demonstration Problem Solving	Class Test Quiz Assignment	CLO3 CLO4
15-18	**Diffraction:** Fresnel and Fraunhofer Diffraction, Single Slit, Double Slit and Multiple Slit Diffraction, Diffraction Grating, Spectrometer, Resolving Power, Circular	Lecture, Numerical Exercises Demonstration	Quiz Class Test Assignment	CLO5

PROVISIONAL

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
	Aperture, Fresnel Half-Period Zones, Straight Edge Diffraction			
19-24	**Polarization of Light:** Plane, Circular and Elliptical Polarization, Malus' Law, Brewster's Law, Double Refraction, Optical Activity, Optic Axis, Half-Wave Plate, Quarter-Wave Plate, Nicol Prism, Construction and Working Principle of Polarimeter, Applications of Polarizer and Analyzer, Polarimeter Experiment and Discussion	Lecture, Multimedia Presentation Case Study Demonstration, Practical Discussion	Quiz Assignment Class Test Practical Assessment	CLO6
25-28	**Dispersion and scattering:** Dispersion of Light, Cauchy and Sellmeier Formula, Rayleigh Scattering, Thomson Scattering, Applications of Optics in Science, Engineering and Modern Technology	Lecture, Numerical Problems Case Study, Group Discussion	Quiz Assignment Class Test Presentation	CLO7

Course Assessment Framework

Total Course Marks: 100 Examination Duration: 4 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Ajoy, K., Ghatak. *Optics* (5th ed.). McGraw-Hill.

Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics* (11th ed.). Wiley.

Hecht, E. (2017). *Optics* (5th ed.). Pearson.

Jenkins, F. A., & White, H. E. (2001). *Fundamentals of optics* (4th ed.). McGraw-Hill.

PROVISIONAL

Pedrotti, F. L., Pedrotti, L. M., & Pedrotti, L. S. (2017). *Introduction to optics* (3rd ed.). Cambridge University Press.

Smith, W. J. (2008). *Modern optical engineering* (4th ed.). McGraw-Hill.

PROVISIONAL

Course Code: 8222755	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Classical Mechanics			

Course Description

This course provides an advanced treatment of classical mechanics using Newtonian, Lagrangian, and Hamiltonian formulations. It introduces generalized coordinates, variational principles, central force motion, rigid body dynamics, canonical transformations, and small oscillations. The course develops analytical and mathematical skills necessary for solving complex physical problems and forms the foundation for advanced studies in theoretical physics.

Course Objectives

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

- Develop a comprehensive understanding of advanced formulations of classical mechanics.
- Apply variational principles and analytical mechanics to solve physical problems.
- Analyze the dynamics of particle systems, rigid bodies, and central force motion.
- Develop mathematical skills required for solving advanced mechanics problems.
- Prepare students for higher studies and research in theoretical and applied physics.

Course Learning Outcomes (CLOs)

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

CLO	Course Learning Outcome	Bloom's Level
CLO1	Explain the fundamental principles of Newtonian mechanics, generalized coordinates, constraints, D'Alembert's principle, and conservation laws.	Understand
CLO2	Apply Lagrangian and Hamiltonian formulations, variational principles, and the principle of least action to solve problems in analytical mechanics.	Apply
CLO3	Analyze two-body central force motion, Kepler's laws, scattering phenomena, and coordinate transformations.	Analyze
CLO4	Analyze the dynamics of rigid bodies using Euler's angles, Euler's equations, and rotational motion.	Analyze
CLO5	Apply canonical transformations, Legendre transformations, Hamilton's equations, and Poisson brackets in solving mechanics problems.	Apply
CLO6	Analyze systems undergoing small oscillations, determine normal modes, normal coordinates, and forced vibrations.	Analyze

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Mapping of CLOs with PLOs

CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓	✓										
CLO2	✓	✓	✓									
CLO3	✓	✓	✓	✓						✓		
CLO4	✓	✓	✓	✓						✓		
CLO5	✓	✓	✓							✓		
CLO6	✓	✓	✓	✓						✓		

Course Contents

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
1-3	**Review of Elementary Principles**: Review of Newtonian Mechanics, Equations of Motion, Conservation Laws, Constraints, Generalized Coordinates and Generalized Forces, D'Alembert's Principle and Lagrange's Equations	Interactive Lecture, Problem Solving	Quiz Assignment Class Test	CLO1
4-6	**Lagrangian Formulation**: Variational Method and Euler-Lagrange Equations, Hamilton's Principle and Derivation of Lagrange's Equations, Applications of Lagrangian Mechanics	Lecture, Numerical Problems	Quiz Assignment Class Test	CLO2
7-10	**Two-body Central Force Problem**: Two-Body Central Force Problem and Equivalent One-Body System, Kepler's Laws, Center of Mass and Laboratory Coordinates, Transformation between Laboratory and Center of Mass Coordinates	Lecture, Tutorial, Problem Solving	Quiz Assignment Class Test	CLO3
11-13	**Dynamics of Rigid Body Motion**: Kinematics and Dynamics of Rigid Bodies, Orthogonal Transformations and Euler Angles, Euler's Equations and Motion of a Symmetric Top	Lecture, Tutorial, Numerical Problems	Quiz Assignment Class Test	CLO4
14-18	**Hamiltonian Mechanics**: Legendre Transformation and Hamiltonian Formulation, Hamilton's Equations of Motion, Variational Principle and Principle of Least Action, Applications of Hamiltonian Mechanics	Lecture, Problem, Numerical Exercises	Quiz Class Test Assignment	CLO5

PROVISIONAL

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
19-22	**Canonical Transformation**: Canonical Transformations, Legendre Transformation and Integral Invariants of Poincaré Lagrangian, Poisson Brackets, Problem Solving Session on Hamiltonian Mechanics	Lecture, Problem Solving	Quiz Class Test Assignment	CLO5
23-28	**Small Oscillations**: Introduction to Small Oscillations, Generalized Coordinates, Normal Coordinates and Normal Modes, Forced Vibrations, Applications of Small Oscillations, Advanced Numerical Problems	Lecture, Problem Solving, Case Study	Assignment Quiz Class Test	CLO6

Course Assessment Framework

Total Course Marks: 100 Examination Duration: 4 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Goldstein, H., Poole, C. P., & Safko, J. L. (2002). *Classical mechanics* (3rd ed.). Addison-Wesley.

Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics* (11th ed.). Wiley.

Kleppner, D., & Kolenkow, R. J. (2014). *An introduction to mechanics* (2nd ed.). Cambridge Univ. Press.

Marion, J. B., & Thornton, S. T. (2003). *Classical dynamics of particles and systems* (5th ed.). Brooks/Cole.

Taylor, J. R. (2005). *Classical mechanics*. University Science Books.

PROVISIONAL

Course Code: 8222758	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Physics Practical-II		Examination Duration: 6 Hours	

Course Description

Physics Practical-II is a laboratory-based course designed to develop experimental skills in Electricity, Electronics, Magnetism, and Optics. The course emphasizes accurate measurement techniques, experimental design, data analysis, uncertainty estimation, scientific report writing, and interpretation of results. Students gain hands-on experience with modern laboratory instruments while relating experimental observations to theoretical principles.

Course Objectives

After completing this course, students will be able to:

- Develop practical skills in performing experiments related to electricity, magnetism, AC circuits, thermal physics, and optics.
- Apply fundamental physical principles and mathematical techniques to analyze experimental observations and determine physical constants.
- Develop competency in data acquisition, uncertainty analysis, graphical representation, and scientific interpretation of experimental results.
- Use laboratory instruments and modern scientific tools safely, ethically, and efficiently while maintaining proper laboratory records.
- Communicate scientific findings effectively through laboratory reports, oral presentations, and viva-voce examinations while working individually or collaboratively.

Course Learning Outcomes (CLOs)

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

CLO	Course Learning Outcome	Bloom's Level
CLO-1	Perform standard laboratory experiments in electricity, magnetism, AC circuits, thermal physics, and optics following appropriate experimental procedures and laboratory safety protocols.	Apply
CLO-2	Analyze experimental data using appropriate mathematical methods, graphical techniques, and uncertainty analysis to determine physical parameters accurately.	Analyze
CLO-3	Operate and calibrate laboratory instruments such as ballistic galvanometer, spectrometer, polarimeter, diffraction grating, thermocouple, AC measuring instruments, and related apparatus.	Apply
CLO-4	Interpret experimental results by comparing them with theoretical predictions and identifying possible sources of experimental error.	Evaluate

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CLO-5	Prepare professional laboratory reports, maintain laboratory notebooks, communicate scientific findings effectively, and demonstrate ethical laboratory practices and teamwork.	Create

Mapping of CLOs with PLOs

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO-1	✓	✓	✓					✓	✓			
CLO-2	✓	✓	✓	✓						✓		
CLO-3			✓	✓				✓	✓		✓	
CLO-4	✓	✓	✓	✓		✓		✓		✓		
CLO-5						✓		✓	✓	✓	✓	

Laboratory Contents: Students will perform the following experiments:

Week	Content	Teaching Learning Week
Group A (Electricity, Magnetism & Thermal Physics)		
1.	Lab safety	**1**
2.	Report writing and analysis of results	**2-3**
3.	Determination of logarithmic decrement of a Ballistic Galvanometer and Current Distribution Ratio (CDR)	**4**
4.	Determination of self-inductance of a coil by Rayleigh's method	**5**
5.	Determination of mutual inductance for varying distances between two coils	**6**
6.	Determination of absolute capacitance of a condenser using a Ballistic Galvanometer	**7**
7.	Determination of platinum resistance thermometer coefficients.	**8**
8.	Investigation of the voltage-current relationship for a simple inductive circuit and determination of inductance	**9**
9.	Investigation of the voltage-current relationship for an AC capacitive circuit and determination of capacitance	**10**
Group B (Optics)		
10.	Study of variation of capacitive and inductive reactance with frequency	**11**
11.	Calibration curve of a thermocouple and determination of the melting point of wax	**12-13**
12.	Determination of wavelength of light using Newton's Rings.	**14-15**
13.	Determination of wavelength using Fresnel's Biprism	**16**

PROVISIONAL

14.	Determination of specific rotation of plane polarized light in sugar solution using a Polarimeter.	**17-18**
15.	Determination of refractive index of prism material using a Spectrometer	**19**
16.	Determination of wavelength of spectral lines using a Diffraction Grating	**20**
17.	Calibration of a Spectrometer and determination of an unknown wavelength.	**21-22**
18.	Determination of Cauchy's constants	**23**
19.	Determination of refractive index of prism material and a given liquid using total internal reflection.	**24-25**
20.	Determination of thickness (or refractive index) of a thin transparent plate	**26**
Practice: Experiment and viva-voce		**27-28**

Teaching-Learning Strategies

- Instructor demonstration
- Guided laboratory experiments
- Individual laboratory practice
- Collaborative laboratory activities
- Experimental data analysis
- Graph plotting and uncertainty analysis
- Laboratory report preparation
- Viva-voce discussion
- Reflective learning and troubleshooting

Laboratory Safety Practices

Students shall

- Follow laboratory safety regulations.
- Handle fragile optical and electrical instruments carefully.
- Maintain laboratory discipline.
- Record observations honestly.
- Report equipment malfunction immediately.
- Dispose of laboratory materials properly.

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Assessment Scheme

Examination duration: 6 hours

Students shall perform **two experiments**, **one from each group**, each of **three hours duration**.

Assessment Component	Marks
Experiment from Group A	35
Experiment from Group B	35
Laboratory Notebook	10
Class Attendance	10
Viva-Voce	10
Total	**100**

Marks Distribution for Each Experiment

Component	Marks
Theory	8
Data Collection & Tabulation	12
Calculations, Graphs & Results	10
Discussion and Interpretation	5
Total	**35**

CLO-wise Assessment Mapping

Assessment Method	CLO1	CLO2	CLO3	CLO4	CLO5
Laboratory Performance	✓		✓		
Data Collection	✓	✓			
Calculations & Graphs		✓	✓	✓	
Experimental Discussion				✓	✓
Laboratory Notebook		✓		✓	✓
Viva-Voce	✓	✓	✓	✓	✓

Mapping of Experiments with CLOs

Experiment Area	CLO1	CLO2	CLO3	CLO4	CLO5
Electricity & Magnetism	✓	✓	✓	✓	✓
AC Circuits	✓	✓	✓	✓	✓
Thermal Physics	✓	✓	✓	✓	✓
Optics	✓	✓	✓	✓	✓

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Graduate Attributes Developed

Upon completion of this course, students will develop:

- Experimental and analytical skills
- Scientific reasoning and critical thinking
- Precision measurement techniques
- Data analysis and uncertainty estimation
- Scientific communication skills
- Ethical laboratory practices
- Teamwork and professional responsibility
- Competence in modern laboratory instrumentation
- Independent learning and problem-solving abilities

List of Books

Ahmed, G. U., & Uddin, M. S. (1992). *Practical physics for degree students* (3rd ed.). Hafiz Book House

Cerny, E. J. (1976). *Introduction to experimental physics*. McGraw-Hill.

Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of physics* (11th ed.). Wiley.

Nelkon, M., & Parker, P. (1978). *Advanced level physics*. Heinemann.

Singh, S. P. (2011). *Advanced practical physics* (18th ed.). Pragati Prakashan.

Squires, G. L. (2001). *Practical physics* (4th ed.). Cambridge University Press.

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Detailed Syllabus

Course Code	8222859	Marks: 100	Credits: 4	Class Durations: 56 Hours
Course Title:	General Chemistry-II			

Course Description

This course provides students with a comprehensive understanding of fundamental concepts and principles of general chemistry, including the chemistry of nonmetals and metals, thermodynamics, chemical kinetics, electrochemistry, catalysis, solid-state chemistry, coordination chemistry, aromatic and organic reactions, carbohydrates, amino acids, and polymers. The course emphasizes the understanding of chemical principles, structures, reactions, mechanisms, properties, and applications across inorganic, physical, organic, and coordination chemistry.

Course Objectives

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

1. Understand the fundamental properties and chemical behaviour of nonmetals, metals, transition metals, and inner transition metals.
2. Explain the principles of thermodynamics, energy changes, chemical kinetics, electrochemistry, and catalysis.
3. Describe the structures, properties, and characteristics of crystalline and amorphous solids and coordination compounds.
4. Explain aromaticity, heterocyclic compounds, major organic reactions, and their mechanisms and applications.
5. Understand the structures, classification, properties, and reactions of carbohydrates, amino acids, and polymers.
6. Apply fundamental chemical concepts to explain chemical properties, reactions, mechanisms, and related phenomena.

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Course Learning Outcomes (CLOs)

CLO#	Course Learning Outcome	Bloom's Level
CLO1	Explain the general properties, structures, bonding, electronic characteristics, and chemical behaviour of nonmetals, metals, transition metals, and inner transition metals.	Understand
CLO2	Explain and apply fundamental principles of thermodynamics, energy changes in chemical reactions, chemical kinetics, electrochemistry, and catalysis.	Apply
CLO3	Describe the properties and structures of solids and explain fundamental concepts of coordination chemistry, including coordination compounds, ligands, nomenclature, bonding, and stability.	Understand
CLO4	Explain aromaticity, aromatic electrophilic substitution reactions, heterocyclic compounds, and major organic reactions with their mechanisms and applications.	Analyze
CLO5	Describe the definition, classification, structures, properties, and reactions of carbohydrates and amino acids, and explain the basic concepts and classifications of polymers.	Understand
CLO6	Analyze chemical concepts, reactions, structures, mechanisms, and properties across inorganic, physical, organic, and coordination chemistry.	Analyze

Mapping CLOs with PLOs

CLO / PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓	✓				✓	✓					
CLO2	✓	✓		✓	✓	✓						
CLO3	✓	✓				✓	✓					
CLO4	✓	✓		✓			✓					
CLO5	✓	✓				✓	✓					
CLO6	✓	✓	✓	✓	✓	✓	✓					✓

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Course Content — 28 weeks, 2 contact hours per week

Module No.	Contents	Teaching–Learning Strategies	Assessment Methods	CLOs
1	**Nonmetals:** General properties of nonmetals, ortho and para hydrogen molecules, allotropy of carbon, catenation, halogens and their basic properties, chemistry of noble gases.	Lecture, interactive discussion, concept explanation	Written examination, class test, short questions	CLO1
2	**Metals:** Metallic bond, electron sea theory of metallic bond, characteristics of metals, band theory of conductivity, conductors, semiconductors and insulators, transition metals and inner transition metals colour and magnetism in transition metal chemistry.	Lecture, discussion, diagrams, conceptual problem-solving	Written examination, class test, short questions	CLO1, CLO6
3	**Energy changes in chemical Reactions:** System and surroundings, open system and closed system, thermodynamics, state functions, the first law of thermodynamics, the concept of internal energy and enthalpy, measurement of enthalpy changes, enthalpy of formation, Hess's law, lattice enthalpy, Born-Haber cycle, second law of thermodynamics, entropy and free energy.	Lecture, numerical problem-solving, board work, discussion	Numerical problems, written examination, class test	CLO2, CLO6
4	**Rates of chemical Reactions:** Reaction rate, rate constant, rate law, order of reactions, first-order reaction, half-life, order and molecularity, effect of temperature on the rate of reaction, collision theory and reaction rates, activation energy, Arrhenius equation.	Lecture, numerical exercises, graphical explanation, problem-solving	Numerical problems, written examination, class test	CLO2, CLO6
5	**Electrochemistry:** Redox reactions, electrolytic and galvanic cells, cell notation, standard reduction potentials, emf of cells, the effect of concentration on cell emf, batteries, corrosion.	Lecture, cell-diagram demonstration, problem-	Written examination, numerical problems, class test	CLO2, CLO6

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		solving, discussion		
6	**Catalysis:** Catalyst, homogeneous catalysis, enzyme catalysis, autocatalysis.	Lecture, discussion,	Written examination, class test	CLO2
7	**Solids:** Properties of solids, crystalline and amorphous solids, distinction between crystalline and amorphous solids, isomorphism, polymorphism and allotropy, crystal lattice, unit cell, crystal systems, Bragg's law.	Lecture, diagrams, model/visual demonstration, discussion	Written examination, short questions, problem-solving	CLO3, CLO6
8	**Coordination Chemistry:** Coordination compounds, ligands, coordination number, nomenclature, structures of complex compounds, Werner's primary and secondary valency concept, Sidgwick's electronic concept, valence bond theory, stability of coordination compounds.	Lecture, structural representation, nomenclature exercises, discussion	Written examination, nomenclature exercises, class test	CLO3, CLO6
9	**Aromatic Compounds:** Aromaticity of benzene, Electrophilic aromatic substitution reactions with reference to nitration, halogenation, sulphonation and alkylation. Heterocyclic compounds: Pyrrole, furan, thiophene, pyridine.	Lecture, structural representation, reaction mechanism discussion	Written examination, reaction-based questions, class test	CLO4
10	**Organic reactions:** Brief study of electrophilic addition, Nucleophilic addition, Elimination reaction, condensation reaction, oxidation, and reduction reactions and organic compounds. Mechanism and application of the following reactions: Friedel-Crafts reaction, Clemmensen reduction, Wolf-Kishner reduction, Perkin reaction, Claisen reaction, Cannizzaro reaction, and Aldol condensation.	Lecture, reaction mechanism demonstration, structural representation, problem-solving	Written examination, reaction mechanisms, class test	CLO4, CLO6
11	**Carbohydrates:** Definition, classification, structure and reactions of	Lecture, structural	Written examination,	CLO5

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	monosaccharides. Polysaccharides: cellulose and starch.	representation, reaction-based learning	short questions, class test	
12	**Amino Acids:** Structures, classification, synthesis, physical and chemical properties of amino acids.	Lecture, structural representation, discussion	Written examination, short questions, class test	CLO5
13	**Polymer Chemistry:** Polymers: homopolymer, heteropolymer, low-density and high-density polymer, copolymers, studies of some polymers-polyvinyl chloride, nylon 66, silk and wool.	Lecture, classification charts, discussion, examples	Written examination, short questions, class test	CLO5

Course Assessment Framework

Total Course Marks: 100 Duration of Examination: 4 Hours

Assessment Category	**Assessment Component**	**Weightage**
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain a maximum of 3 sub-sections (e.g., a, b, c) • Duration of Examination: 4 Hours	80%

List of Books

Cotton, F. A., Wilkinson, G., & Gaus, P. L. (1987). *Basic inorganic chemistry*. John Wiley & Sons.

Ebbing, D. D., & Wrighton, M. S. (1996). *General chemistry*. Houghton Mifflin.

Finar, I. L. (1973). *Organic chemistry: Volume I: The fundamental principles*. Longmans.

Haider, S. Z. (n.d.-a). *Introduction to modern inorganic chemistry*. Friends International.

Haider, S. Z. (n.d.-b). *Selected topics on advanced inorganic chemistry*. Students' Publication.

Huque, M. M., & Nawab, M. A. (n.d.). *Principles of physical chemistry*. Students' Publications.

Madan, R. D. (n.d.). *Modern inorganic chemistry*. S. Chand & Company Ltd.

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Malik, W. U., Tuli, G. D., & Madan, R. D. (n.d.). *Selected topics in inorganic chemistry*. S. Chand & Company Ltd.

Morrison, R. T., & Boyd, R. N. (n.d.). *Organic chemistry*.

Silberberg, M. (2009). *Chemistry: The molecular nature of matter and change*. McGraw-Hill Higher Education.

PROVISIONAL

Course Code: 8222861	Marks: 50	Credits: 2	Class Hours: 42
Course Title: Environmental Chemistry			

Course Description

This course provides a comprehensive introduction to the chemical principles governing the natural environment and the impact of anthropogenic activities on earth systems. It encompasses a detailed study of the structural segments of the environment—atmosphere, hydrosphere, lithosphere, and biosphere—and focuses on the chemical pathways, transport dynamics, and transformations of pollutants. Students will explore the mechanisms behind critical global phenomena, including acid rain, the greenhouse effect, ozone depletion, and bio-magnification. The curriculum emphasizes quantitative water quality metrics (pH, DO, BOD, COD), modern wastewater treatment processes, soil degradation vectors, and the biochemical toxicology of toxic persistent compounds like PCBs and heavy metals. Through theoretical frameworks, case studies, and numerical assessments, this course equips students with the essential analytical tools needed to evaluate environmental degradation and formulate sustainable mitigation strategies.

Course Objectives

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

- **Develop** a fundamental understanding of the chemical composition, interactions, and structural layers defining environmental segments.
- **Analyze** the chemical reactions, source identification methods, and transport pathways of hazardous air, water, and soil pollutants.
- **Evaluate** industrial and municipal water contamination by measuring key water quality parameters and understanding standard purification technologies.
- **Explain** the biochemical mechanisms of toxicity, bioaccumulation, and environmental hazards associated with heavy metals and persistent organic compounds.
- **Apply** physical and chemical principles to design sustainable control mechanisms for industrial effluents, urban waste management, and soil remediation.
- **Cultivate** scientific reasoning, problem-solving abilities, and an ethical foundation required to address domestic and global environmental challenges.

Course Learning Outcomes (CLOs)

By the end of this course, students will be able to:

CLO	Course Learning Outcome	Bloom's Level
CLO 1	**Define** and **explain** the fundamental segments of the environment and their systemic interactions	Understand
CLO 2	**Analyze** the sources, chemical behavior, and global consequences of air, water, and soil pollutants.	Analyze

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CLO 3	**Evaluate** wastewater and municipal water treatment parameters (pH, DO, BOD, COD).	Evaluate
CLO 4	**Assess** the biochemical toxicity and control methods for heavy metals and hazardous compounds like PCBs.	Evaluate

Mapping CLOs to PLO Matrix

CLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓						✓			✓		
CLO2		✓					✓					
CLO3			✓				✓					
CLO4							✓					

Course Contents

Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
1-3	**1. Environment:** Introduction components of environment, factors affecting environment, environmental management, environment and health, environmental chemistry, segments of environment – atmosphere, hydrosphere, lithosphere and biosphere, structure of atmosphere.	Interactive Lecture, Group Discussion, Concept Mapping	Quiz, Class Test, Short Assignment	**CLO1**
4-7	**2. Pollution and Pollutants:** Pollution, environmental pollution, pollutant, classification of pollutants, types of pollution. PCBs and their sources and hazards, Detection & estimation of PCBs. Bio-magnification/Biomultification.	Lecture, Case Study Analysis, Group Discussion	Class Test, Assignment, Viva-voce	**CLO2 CLO4**
8-14	**3. Air Pollution:** Introduction, air quality, major sources of air pollution, gaseous pollutants. Acid rain-how acid rain is formed, adverse effects of acid rain. Greenhouse effect- how the greenhouse effect is produced, consequences of greenhouse effect and global warming. El Niño phenomenon and its effect. Ozone depletion, mechanism of ozone depletion, effects of ozone depletion.	Lecture, Multimedia Presentation, Problem-Based Learning	Quiz, Mid Term Exam, Assignment	**CLO2**
15-19	**4. Water Pollution:** Introduction, classification of water pollutants. Physical, chemical and biological characteristics of wastewater. Industrial wastewater treatment, municipal water	Interactive Lecture, Numerical Exercises,	Class Test, BOD/COD Problems,	**CLO3**

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Week	Topics	Teaching-Learning Strategy	Assessment Strategy	CLO
	treatment. Water quality parameters and standards, measurements of important parameters such as pH, DO, BOD, COD and temperature for water quality assessments.	Laboratory Demonstration	Report Writing	
20-24	**5. Soil Pollution:** Composition of soil, importance of soil to the biosphere, sources of soil pollution. Effects of soil pollution- synthetic fertilizer and pesticides, effects of industrial effluents, effects of urban wastes, control of soil pollution.	Lecture, Case Study Analysis, Group Discussion	Quiz, Assignment	**CLO2**
25-28	**6. Heavy metals in the Environment:** Trace metals, light metals and heavy metals, deadly heavy metals, sources of heavy metals, biochemical effects, toxicity, toxicology, control and treatment of mercury, chromium, arsenic and lead.	Lecture, Problem-Based Learning, Course Revision	Final Assessment, Viva-voce	**CLO4**

Course Assessment Framework:

Total Course Marks: 50 Exam Duration: **2.5** Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	4%
	In-course Examination	10%
	Quiz / Assignment Presentation	6%
Summative Assessment (80%)	Final Examination • Students will have to answer 4 questions out of 6 • 10 marks per question ($4 \times 10 = 40$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Dara, S. S. (2010). *A textbook of environmental chemistry and pollution control*. S. Chand & Company Ltd.

De, A. K. (2010). *Environmental chemistry* (7th ed.). New Age International Publishers.

Manahan, S. E. (2022). *Environmental chemistry* (11th ed.). CRC Press.

Sharma, B. K. (2014). *Environmental chemistry*. Goel Publishing House.

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Course Code: 8223757	Marks: 100	Credits: 4	Class Hours: 56
Course Title: Calculus II and Ordinary Differential Equations			

Course Description

This course introduces the fundamental concepts of multivariable calculus and ordinary differential equations. It develops students' analytical and problem-solving skills through the study of vector-valued functions, functions of several variables, multiple integrals, and ordinary differential equations. The course emphasizes the application of calculus and differential equations to mathematical modelling and problems arising in science, engineering, and related disciplines.

Course Objectives (COs):

This course aims to

- Develop a sound understanding of multivariable calculus and ordinary differential equations.
- Develop analytical and problem-solving skills for vector functions, partial differentiation, multiple integration, and differential equations.
- Enable students to apply calculus and differential equation techniques to mathematical models and problems in science, engineering, and related disciplines.

Course Learning Outcomes (CLOs)

After completing this course, students will be able to

CLO	Course Learning Outcome	Bloom's Level
CLO1	Explain and analyze vector-valued functions of a single variable, including limits, derivatives, integrals, and geometric properties such as tangent lines and arc length.	Analyze
CLO2	Determine the curvature and radius of curvature, and identify properties of space curves using Cartesian and parametric equations.	Apply
CLO3	Compute limits, partial derivatives, and differentials of functions of several variables, and apply optimization techniques including Lagrange multipliers.	Apply
CLO4	Evaluate double and triple integrals over different regions and coordinate systems to compute areas, volumes, and other applications.	Apply
CLO5	Classify ordinary differential equations and interpret their solutions using direction fields and basic existence and uniqueness concepts.	Analyze
CLO6	Apply appropriate methods to solve first-order differential equations, including separable, linear, exact, homogeneous, Bernoulli, Riccati, and Clairaut's forms.	Apply

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CLO7	Solve higher-order linear differential equations, both homogeneous and non-homogeneous, using linear operators, reduction of order, and constant coefficient methods.	Apply

Mapping of CLOs with PLOs

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√	√										
CLO2	√	√										
CLO3	√	√										
CLO4	√	√								√		
CLO5	√	√								√		
CLO6	√	√								√		
CLO7	√	√										

Course Contents

Week	Topic	Teaching Learning Strategy	Assessment	CLOs
1–3 (3 weeks)	**Vector-valued functions of a single variable:** Limits. Derivatives and integrals. Tangent lines to graphs of such functions. Arc length from the vector viewpoint. Arc length parametrization.	Lecture; Whiteboard Teaching; Worked Examples	Written Quiz; Tutorial Exercise; Class Test	CLO1
4–6 (3 weeks)	**Curvature of space curves:** Definition. Curves of zero curvature. Curves of constant non-zero curvature. Cartesian equations and parametric equations. Radius of curvature. Centre of curvature.	Lecture; Worked Examples; Tutorial	Tutorial Exercise; Problem Solving; Class Test	CLO2
7–11 (5 weeks)	**Functions of several variables:** Limits and continuity. Partial derivatives. Differentiability, linearization, and differentials. The chain rule. Partial derivatives with constrained variables. Extreme values and saddle points of functions of several variables. Lagrange multipliers.	Lecture; Whiteboard Teaching; Problem Solving	Assignment; Problem Solving; Class Test	CLO3
12–15 (4 weeks)	**Multiple Integration:** Double integrals and iterated integrals. Double integrals over nonrectangular regions. Double integrals in	Lecture; Worked Examples;	Tutorial Exercise; Problem	CLO4

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Week	Topic	Teaching Learning Strategy	Assessment	CLOs
	polar coordinates. Area by double integrals. Triple integrals and iterated integrals: Volume as a triple integral.	Tutorial	Solving; Class Test	
16–18 (3 weeks)	**Ordinary differential equations and their solutions:** Classification of differential equations. Solutions. Implicit solutions. Singular solutions. Initial value problems. Boundary value problems. Basic existence and uniqueness theorems (statement and illustration only). Direction fields. Phase plane.	Lecture; Whiteboard Teaching; Interactive Discussion	Written Quiz; Tutorial Exercise; Class Test	CLO5
19–23 (5 weeks)	**Solution of first-order differential equations:** Separable equations. Linear equations. Exact equations. Special integrating factors. Substitutions and transformations. Homogeneous equations. Bernoulli equation. Ricatti equation. First-order higher degree equation solvable for x, y, and p. Clairaut's equation.	Lecture; Worked Examples; Problem Solving	Assignment; Problem Solving; Class Test	CLO6
24–28 (5 weeks)	**Solution of higher-order linear equations:** Linear differential operators. Basic theory of linear differential equations. Solution space of homogeneous linear equations. Fundamental solutions of homogeneous solutions. Reduction of orders, Homogeneous linear equations with constant coefficients. Non-homogeneous equation.	Lecture; Worked Examples; Problem Solving	Problem Solving; Tutorial Exercise; Class Test	CLO7

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Course Assessment Framework

Total Course Marks: 100 Examination Duration: 4 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Anton, H. (1995). *Calculus* (5th ed.). Wiley.

Ayres, F., & Ayres, J. R. (1999). *Theory and problems of differential equations* (Schaum's Outline Series). McGraw-Hill.

Braun, M. (1983). *An introduction to differential equations and their applications*. Springer-Verlag.

Gill, D. (1986). *Introduction to differential equations*. McGraw-Hill.

Ross, S. L. (1984). *Differential equations*. John Wiley & Sons.

Zill, D. G. (2009). *A first course in differential equations with applications*. Brooks/Cole, Cengage Learning.

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Course Code: 8223758	Marks: 50	Credits: 2	Class Hours: 42
Course Title: Math Lab (Mathematica)			

Course Description

This course introduces students to the use of Mathematica, a powerful Computer Algebra System (CAS), for solving mathematical problems. Students will perform symbolic, numerical, and graphical computations. Emphasis is placed on applying these skills to topics from first-year mathematics courses.

Course Objectives

The main objectives of the course are as follows:

- Familiarize students with Mathematica software.
- Teach students how to use Mathematica for symbolic and numerical calculations, data analysis, visualization, and problem-solving in mathematics and scientific research.
- Enhance students' proficiency in utilizing Mathematica to improve their understanding and problem-solving abilities in various mathematical domains.

Course Learning Outcomes (CLOs)

After completing this course, students will be able to

CLO	Course Learning Outcome	Bloom's Level
CLO1	Demonstrate fundamental skills in operating the Mathematica software interface and executing basic commands.	Apply
CLO2	Apply Mathematica for symbolic and numerical computation, including operations with expressions, equations, and matrices.	Apply
CLO3	Apply Mathematica to compute and verify derivatives, integrals, limits, and series solutions for problems drawn from Calculus and related mathematical courses.	Apply
CLO4	Create 2D and 3D graphical representations of mathematical functions and data using Mathematica's visualization tools.	Apply
CLO5	Solve problems from first- and second-year allied math courses (e.g., Foundations of Mathematics, Calculus I, Calculus II, and Ordinary Differential Equations) using Mathematica's built-in functions and packages.	Apply
CLO6	Utilize Mathematica to explore mathematical patterns, test conjectures, and support experimental mathematics.	Analyze
CLO7	Integrate Mathematica into scientific or mathematical reporting, presentations, and research-oriented tasks.	Create

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Mapping of CLOs with PLOs

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	√									√		
CLO2	√				√					√		
CLO3	√				√					√		
CLO4	√				√					√		√
CLO5	√									√		
CLO6	√				√					√		
CLO7	√			√	√					√		√

Course Contents

Problem-solving using the Computer Algebra System (CAS) Mathematica: Running the package. Numerical computation. Algebraic computation. Mathematical functions. Derivatives and integrals. Limits and series. Lists and matrices. Graphics. Standard packages. Solving problems in Foundations of Mathematics, Calculus I, Calculus II, and Ordinary Differential Equations that students studied in the first and second years.

Teaching Learning Activities:

Class Lecture Lab-based 21 (Each 2-hour lab class covers first- and second-year problems of allied Mathematics courses)

Class Test 1

Lab Notebook 1 (Instructors will assign at least 15 lab tasks)

Assessment Strategy:

Type of evaluation	Time	Marks	Guideline
Final Exam	2 hours	30	Three questions have to be answered out of the five questions
Continuous Assessment (Class Test)	1 hour	10	Internal Assessment: Conducted during the academic year
Continuous Assessment (Lab Performance & Notebook)	-----	5	Internal Assessment: Based on laboratory performance and completion of at least 15 laboratory exercises
Continuous Assessment (Class attendance)	-----	5	Internal Assessment: Assessed according to the University's attendance policy

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List of Books

Don, E. (2009). *Schaum's outline of Mathematica and the Wolfram language* (2nd ed.). McGraw-Hill Education.

Mangano, S. (2009). *Mathematica cookbook: Building blocks for science, engineering, finance, music, and more*. O'Reilly Media.

Wolfram Research, Inc. (2024). *Mathematica (Student Edition)* [Software]. Wolfram Research, Inc.

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Course Code: 8223659	Marks: 100	Credits:4	Class Hours: 56
Course Title: Methods of Statistics			Exam Duration: 4 hours

Course Description

This course provides a rigorous mathematical and applied introduction to the core pillars of statistical inference. Students will explore the theoretical foundations of sampling distributions (Normal, χ^2, t, and F), the logic of experimental design and ANOVA (CRD, RBD, LSD, and Factorials), probabilistic survey sampling techniques (SRS, Stratified, Systematic, Cluster, and Multistage), and the Neyman-Pearson paradigm of hypothesis testing. The curriculum culminates in the practical application of parametric and non-parametric tests for means, variances, proportions, correlation, regression, and goodness-of-fit, equipping students to design studies, analyze data critically, and communicate findings effectively.

Course Learning Outcomes

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	**Define** sampling distributions, mathematically derive the standard error of statistics, and differentiate the properties, assumptions, and appropriate applications of the Normal, χ^2, t, and F distributions.	Level 1, 4: Understand, Analyze
CLO-2	**Apply** the principles of Randomization, Replication, and Local Control to construct complete ANOVA tables, estimate parameters, and perform missing plot analysis for CRD, RBD, and LSD.	Level 3, 4: Apply, Analyze
CLO-3	Design, analyze, and interpret main and interaction effects for $\mathbf{2^2}$ and $\mathbf{2^3}$ factorial experiments, utilizing interaction plots to draw valid conclusions.	Level 4, 5: Analyze, Evaluate
CLO-4	Distinguish between censuses and sample surveys, identify sampling and non-sampling errors, and execute parameter estimation (means, totals, proportions) using SRS, Stratified, Systematic, Cluster, and Multistage sampling designs.	Level 3, 4: Apply, Analyze
CLO-5	Critically **evaluate** the statistical and logistical trade-offs between probability sampling methods and non-probability quota sampling in real-world survey contexts.	Level 5: Evaluate
CLO-6	Explain the Neyman-Pearson logic of hypothesis testing, formulate null/alternative (simple/composite) hypotheses, and correctly compute Type I/II errors, power, significance levels, and p-values for one- and two-tailed tests.	Level 1, 3: Understand, Apply

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CLO-7	Execute significance tests and construct confidence intervals for single/double means, variances, proportions, correlation coefficients, and regression coefficients (including paired t-tests).	Level 3, 4: Apply, Analyze
CLO-8	Apply χ^2 tests of homogeneity to compare several population means, variances, and proportions, and perform χ^2 goodness-of-fit tests for theoretical distributions.	Level 3, 5: Apply, Evaluate
CLO-9	Synthesize sampling, experimental design, and hypothesis testing methods to design a complete statistical investigation, analyze data using appropriate tools, and communicate evidence-based conclusions effectively.	Level 5, 6: Evaluate, Synthesize

Mapping of CLOs with PLOs

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes.

Indication: ✓ = Mapped / Aligned

CLOs / PLOs	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**	**PLO 12**
CLO 1	✓	✓								✓		
CLO 2	✓	✓								✓		
CLO 3	✓	✓								✓		
CLO 4	✓	✓			✓					✓		
CLO 5	✓	✓								✓		
CLO 6	✓	✓								✓		
CLO 7	✓	✓								✓		
CLO 8	✓	✓								✓		
CLO 9	✓	✓			✓					✓		

PROVISIONAL

Course Content

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 1 (Class Hours 10)	**Sampling Distributions** • Concept of sampling distribution of a statistic. • Derivation of Standard Error (SE) for sample means and proportions. • χ^2 distribution: properties, degrees of freedom, and uses. • t-distribution: properties, relationship to Normal, and uses. • F-distribution: properties, ratio of variances, and uses.	• Lectures: Interactive chalk-and-tal for derivations. • Collaborative Learning: Group proble solving sessions on deriving SE. • Inquiry-Based: Students compare shape of t, χ^2, and F curves for different df using software.	Quiz 1 Assignment 1 Class Test 1	CLO 1
Module 2 (Class Hours 12)	**Design of Experiments (Part A: Basic Designs)** •Principles: Randomization, Replication, Local Control. •ANOVA logic and construction of analysis tables. •Completely Randomized Design (CRD): Analysis & parameter estimation. •Randomized Block Design (RBD): Analysis & parameter estimation. •Latin Square Design (LSD): Analysis & parameter estimation. •Missing plot estimation techniques and adjusted analysis.	• Lectures: Step-by-step constructio of ANOVA tables. • Flipped Classroom: Students watch video on missing plot estimation before class; practice in class. • Hands-on Lab: Use R/Minitab to analyz RBD and validate manu calculations.	Lab Assignmen Assignment 2 Class Test 2	CLO 2

PROVISIONAL

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 2 (Class Hours 8)	**Design of Experiments (Part B: Factorial Designs)** • Introduction to factorial experiments. • 2^2 Factorial design: Main effects, interaction effects, and analysis. • 2^3 Factorial design: Main effects, two-way and three-way interactions. • Interpretation of results and interaction plots. • Choosing the appropriate design based on experimental constraints.	• Lectures: Demonstrate effect calculation using contras coefficients. • Visual Learning: Construct interaction plots using data from cas studies. • Case-Based Learning: Real-world factorial experiments (e.g., agriculture, manufacturing).	Assignment 3 Lab Assignmen Class Test 3	CLO 3
Module 3 (Class Hours 12)	**Survey Methods & Sampling Techniques** • Population, sample, census vs. surveys; Sampling frame. • Sampling vs. Non-sampling errors. • Simple Random Sampling (SRS): Estimation of mean, total, proportion, and SE. • Stratified Random Sampling: Proportional & Optimal (Neyman) allocation. • Systematic Sampling: Selection methods and variance estimation. • Cluster Sampling (equal & unequal clusters). • Quota Sampling and Multistage Sampling: Concepts and practical trade-offs.	• Lectures: Derive estimators for ea sampling method. • Problem-Based Learning: Real-world survey data (e.g., national census, health surveys). • Comparative Analysis: Compare variance reduction across SRS, Stratified, and Cluster using simulated data.	Assignment 4 Quiz 2 Class Test 4	CLO 4, CL 5

PROVISIONAL

Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessment	CLOs Mapped
Module 4 (Class Hours 8)	**Test of Hypothesis (Theory & Logic)** • Concept and logic of hypothesis testing. • Neyman-Pearson approach to testing. • Null (H_0) and Alternative (H_1) hypotheses; Simple vs. Composite. • Test of significance procedures. • Type I error, Type II error, and Statistical Power. • Level of significance (2-level concept). • One-tailed vs. Two-tailed tests. • P-value interpretation and decision-making. • Overview of test statistics: Normal, χ^2, t, and F.	• Lectures: Build the Neyman-Pearson framework step-by-step. • Interactive Discussion: Real-world analogies (e.g., medical trials, cou trials) to explain Type I/ errors. • Peer Instruction: Students formulate H_0 a H_1 for given scenarios a share with peers.	Quiz 3 Assignment 5 In-course Exam	CLO 6
Module 5 (Class Hours 10)	**Statistical Tests (Parametric & Non-Parametric)** • Single mean, single variance, single proportion (tests & CIs). • Difference of two means (independent) and two proportions. • Ratio of two variances (F-test) and confidence intervals. • Confidence intervals for simple correlation coefficient (ρ). • Confidence intervals for regression coefficients (single & double sample). • Paired t-test (dependent samples). • χ^2 test of Homogeneity for several population means, variances, and proportions. • χ^2 Test of Goodness of Fit.	• Lectures: Derive test statistics for each test type. • Demonstration: Use software to run tests and compare with manu calculations. • Capstone Project: Students design a mini-study, collect data, and apply appropriate tests. • Case Studies: Real datasets from publi health, economics, and education.	Lab Assignmen Assignment 6 In-course Exam	CLO 7, CL 8, CLO 9

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Course Assessment Framework:

Total Course Marks: 100 Examination Duration: 4 Hours

Assessment Category	Assessment Component	Weightage
Formative Assessment (20%)	Attendance & Class Participation	5%
	In-course Examination	10%
	Quiz / Assignment Presentation	5%
Summative Assessment (80%)	Final Examination • Students will have to answer 8 questions out of 12 • 10 marks per question ($8 \times 10 = 80$ marks) • Each question may contain maximum 3 sub-sections (e.g., a, b, c)	80%

List of Books

Casella, G., & Berger, R. L. (2024). *Statistical Inference* (2nd Edition, Cengage Learning). *[Excellent for Modules 1, 4, and 5—covers distributions, Neyman-Pearson lemma, and tests with mathematical rigor.]*

Montgomery, D. C. (2023). *Design and Analysis of Experiments* (10th Edition, Wiley). *[The definitive text for Module 2—contains detailed chapters on CRD, RBD, LSD, factorial designs, and missing plot techniques.]*

Cochran, W. G. (1977; Re-printed 2022). *Sampling Techniques* (3rd Edition, Wiley Classics Library). *[Still the gold-standard for Module 3—comprehensive coverage of SRS, stratification, systematic, cluster, and multistage sampling.]*

Peck, R., Olsen, C., & Devore, J. L. (2020). *Introduction to Statistics and Data Analysis* (6th Edition, Cengage).

[Excellent supplementary text for practical examples of hypothesis testing, CIs, and real-data case studies for Module 5.]

Agresti, A. (2018). *Statistical Methods for the Social Sciences* (5th Edition, Pearson). *[Highly recommended for applied χ^2 tests, homogeneity, and goodness-of-fit applications in Module 5.]*

PROVISIONAL

Course Code: 8223660	Marks: 50	Credits:2	Class Hours: 42
Course Title: Statistics Practical-II			Exam Duration: 5 hours

Course Description

This practical-oriented course is designed to provide hands-on experience in advanced statistical methods, including design of experiments, sampling techniques, and hypothesis testing. Students will learn to analyze basic and factorial designs, handle missing plot estimation, and compute measures of relative efficiency. The course covers various sampling methods such as Simple Random Sampling (SRS), Stratified, Cluster, and Systematic sampling, along with estimation of population parameters. Additionally, students will gain proficiency in conducting common tests of significance for means, variances, proportions, correlation, and regression coefficients, fitting theoretical distributions, testing goodness-of-fit, and constructing confidence intervals. The course emphasizes practical problem-solving, data analysis using statistical software, report writing, and teamwork through a mini-project, preparing students for careers in research, data management, and academia.

Course Learning Outcomes (CLOs)

CLO #	Course Learning Outcomes	Bloom's Level
CLO-1	**Remember** the fundamental concepts and formulas related to design of experiments (basic and factorial designs), missing plot estimation, and relative efficiency.	Level 1: Remembering
CLO-2	**Understand** and explain the principles and assumptions underlying various sampling techniques (SRS, Stratified, Cluster, Systematic) and hypothesis testing procedures.	Level 2: Understand
CLO-3	**Apply** appropriate statistical methods to analyze basic and factorial designs, estimate missing plot values, compute relative efficiency, draw various types of samples, and estimate population parameters with standard errors.	Level 3: Apply
CLO-4	**Analyze** and interpret statistical outputs from hypothesis tests (means, variances, proportions, correlation, regression), goodness-of-fit tests, and tests of homogeneity to draw valid conclusions.	Level 4: Analyze
CLO-5	**Evaluate** the appropriateness of different statistical techniques for given research problems and justify the selection of specific sampling designs or hypothesis tests based on data characteristics.	Level 5: Evaluate
CLO-6	**Create** comprehensive statistical reports and deliver effective presentations based on practical projects, demonstrating the ability to synthesize statistical findings and communicate them clearly to diverse audiences.	Level 6: Create

PROVISIONAL

Mapping Of CLOs with PLOs

This table demonstrates how each CLO contributes to achieving the broader Program Learning Outcomes.

Indication: ✓ = Mapped / Aligned

CLOs / PLOs	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-9	PLO-10	PLO-11	PLO-12
CLO-1	✓		✓	✓						✓		
CLO-2	✓		✓	✓						✓		
CLO-3	✓			✓						✓		
CLO-4	✓	✓		✓						✓		
CLO-5	✓	✓		✓						✓		
CLO-6	✓		✓	✓					✓	✓		

Course Content

Module & Class Hours	**Contents**	Teaching-Learning Approach	**Module Assessmen**	**CLOs Mapped**
Module 1: Design of Experiments *(8 Hours)*	Introduction to basic experimental designs: CRD, RCBD, and LSD. - Analysis of variance (ANOVA) for CRD, RCBD, and LSD. - Missing plot estimation techniques for RCBD and LSD. - Measures of relative efficiency of designs. - Introduction to factorial designs (2^2 and 2^3). - Analysis of factorial designs: main effects and interactions.	- Lectures: Conceptual explanation and derivation of formulas. - Demonstrations: Step-by-step problem-solving on board. - Practical Sessions: Hands-on lab work using manual calculations.	- Practical Assignments: - Viva Voce:, - Quiz:	CLO 1, CLO 2, CLO 3

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessmen	CLOs Mapped
Module 2: Sampling Techniques *(10 Hours)*	- Simple Random Sampling (SRS) with and without replacement. - Estimation of population mean, total, and proportion with standard errors in SRS. - Stratified Random Sampling: proportional and Neyman allocation. - Estimation of population mean and variance from stratified samples. - Cluster Sampling: introduction and estimation procedures. - Systematic Sampling: introduction and estimation procedures. - Determination and interpretation of Relative Efficiency of different sampling designs. - Practical exercises comparing sampling methods using simulated data.	- Lectures: Conceptual framework and formulas for each sampling method. - Demonstrations: Selecting samples using random number tables and software. - Practical Sessions: Simulating different sampling designs and comparing estimates. - Case Studies: Real-world applications.	- Practical Report, - Problem-Solving Exercises: - Group Activity:	CLO 1, CLO 2, CLO 3, CLO 5

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Module & Class Hours	Contents	Teaching-Learning Approach	Module Assessmen	CLOs Mapped
Module 3: Hypothesis Testing and Confidence Intervals *(8 Hours)*	- Tests of significance for a single mean (z-test, t-test). - Tests for difference of two means (independent and paired samples). - Tests for variance (Chi-square test). - Tests for proportion (z-test). - Tests for correlation coefficient (t-test). - Tests for regression coefficient (t-test). - Construction of confidence intervals for means, proportions, and variances. - Fitting of theoretical distributions (Binomial, Poisson, Normal). - Testing goodness-of-fit using Chi-square test. - Large sample tests (z-tests). - Tests of homogeneity (Chi-square test for contingency tables). - Practical exercises using real-world datasets.	- Lectures: Step-by-step guide to hypothesis testing procedures and assumptions. - Practical Sessions: Performing tests on real-world datasets using software and manual calculations. - Case Studies: Applying tests to problems in public health, business, and social sciences. - Peer Teaching: Students explain concepts to each other.	- Practical Assignments, - Quiz: - Viva Voce:, - Problem-Solving:	CLO 2, CLO 3, CLO 4, CLO 5
Module 4: Project Work and Communication Skills *(4 Hours)*	- Identification of a real-world research problem. - Data collection and management. - Application of appropriate statistical techniques (designs, sampling, hypothesis tests). - Analysis using statistical software. - Interpretation of results and drawing logical conclusions. - Report writing: structure, content, and formatting. - Presentation of findings using tables, graphs, and oral communication. - Peer review and feedback.	- Project-Based Learning: Students work in teams on a mini-project.	- Mini-Project Report: , - Oral Presentation - Peer Evaluation: , - Project Viva	CLO 1, CLO 2, CLO 3, CLO 4, CLO 5, CLO 6

PROVISIONAL

List of Books

Montgomery, D. C. (2017). *Design and Analysis of Experiments* (9th ed.). Wiley.

(Comprehensive coverage of CRD, RCBD, LSD, factorial designs, and missing plot estimation.)

Cochran, W. G. (2015). *Sampling Techniques* (3rd ed.). Wiley-India.
(Classic and authoritative text covering SRS, stratified, cluster, and systematic sampling.)

Casella, G., & Berger, R. L. (2024). *Statistical Inference* (3rd ed.). Cengage Learning.
(Rigorous coverage of theoretical distributions, hypothesis testing, and confidence intervals.)

Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2021). *Probability & Statistics for Engineers & Scientists* (9th ed.). Pearson.

(Excellent for practical applications of tests of significance, regression, and goodness-of-fit.)

Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed.). SAGE Publications.

(Focuses on practical application and interpretation using software, suitable for lab sessions.)

Devore, J. L., & Berk, K. N. (2021). *Modern Mathematical Statistics with Applications* (3rd ed.). Springer.
(Bridges theory and application with modern examples and datasets.

PROVISIONAL

Guideline for Viva-Voce

Course Code: 8222760	**Marks:** 50	**Credits:** 2
Course Title: Viva-voce (Physics)		

Course Description

The Viva Voce is designed to comprehensively assess students' conceptual understanding, analytical ability, communication skills, ethical reasoning, professional values, and practical competence acquired throughout the second year of the Bachelor of Science (Honors) program in Physics. The examination covers all major courses of the second year along with contemporary national and global issues related to physical science, including energy, technology, social protection, mental health, digital transformation, artificial intelligence, sustainable development goals (SDGs), and evidence-based STEM education practice. The viva also evaluates students' critical thinking, problem-solving ability, leadership potential, and professional readiness.

Course Objectives

- Assess the depth of students' understanding of second-year courses on Physics.
- Evaluate students' analytical and critical thinking abilities regarding social issues.
- Measure professional communication and presentation skills.
- Assess students' ethical reasoning and professional values.
- Examine the application of theories Physics, methods, and intervention strategies.
- Evaluate students' awareness of development of science and technology related issues.
- Prepare students for higher education, professional practice, and lifelong learning.

Course Learning Outcomes (CLOs)

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

CLO1: Demonstrate the level of knowledge of concepts, theories, principles and professional terminology.

CLO2: Analyze social problems and explain them using social work theories.

CLO3: Analyze cases using appropriate intervention strategies and professional judgment.

CLO4: Apply social work knowledge to contemporary national and global issues.

CLO5: Demonstrate ethical reasoning, communication, leadership and reflective practice.

CLO6: Design innovative and sustainable social work interventions for emerging social issues.

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CLO to PLO Mapping Matrix

CLO/ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	✓✓	✓		✓							✓	✓
CLO2	✓✓	✓✓		✓✓	✓	✓			✓	✓		✓
CLO3	✓	✓✓	✓	✓✓	✓	✓✓	✓		✓	✓	✓	✓✓
CLO4	✓	✓✓	✓	✓✓	✓	✓	✓	✓✓	✓✓	✓✓	✓	✓
CLO5		✓✓	✓	✓	✓	✓✓	✓		✓	✓✓	✓✓	✓✓
CLO6	✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓	✓✓

✓✓ = Strong Relation	✓ = Moderate Relation	Blank = Limited or No Relation

Teaching System

The course is conducted through an interactive and student-centered approach. Teaching and learning activities include orientation sessions, revision of core topics of Physics, guided discussions, question-answer sessions, mock viva examinations, individual consultations, self-directed learning, and review of important concepts from previous courses.

Students are encouraged to develop effective communication skills, critical thinking ability, analytical skills, and confidence for successful performance in the viva-voce examination.

Assessment Strategy

Students will be assessed through a comprehensive viva-voce examination conducted by the designated Examination Committee after completion of written examinations.

The assessment will evaluate students' understanding of Physics, ability to explain and apply Physics knowledge, analytical and critical thinking skills, oral communication ability, professional attitude, confidence, and responsiveness to questions. The final grade will be awarded based on the overall performance demonstrated during the viva-voce examination.

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