Holy Cross College (Autonomous), Nagercoil
Kanyakumari District, Tamil Nadu.
Accredited with A^{++} by NAAC - V Cycle (CGPA 3.53)

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli

DEPARTMENT OF PHYSICS

Teaching Plan (UG)

Odd Semester

2025-2026

Vision

Envisions training students for quality Physics education and holistic development empowered to meet challenges and embark on luxuriant careers.

Mission

- To produce competent graduates infused with professionalism, ethical values and social responsibility.
- To prepare students to accentuate learning for life.
- To foster a research environment, to keep up with global development in Science.
- To evolve strategies for the growth of the department towards excellence.

Graduate Attributes

Graduates of our College develop the following attributes during the course of their studies.

- **Creative thinking:**

Equipping students with hands-on-training through skill-based courses and promote startup.

- **Personality development:**

Coping with increasing pace and change of modern life through value education, awareness on human rights, gender issues and giving counselling for the needful.

- **Environmental consciousness and social understanding:**

Reflecting upon green initiatives and understanding the responsibility to contribute to the society; promoting social and cultural diversity through student training and service-learning programmes.

- **Communicative competence:**

Offering effective communication skills in both professional and social contexts through bridge courses and activities of clubs and committees.

- **Aesthetic skills:**

Engaging mind, body and emotions for transformation through fine arts, meditation and exercise; enriching skills through certificate courses offered by Holy Cross Academy.

- **Research and knowledge enrichment:**

Getting in-depth knowledge in the specific area of study through relevant core papers; ability to create new understanding through the process of critical analysis and problem solving.

- **Professional ethics:**

Valuing honesty, fairness, respect, compassion and professional ethics among students. The students of social work adhere to the *National Association of Social Workers Code of Ethics*

- **Student engagement in the learning process:**

Obtaining extensive and varied opportunities to utilize and build upon the theoretical and empirical knowledge gained through workshops, seminars, conferences, industrial visits and summer internship programmes.

- **Employability:**

Enhancing students in their professional life through Entrepreneur development, Placement & Career guidance Cell.

- **Women empowerment and leadership:**

Developing the capacity of self-management, team work, leadership and decision making through gender sensitization programmes.

Programme Educational Objectives (PEOs)

PEOs	Upon completion of B.A/B.Sc. degree programme, the graduates will be able to	Mission addressed
PEO1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	**M1 & M2**
PEO2	inculcate practical knowledge for developing professional empowerment and entrepreneurship and societal services.	**M2, M3, M4 & M5**
PEO3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	**M3, M4, M5 & M6**

Programme Outcomes (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	**PEO1**
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	**PEO2**
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	**PEO2**
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	**PEO1 & PEO3**
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	**PEO2 & PEO3**
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	**PEO2 & PEO3**
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to improve knowledge and skills.	**PEO1 & PEO3**

Programme Specific Outcome (PSOs)

PSOs	Upon completion of B.Sc. Physics Degree Programme, the graduates of Physics will be able to:	Mapping with POs
PSO1	understand the core theories and principles of physics which include mechanics, thermodynamics, electronics, material science etc.	**PO1**
PSO2	develop extensive comprehension of fundamental and diverse applications of Physics.	**PO2 & PO3**
PSO3	apply knowledge of principles, concepts in Physics and analyze their local, national and global impact. Apply the critical reasoning and computing skills to analyze and solve problems in physics.	**PO4 & PO5**
PSO4	analyze the observed experimental data and relate the results with theoretical expectations. Communicate appropriately and effectively, in a scientific context using present technology.	**PO6**
PSO5	develop entrepreneurial skills, empowered according to the professional requirement and become self-dependent. Understand the professional, ethical, legal, security, social issues and responsibilities.	**PO5 & PO7**

Department : Physics
Class : I B.Sc. Physics
Title of the Course : Core Course –I: PROPERTIES OF MATTER AND ACOUSTICS
Semester :I
Course Code :PU231CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU231CC1	5	-	-	-	5	5	75	25	75	100

Objectives

1. To study the properties of matter leads to information which is of practical value to the physicists.
2. To provide information about the internal forces which act between the constituent parts of the substance.

Course outcomes

On the successful completion of the course, students will be able to:		
1	relate elastic behavior in terms of three modulii of elasticity and working of torsion pendulum.	**K1 & K2**
2	appreciate concept of bending of beams and analyze the expression, quantify and understand nature of materials.	**K2 & K3**
3	explain the surface tension and viscosity of fluid and support the interesting phenomena associated with liquid surface, soap films provide an analogue solution to many engineering problems.	**K2 & K3**
4	analyze simple harmonic motions mathematically and apply them. understand the concept of resonance and use it to evaluate the frequency of vibration. Set up experiment to evaluate frequency of ac mains	**K1 & K3**
5	understand the concept of acoustics, importance of constructing buildings with good acoustics. Also, to apply their knowledge of ultrasonics in real life, especially in medical field and assimilate different methods of production of ultrasonic waves.	**K2 & K3**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching Plan
Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation
I	**ELASTICITY**								
	1.	Hooke's law – stress-strain diagram – elastic constants	3	2	K1 (R)	Visual and Derivation-Based Teaching using real-life examples	Think-Pair-Share, Group Activity	YouTube – lectures on stress strain diagram	MCQ quiz, Group Presentation, CIA 1
	2.	Poisson's ratio – relation between elastic constants and Poisson's ratio	3		K2 (U)	Conceptual and Formula-Derivation-Based Pedagogy using Stress-Strain Diagrams and Elasticity Model	Hands-On Demonstration with rubber bands or elastic wires	NPTEL: Strength of Materials – Elastic Constants Module	Oral Questions on elastic constants, CIA 1
	3.	Work done in stretching and twisting a wire – twisting couple on a cylinder	3		K2 (U)	Experimental and Analytical Pedagogy using Derivation and Real-World Examples (e.g., torsion in rods and shafts)	Hands-On Demonstration using wires or rods, Concept Mapping of torque and angular deformation	YouTubeVideo: "Torsion of Circular Shafts Explained"	Derivation-based quiz on torsional rigidity and work done, CIA 1
	4.	Rigidity modulus by static torsion– torsional pendulum (with and without masses)	3	1	K2 (U)	Experimental and Derivation-Based Teaching with Emphasis on Measurement and Material Properties	Lab Demonstration of Static Torsion & Torsional Pendulum, Group Data Collection & Analysis	Virtual Labs (IIT)	Numerical problems on rigidity modulus calculation, Lab report submission, CIA 1
II	**BENDING OF BEAMS**								
	1.	Cantilever– expression for Bending moment – expression for	3	2	K3 (Ap)	Analytical and Application-Based Pedagogy using Beam Theory and	Guided Derivation in Pairs, Real-World Demonstration (mini-	Virtual Labs (IIT)	Derivation-based quiz (bending moment and depression), CIA 1

		depression at the loaded end of the cantilever				Real-Life Examples (e.g., diving boards, shelves)	cantilever setup)		
	2.	Oscillations of a cantilever – expression for time period – experiment to find Young's modulus	5		K3 (Ap)	Derivation and Experiment-Centric Pedagogy, Focused on Elastic Properties and Vibrational Mechanics	Hands-On Lab Activity using a cantilever setup, Collaborative Derivation of Time Period Expression	Virtual Labs (IIT)	Numerical Problems on Time Period and Young's Modulus Calculation, CIA 1
	3.	Non-uniform bending– experiment to determine Young's modulus by Koenig's method – uniform bending	3	1	K3 (Ap)	Experimental and Conceptual Pedagogy with Emphasis on Beam Bending and Material Elasticity	Lab Demonstration of Bending Methods, Peer Teaching on Difference Between Uniform and Non-Uniform Bending	YouTube Videos, Virtual Labs (IIT)	Numerical Problems on Young's Modulus from Depression Formula, CIA 1I
	4.	Expression for elevation – experiment to determine Young's modulus using microscope	1		K3 (Ap)	Conceptual and Measurement-Based Pedagogy with Emphasis on Beam Elevation and Precise Observation Techniques	Hands-On Experiment using a traveling microscope, Group Calculation of Elevation and Young's Modulus	ouTube: "Young's Modulus Using Microscope", Virtual Labs (IIT)	Numerical Problems on Young's Modulus from Depression Formula, CIA II
III	**FLUID DYNAMICS**								
	1.	Surface tension: definition – molecular forces– excess pressure over curved surface – application to spherical and cylindrical drops and bubbles	4	2	K3 (Ap)	Conceptual and Analytical Pedagogy using Real-Life Analogies (e.g., water droplets, bubbles) and Derivation-Based Teaching	Think-Pair-Share on cohesive vs adhesive forces, Hands-On Demo using soap films and droplets	YouTubeVideo: "Surface Tension and Bubbles"	Derivation-based quiz on excess pressure for drops/bubbles , CIA II
	2.	Determination of surface tension by Jaegar's method– variation of surface	3		K3 (Ap)	Experimental and Conceptual Pedagogy focused on	Collaborative Data Collection and Graphing (Surface	Virtual Lab Simulations	Numerical problems on capillary rise and surface tension

		tension with temperature				capillary action and temperature effects on molecular cohesion	Tension vs Temperature), Peer Discussion		variation, CIA II
	3.	Viscosity:definition – streamline and turbulent flow – rate of flow of liquid in a capillary tube	3		K2 (U)	Conceptual and Application-Based Pedagogy using Real-World Examples (e.g., blood flow, oil through pipes), and Derivation of Poiseuille's Law	Think-Pair-Share on types of flow, Group Activity on flow visualization	Virtual Labs – Capillary Flow	Conceptual MCQ on flow types, CIA II
	4.	Poiseuille's formula – corrections – terminal velocity and Stoke's formula– variation of viscosity with temperature	2	1	K3 (Ap)	Analytical and Conceptual Pedagogy using Fluid Flow Theory, Experimental Corrections, and Real-World Applications (e.g., sedimentation, lubricants)	Guided Derivation of flow rate formula (Poiseuille's law)	Guided Derivation of Poiseuille's and Stoke'sFormula,Graphing Activity: Viscosity vs Temperature	Conceptual MCQ, CIA 1I
IV	**WAVES AND OSCILLATIONS**								
	1.	Simple Harmonic Motion (SHM) – differential equation of SHM – graphical representation of SHM- composition of two SHM in a straight line and at right angles	3	2	K2 (U)	Conceptual and Visual Pedagogy with Derivation Support and Real-Life Analogies	Interactive Demonstrations , Diagram-based Concept Mapping of Wave Relations	NPTEL: Fluid Mechanics Modules	Derivation-based questions on pressure difference, Numerical problems on drops and bubbles, CIA 1
	2.	Lissajous's figures-free, damped, forced vibrations – resonance and Sharpness of resonance.	3		K2 (U)	Visualization and Simulation-Based Pedagogy for Vibrational Motion and Frequency	Simulation-Based Exploration of Lissajous Figures, Inquiry-Based Learning on Resonance	PhET Simulations: "Wave Interference" & "Forced Damped Harmonic Oscillator"	Graph-based Quiz on Lissajous Figures, Numerical Problems on Damping and Resonance,

						Response Concepts			CIA I
	3.	Laws of transverse vibration in strings – sonometer – determination of AC frequency using sonometer	3	1	K3 (Ap)	Experimental and Conceptual Pedagogy using String Vibration Theory and Sound Wave Applications	Hands-On Experiment Using Sonometer, Think-Pair-Share on Factors Affecting Frequency, Peer Demonstration on AC Frequency Determination	Virtual Labs – Sonometer Simulation	Lab Report on Frequency Determination, CIA I
	4.	Determination of frequency usingMelde's string apparatus	3		K3 (Ap)	Experimental and Application-Based Pedagogy with Focus on Vibrational Modes and Standing Waves in Strings	Hands-On Lab Activity using Melde's Apparatus, Think-Pair-Share to classify transverse vs longitudinal modes	Virtual Labs – Mechanical Waves	Lab Report with calculation of frequency and tension, Viva on experimental setup and observations, CIA I
V	**ACOUSTICS OF BUILDINGS AND ULTRASONICS:**								
	1.	Intensity of sound – decibel – loudness of sound – reverberation – Sabine's reverberation formula	3	2	K2 (U)	Application-Based and Conceptual Pedagogy using Real-World Examples (auditoriums, speakers), Formula Derivation for Acoustic Design	Group Activity: Measuring sound levels using mobile apps, Guided Derivation of Sabine's Formula	Virtual Labs – Simulation	Numerical problems on sound level in dB, CIA II
	2.	acoustic intensity – factors affecting the acoustics of buildings	3		K3 (Ap)	Application-Oriented Pedagogy with Conceptual and Case Study-Based Learning (theaters, classrooms, auditoriums)	Case Study Analysis of real buildings with good/poor acoustics	Virtual Labs – Sound Propagation Simulations	Short report on acoustic treatment, MCQ quiz on acoustic defects,
	3.	Ultrasonic waves: production of ultrasonic waves,	4	1	K2 (U)	Conceptual and Experimental	Video Analysis of piezoelectric	YouTubeVideo: "Piezoelectric Effect and	Diagram labeling and explanation of

		Piezoelectric crystal method				Pedagogy using Visual Aids and Real-Life Applications (e.g., SONAR, medical imaging)	setup	Ultrasonic Wave Generation"	piezoelectric generaton, CIA II
	4.	Magnetostriction effect, application of ultrasonic waves	2		K3 (Ap)	Conceptual and Application-Based Pedagogy using Comparative Explanation (Magnetostriction vs Piezoelectric), Real-World Use Cases	Group Discussion on ultrasonic applications (SONAR, NDT, medical imaging)	Virtual Lab Simulations	Oral presentation on any one real-life use of ultrasonics, CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability**
Activities (Em/ En/SD): **Model Making**
Course Focussing onCross Cutting Issues(Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -
Activities related to Cross Cutting Issues:-
Assignment: (Mention Topic and Type): **Application of ultrasonics – LMS**

Sample questions

Part A (1 mark)

Answer all the questions

1. The ratio of volume stress to the volume strain is known as _____ **(K2-U, CO 1)**

   a) Volume stain b) Young's modulus c) Bulk modulus d) none of the above

2. The ratio of change in any dimension to its original value is called _____**(K1-R, CO 2)**

   a) stress b) stain c) poisson's ratio d) Rigidity modulus

3. The unit of co-efficient of viscosity is _____ **(K1-R, CO 3)**

   a)Nm b) N/sec c) Nm^2 d) Nsm^{-2}

4. The simple pendulum vibrates with a time period T given by _____ **(K3-Ap, CO 4)**

   a) $T = 2\pi\sqrt{\frac{l}{g}}$ (b) $T = 2\pi\sqrt{\frac{k}{g}}$ (c) $T = \sqrt{\frac{g}{l}}$ (d) $T = \pi\sqrt{\frac{l}{2g}}$

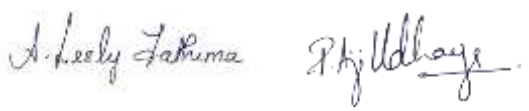
4. The persistence of sound in an enclosure due to multiple reflections of sound at the walls after the source has ceased to emit sound is known as _____. **(K1-R, CO 5)**

Part B (6 marks)

1. Define beam. Derive the expression for bending moment. **(K2-U, CO 1)**
2. Derive an expression for time period of cantilever oscillations. **(K2- U, CO 2)**
3. Explain streamline flow and turbulent flow.**(K1-R, CO 3)**
4. Obtain the differential equation of S.H.M. **(K2-U, CO 4)**
5. Explain the production of ultrasonic waves using piezoelectric crystal method.**(K2-U, CO 5)**

Part C (12 marks)

1. Explain in detail different moduli of elasticity and Possion's ratio. **(K2-U, CO1)**
2. Explain the experimental method to determine the Youngs modulus of the beam using non uniform set up. **(K2-U, CO 2)**
3. Describe Jaegar's method of determining surface tension of liquids. **(K2-U, CO 3)**
4. Explain the transverse and longitudinal modes of the Melde's string and hence determine the frequency of the fork. **(K3-Ap, CO 4)**
5. Discuss the factors affecting the architectural acoustics and their remedies.**(K3-Ap, CO 5)**



Dr. V. Shally
Head of the Department

Dr. A. Lesly Fathima & Dr. P.Aji Udhaya
Course Instructors

Teaching Plan

Department : Physics
Class : I B.Sc. Physics
Title of the Course : CORE LAB COURSE I: GENERAL PHYSICS LAB I
Semester : I
Course Code : PU231CP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU231CP1	-	-	3	-	3	3	45	25	75	100

Learning Objectives:

1. To understand the role of different components in generating pulses and stable signals.
2. To observe the frequency generation and stability of the oscillator circuits.

Course Outcomes

On the successful completion of the course, students will able to:		
1.	understand the strength of material using Young's modulus.	**K2**
2.	acquire knowledge of thermal behaviour of the materials.	**K1**
3.	analyze the physical principle involved in the various instruments	**K4**
4.	understand the scientific method and an ability to apply the scientific method in practice.	**K2**

K**1**–Remember**; K2**–Understand**; K4-**Analyze

Total Contact hours: 45 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Young's modulus – Uniform bending	7	1	K1& K2	Experiential Learning	Hands-on experiment, peer	YouTube lab demos, virtual lab	Observation record, viva, result

						observation		calculation
2	Young's modulus – Non - Uniform bending	7	1	K1& K2	Inquiry-Based Learning	Formulating hypotheses, exploring outcomes	NPTEL lab videos	Lab report, error analysis, oral quiz
3	Coefficient of viscosity - Variable pressure head	7	1	K1& K2	Problem-Based Learning	Solving based on changing parameters, peer discussion	YouTube lab demos	Viva, graphical analysis, performance rubric
4	Coefficient of viscosity - Stokes method	6	1	K1& K2	Project-Based Learning	Team setup of apparatus, recording trials	Virtual experiment videos	Lab report, collaborative worksheet, viva voce
5	Surface tension and interfacial surface tension - drop weight method	6		K1& K2	Active Learning	Live demonstration + pause-and-predict questions	Interactive animations	Short quiz, precision in result, lab notes
6	Rigidity modulus - torsion pendulum	7	1	K2& K4	Blended Learning	Hybrid: pre-lab video + physical lab, peer timing validation	Pre-lab NPTEL video	Performance evaluation, lab record, post-lab quiz

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): NIL

Environment Sustainability activities related to Cross Cutting Issues: NIL

Sample questions

1. Using Pin and Microscope, determine the Young's modulus of the material of the given bar by uniform bending.
2. Determine the Young's modulus of the given bar by non-uniform bending. Scale and telescope are given.
3. Determine the Coefficient of viscosity of the given liquid by Variable pressure head using a graduated burette.
4. Determine the Coefficient of viscosity of the given highly viscous liquid by Stokes method.
5. Determine the surface tension and interfacial surface tension of the given liquid by the drop weight method.
6. Determine the rigidity modulus of the given wire and moment of inertia of the disc using torsion pendulum.

V. Shally

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Course Instructors
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Department : Physics
Class : I B.Sc. Mathematics
Title of the Course : Elective Course I: Allied Physics for Mathematics-I
Semester : I
CourseCode : PU231EC1

Course Code	L	T	P	Credits	Inst. Hours	Total Hours	Marks		
							CIA	External	Total
PU231EC1	4	-	-	3	4	60	25	75	100

Objectives

1. To impart basic principles of Physics
2. To incorporate concepts of Physics in day- to-day life

Course outcomes

Upon completion of this course, the students will be able to:		Cognitive level
1	acquire knowledge on elementary ideas of waves, properties of matter, electricity and magnetism, electronics	**K1**
2	analyze the concepts of ultrasonics, surface tension and study their applications in the medical field.	**K2**
3	interpret the real-life solution using concepts of electricity, magnetism, and electronics in Digital India.	**K3**
4	apply their depth knowledge of Physics in day today life.	**K4**
5	develop their knowledge to carry out the practical by applying these concepts of Physics	**K3**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact Hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive Level	Pedagogy	Student-Centric Method	E-resources	Assessment/ Evaluation Methods
I	**Waves, Oscillations and Ultrasonics**								
	1	Simple harmonic motion (SHM) – composition of two SHMs at right angles (periods in the ratio 1:1) – Lissajous figures –uses	2	1	K1(R)	Experiential Learning, inquiry based learning, flipped classroom	Brainstorming, Discussion of experiences, group activities	Video Lectures, Interactive notes	Conceptual Quiz, Formative worksheet, Peer discussion, CIA-I
	2	Laws of transverse vibrations of strings – determination of AC frequency using sonometer	1		K2 (U)	Experiential learning, problem-based learning, active learning	Formulating questions, solving challenges and puzzles	Desmos, Interactive PPT, Youtube videos	Problem-Solving Assignments, Open Book Exam, short oral test, CIA-I
	3	ultrasound – production - piezoelectric method	2	1	K3 (Ap)	Lecturing, flipped classroom	Think-pair-share, group activities	Physics libre texts, youtube visual models	Matching exercises, diagram based MCQs, CIA-II
	4	application of ultrasonics: medical field – lithotripsy	1		K4(An)	Reflective pedagogical approach, peer teaching	Group discussion and activities, debates	Lab Videos, Libre texts, Interactive PPT	Oral quiz, activity worksheet, conceptual MCQ, CIA-II
	5	ultrasonography– ultrasonoimaging -	1	1	K2(U)	Reflective pedagogical approach, peer	Learning circles, cooperative activities	Khan academy youtube channel,	Conceptual questions, peer assessed quiz,

		ultrasonics in dentistry – physiotherapy				teaching, Lecturing	involving pairs and small groups	physics galaxy	CIA-II
	6	opthalmology – advantages of noninvasive surgery – ultrasonics in green chemistry	2		K3(Ap)	Application-Oriented Learning, Analytical Learning	Assign pre-class video viewing and in-class problem-solving	Youtube lecture videos, Interactive PPT	Oral quiz, activity worksheet, conceptual MCQ, CIA-II
II	**Properties of Matter**								
	1	Elasticity: elastic constants – bending of beam – theory of non- uniform bending	1	1	K2(U)	Concept Mapping, experiential learning, reflective approach	Think-Pair-Share, working through problems	YouTube lecture videos, physics galaxy channel, libre text	Assignment, conceptual MCQs, table analysis task, CIA-I
	2	determination of Young's modulus by non-uniform bending – energy stored in a stretched wire	2		K2 (U)	Inquiry based learning, peer teaching	Lab Analysis	Video Lecture	rmative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	3	torsion of a wire – determination of rigidity modulus by torsional pendulum	1	1	K3(Ap)	Active learning, Flipped classroom	Brainstorming, Group discussions	Video Lectures, Simulations, web tools	Formative Quiz using Google Forms, CIA I
	4	Viscosity: streamline and turbulent motion – critical velocity – coefficient of viscosity	1		K3(Ap)	Lecture with Visual Aids such as PPT,Conceptual Demonstration, Flipped Classroom.	Think-Pair-Share, Concept Mapping	Youtube lecture videos, Interactive PPT	Assignment, conceptual MCQs, short test, CIA-I

	5	Poiseuille's formula – comparison of viscosities – burette method, Surface tension: definition – molecular theory	2	1	K3(Ap)	Active learning, Flipped classroom, concept based discussions	Peer teaching , Quiz, Explaining concepts and derivations	Interactive Notes, Online Tutorials and Notes: Hyper Physics	Problem-Solving Assignments, Open Book Exam Questions, CIA I
	6	droplets formation– shape, size and lifetime – COVID transmission through droplets, saliva – drop weight method – interfacial surface tension	2		K2 (U)	Inquiry-Based learning, blended learning	Think-Pair-Share, hands on experiments	YouTube video lectures	Conceptual MCQ, Peer discussions and concept maps, CIA-I
III	**Heat and Thermodynamics**								
	1	Joule-Kelvin effect – Joule-Thomson porous plug experiment – theory	2	1	K2 (U)	Conceptual Demonstration, Flipped Classroom	Peer Teaching, Gamified Quiz, Concept Mapping.	NPTEL Lectures, Khan Academy Physics – Conceptual videos	Poster/chart Presentation,Short-answer conceptual questions, CIA I
	2	temperature of inversion – liquefaction of Oxygen– Linde's process of liquefaction of air	2		K1(R)	Core Conceptual Approach, Application-Based Teaching	Debate, answering questions from peers	Hyper Physics, Visual and animated tutorials	Quick quizzes - Concept check MCQs, CIA-II
	3	liquid Oxygen for medical purpose-importance of	1	1	K1(R)	Inquiry-Based Learning, Visual/Grap	Animation-based learning, Think-pair-	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-II

		cryocoolers				hical Pedagogy	share		
	4	thermodynamic system – thermodynamic equilibrium	1		K3(Ap)	Diagram-Based, reflective pedagogical approach	Group Presentation, peer feedback on reflective practices	Thermo Simulators, Youtube video lectures	Problem-Solving Assignments, Open Book Exam Questions, CIA II
	5	laws of thermodynamics – heat engine – Carnot's cycle – efficiency	1	1	K2(U)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-II
	6	entropy – change of entropy in reversible and irreversible process.	2		K3(Ap)	Conceptual Demonstration, Flipped Classroom	Peer Teaching, Gamified Quiz, Concept Mapping.	NPTEL Lectures, Khan Academy Physics – Conceptual videos	Poster/chart Presentation,Short-answer conceptual questions, CIA II
IV	**Electricity and Magnetism**								
	1	Potentiometer – principle – measurement of thermo emf using potentiometer	2	1	K3(Ap)	Conceptual Demonstration, Flipped Classroom	Peer Teaching, GamifiedQuiz, Concept Mapping.	NPTEL Lectures, Khan Academy Physics – Conceptual videos	Poster/chart Presentation,Short-answer conceptual questions, CIA II
	2	magnetic field due to a current carrying conductor – Biot-Savart's law – field along the axis of the coil carrying	2		K2 (U)	Core Conceptual Approach, Application-Based Teaching	Debate, answering questions from peers	Hyper Physics, Visual and animated tutorials	Quick quizzes - Concept check MCQs CIA-II

		current							
	3	peak, average and RMS values of ac current and voltage	1	1	K3(Ap)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-II
	4	power factor and current values in an AC circuit- types of switches in household and factories	2		K3(Ap)	Diagram-Based, reflective pedagogical approach	Group Presentation, peer feedback on reflective practices	Thermo Simulators, Youtube video lectures	Problem-Solving Assignments, Open Book Exam Questions, CIA II
	5	Smart wifi switches- fuses and circuit breakers in houses	2	1	K3(Ap)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-II
V	**Digital Electronics and Digital India**								
	1	logic gates, OR, AND, NOT	2	1	K2 (U)	Experiential Learning, inquiry based learning, flipped classroom	Brainstorming, Discussion of experiences, group activities	Video Lectures, Interactive notes	Conceptual Quiz, Formative worksheet, Peer discussion, CIA-I

	2	NAND, NOR , EXOR logic gates- universal building blocks	2		K3 (Ap)	Experiential learning, problem-based learning, active learning	Formulating questions, solving challenges and puzzles	Desmos, Interactive PPT, Youtube videos	Problem-Solving Assignments, Open Book Exam, short oral test, CIA-I
	3	Boolean Algebra, De Morgan theorem-verification	2	1	K3 (Ap)	Lecturing, flipped classroom	Think-pair-share, group activities	Physics libre texts, youtube visual models	Matching exercises, diagram based MCQs, CIA-I
	4	overview of Government initiatives: software technological parks under MeitY, NIELIT-	2		K3(Ap)	Reflective pedagogical approach, peer teaching	Group discussion and activities, debates	Lab Videos, Libre texts, Interactive PPT	Oral quiz, activity worksheet, conceptual MCQ, CIA-I

	5	semiconductor laboratories under Dept. of Space – an introduction to Digital India	1	1	K3(Ap)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	HyperPhysics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-I

Course Focusing on Employability/Entrepreneurship/Skill Development: **Skill Development**

Activities (Em/En/SD):**Model making on simple harmonic motion**

Course Focusing on Cross Cutting Issues (Professional Ethics/Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues:-

Assignment: **Overview of government initiatives in digital electronics**

Seminar Topic: -

Sample questions

Part - A

1. The figures used for the accurate determination of the frequency of a tuning fork are _____. **(K1-R,CO-1)**
2. Within elastic limit, the stress is directly proportional to strain. State True / False. **(K4-An,CO-4)**
3. The device used for measuring potential differences is**(K2-U,CO-2)**
   a) Meter Bridge b) Potentiometer c) Carey Foster Bridge.
4. The maximum value of alternating current in any direction is called its _____ value. **(K3-Ap,CO-3)**
   a) Peak b) Mean c)Maximum d)RMS
5. When NOT gate follows an AND gate, the combination is called as _____ **(K3-Ap,CO-3)**
   a) NAND b)AND c)EX-OR d)NOR

Part –B (6 marks)

1. Interpret the production of ultrasonic waves using piezoelectric crystal method. **(K4- An , CO-4)**
2. Derive the expression for the bending moment.**(K3-Ap,CO-3)**
3. Explain the change of entropy in reversible and irreversible process.**(K2-U,CO-2)**
4. Determine the thermo emf of a cell using potentiometer. **(K2-R,CO-2)**
5. Show that the NAND gate is an universal building block.**(K3-Ap,CO-3)**

Part –C (12 marks)

1. Describe the applications of ultrasonic waves.**(K2-U,CO-2)**
2. Determine the Rigidity modulus by Torsion pendulum by Dynamic torsion method. **(K4-An,CO-4)**
3. Obtain the efficiency of Carnot's cycle with suitable phase diagram. **(K2-U,CO-2)**
4. Define Biot-Savart's law and obtain an expression for field along the axis of the coil carrying current. **(K3-Ap, CO-3)**
5. State and Verify the DeMorgan's theorem. **(K3-Ap,CO-5)**

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Head of the Department

S Virgin Jeba S. Sebastiammal

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Course Instructors

Teaching Plan

Department : Physics
Class : I B.Sc. Mathematics
Title of the Course : Elective Lab Course I: Allied Physics Practical for Mathematics – I
Semester : I
Course Code : PU231EP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU231EP1	-	-	2	-	2	2	30	25	75	100

Pre-requisite:
Knowledge in basic Physics

Learning Objectives:

1. To make the students more innovative, in hands on experiments.
2. To elucidate theory through simple experiments in physics.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1	understand the basic principles of Physics through experiments.	**K2**
2	measure and determine the various physical parameters.	**K3**
3	develop an idea about the handling of various instruments.	**K2**
4	get an idea about basic Scientific knowledge and implications of its broad working principle	**K2 & K3**
5	analyze, interpreting and evaluate data.	**K3 & K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

Total Contact hours: 30 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Young's modulus by non-uniform bending using optic lever, scale and telescope	4	1	K2	Inquiry-Based Learning, Project-Based Learning	Real world application of skills, Peer Learning through group tasks	Virtual labs by MHRD vlab.co.in	concept explanation, teamwork, result accuracy, Model Exam
2	Verification of laws of transverse vibrations using sonometer	4	1	K3	Peer Teaching, Reciprocal Learning, Reciprocal method	Group Activity, Think-Aloud Protocol	Amrita virtual labs amritavlab.amrita.edu	Project based Evaluation, result accuracy, Model Exam
3	Calibration of low range voltmeter using potentiometer	4	1	K2	Blended Learning, Demonstration method	Hands-on circuit construction and real-time experimentation		Oral Q&A ,Troubleshooting questions, circuit construction, Model Exam
4	Surface tension and interfacial Surface tension – drop weight method	4	1	K3	Constructivist Pedagogy, Activity-Based Learning	Peer Teaching (exchanging roles during circuit building), Think-Pair-Share (for truth table generation and circuit design)	Physics galaxy Youtube channel, Lab manuals	Result accuracy, Lab report with calculation, team work
5	Determination of coefficient of viscosity – variable pressure head	5		K4	Experiential Learning, Inquiry-Based Pedagogy	Lab work, Peer Learning through group tasks	NPTEL nptel.ac.in, Amrita virtual labs amritavlab.amrita.edu	Concept-based oral questions, Lab report with calculated vs observed values, Peer evaluation on troubleshooting skills, Model Exam

6	Verification of truth tables of basic logic gates using ICs	4	1	K3	Project-Based Learning, Problem-Based Learning	Peer Teaching (exchanging roles during circuit building), Think-Pair-Share (for truth table generation and circuit design)	Learn engineering Youtube channel	Viva on truth table, logic equations, Circuit functionality test, Model Exam.

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training , Project

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): NIL

Environment Sustainability activities related to Cross Cutting Issues: NIL

Sample Questions

1. Determine Young's modulus of the material of a given beam by non-uniform bending using an optical lever, scale, and telescope.
2. Verify the laws of transverse vibrations of a stretched string using a sonometer.
3. Calibrate the given low-range voltmeter using a potentiometer.
4. Determine the surface tension of a liquid and the interfacial surface tension between two immiscible liquids using the drop weight method.
5. Determine the Coefficient of viscosity of the given liquid by Variable pressure head using a graduated burette.
6. Verify the truth tables of OR, AND, NAND, NOR and NOT gates using ICs.

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Head of the Department

Course Instructors

Department : Physics
Class : I NME
Title of the Course : Non-Major Elective NME I: Physics for Everyday Life
Semester : I
Course Code : PU231NM1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU231NM1	2	-	-	-	2	2	30	25	75	100

Learning Objectives:

1. To introduce fundamental physics concepts and their applications in everyday life.
2. To comprehend where all physics principles have been applied in everyday life and to appreciate the concepts with a greater understanding, as well as to learn about Indian scientists who have made significant contributions to Physics.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1.	understand the knowledge of basic scientific principles and fundamental concepts in motion of bodies.	**K2**
2.	understand the basic laws of physics in domestic appliances	**K2**
3.	recall the physics notions applied in various optical instruments	**K1**
4.	comprehend the utilization of solar energy in everyday life activities	**K2**
5.	know about the various physicists contribution towards science and technology	**K2**

K1 - Remember; **K2** – Understand

Teaching Plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**MECHANICAL OBJECTS**								
	1	Spring scales – bouncing balls	1	1	K1 (R) & K2 (U)	Lecture with demonstration	Group activity: measure forces using spring scales	YouTube videos on spring scales; physics simulations https://www.youtube.com/results?search_query=spring+scales+physics https://phet.colorado.edu/en/simulation/balancing-act	Quiz, group report CIA I
	2	Roller coasters – bicycles	2		K1 (R) & K2 (U)	Lecture, discussion	Problem-solving on energy conversion in bicycles	Interactive applets; Khan Academy videos https://phet.colorado.edu/en/simulations/category/physics https://www.khanacademy.org/science/physics	Short test, oral questioning CIA I
	3	Rockets and space travel.	2		K1 (R) & K2 (U)	Lecture, storytelling	Case study: Indian space missions	ISRO website; documentaries https://www.isro.gov.in https://www.	Assignment, presentation CIA I

								youtube.com/results?search_query=ISRO+documentary	
II	**OPTICAL INSTRUMENTS AND LASER**								
	1	Vision corrective lenses	1	1	K1 (R) & K2 (U)	Lecture with models	Group discussion on types of lenses	Optics simulation tools https://phet.colorado.edu/en/simulation/geometric-optics	Worksheet, quiz CIA I
	2	Polaroid glasses – UV protective glass	1		K1 (R) & K2 (U)	Lecture, demonstration	Hands-on: test UV protection using materials	Educational videos on light polarization https://www.youtube.com/results?search_query=light+polarization+physics	Short test CIA I
	3	Polaroid camera – colour photography	2		K1 (R) & K2 (U)	Lecture, discussion	Photo analysis project	Online resources on camera optics https://www.cambridgeincolour.com/tutorials/camera-lenses.htm	Report submission CIA I
	4	Holography and laser	1		K1 (R) & K2 (U)	Lecture, video demonstration	Group activity: explore hologram images	YouTube videos on holography https://www.youtube.com/results?search_query=holography+physics	Quiz CIA I
III	**PHYSICS OF HOME APPLIANCES**								

	1	Bulb – fan – hair drier	1	1	K1 (R) & K2 (U)	Lecture with appliance demo	Group discussion on safety features	Manufacturer websites, appliance manuals https://www.philips.co.in/c-m-ho/household-products https://www.lg.com/in	Quiz CIA I
	2	Television – air conditioners	2		K1 (R) & K2 (U)	Lecture, video explanation	Debate on energy efficiency	Energy efficiency videos, government websites https://beeindia.gov.in https://www.youtube.com/results?search_query=energy+efficiency+appliances	Short answer test CIA I
	3	Microwave ovens – vacuum cleaners	2		K1 (R) & K2 (U)	Lecture with diagrams	Project on usage and safety tips	User manuals, YouTube appliance guides https://www.youtube.com/results?search_query=microwave+oven+vacuum+cleaner+working	Presentation CIA II
IV	**SOLAR ENERGY**								
	1	Solar constant – General applications of solar energy – Solar water heaters	2	1	K1 (R) & K2 (U)	Lecture, charts	virtual tour	MNRE website, solar energy videos https://mnre.gov.in https://www.youtube.com/	Quiz, field visit report CIA II

								results?search_query=solar+energy+applications	
	2	Solar Photo – voltaic cells General applications of solar cells.	3		K1 (R) & K2 (U)	Lecture, case study	Simulation: solar power generation	Educational apps, videos on PV cells https://www.youtube.com/results?search_query=photovoltaic+cell+working	Assignment CIA II
V	**INDIAN PHYSICIST AND THEIR CONTRIBUTIONS**								
	1	C.V.Raman, Homi Jehangir Bhabha, Vikram Sarabhai, Subrahmanyan Chandrasekhar, Venkatraman Ramakrishnan, Dr. APJ Abdul Kalam	3	1	K1 (R)	Lecture, storytelling	Poster preparation on scientists	Biographies, documentaries https://www.youtube.com/results?search_query=indian+physicists+documentary	Poster, oral presentation CIA II
	2	Contribution of Scientists to science and technology.	2		K2 (U)	Lecture, discussion	Group research project	NCERT, NPTEL resources https://ncert.nic.in https://nptel.ac.in/courses/115	Project report CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development : **Employability**

Activities (Em/ En/SD): **Poster Presentation**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity):
-

Activities related to Cross Cutting Issues :-

Assignment : (Mention Topic and Type): **Contribution of Indian Scientist to Science and Technology - LMS**

Sample Questions

Part A (2 marks)

1. State Hooke's law. **(K2-U, CO1)**
2. Define eyeglasses.**(K2-U, CO2)**
3. What are the main components of hair dryer?**(K1-R, CO3)**
4. Define solar Constant.**(K2-U, CO4)**
5. What do you mean by Raman effect?**(K2-U, CO5)**

Part B (4 marks)

1. Describe the working of bicycle.**(K2-U, CO1)**
2. Explain the need of UV Protection for our eyes.(**K1-R, CO3)**
3. Why is the bulb filled with noble gas? **(K2-U, CO2)**
4. Explain the principle of voltaic cells. **(K2-U, CO4)**
5. Discuss in detail about the scientific contributions made by Subrahmanyan Chandrasekhar. **(K2-U, CO5)**

Part C (9 marks)

1. Describe the working principle of rockets. **(K2-U, CO1)**
2. Enumerate the various applications of holography techniques. **(K1-R, CO3)**
3. With a neat sketch explain the working of electric fan. **(K2-U, CO2)**
4. Summarize the applications of solar cells. **(K2-U, CO5)**
5. Discuss in detail about the scientific contributions made by C. V. Raman. **(K2-U, CO5)**

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Head of the Department

Dr. S. Sonia and Dr. P. Aji Udhaya

Course Instructors

Department : Physics
Class : I B.Sc. Physics
Title of the Course : FOUNDATION COURSE: INTRODUCTORY PHYSICS
Subject code : PU231FC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU231FC1	2	–	–	–	2	2	30	25	75	100

Learning Objectives

1. To help students get an overview of Physics before learning their core courses.
2. To serve as a bridge between the school curriculum and the degree programme.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	apply concept of vectors to understand concepts of Physics and solve problems	**K3**
2.	interpret different forces present in Nature while learning about phenomena related to these different forces.	**K4**
3.	describe energy in different process and relate momentum, velocity and energy	**K2**
4.	differentiate different types of motions they would encounter in various courses and understand their basis	**K3**
5.	relate various properties of matter with their behavior and connect them with different physical parameters involved.	**K4**

K1 - Remember; **K2** - Understand; **K3**– Apply

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topics	Teaching Hours	Assessment Hours	Cognitive Level	Pedagogy	Student Centric Method	E-Resources	Assessment / Evaluation
1	**Vector**								
	1	Scalars and vectors; physical quantity examples, units and dimensions	2	1	K2	Lecture with visuals	Flashcards, Pair Work, Quiz	NCERT Books, YouTube Lectures	MCQ, Short Answer
	2	Vector operations: addition, subtraction, resolution, resultant; standard constants	3		K3	Problem-solving	Group Activity, Derivation	Khan Academy, PhET Simulations	Problem Set Submission
II	**Force**								
	1	Fundamental forces: gravitational, electrostatic, magnetic, nuclear	2	1	K1	Explanation and Demonstration	Concept Mapping, Think-Pair-Share	Online Physics Simulations	Quiz, Oral Questions

	2	Mechanical forces: friction, centripetal, centrifugal, cohesive, adhesive, tension	3		K2	Case-based Discussion	Poster Creation, Lab Models	Discovery Ed, NCERT	Poster Evaluation, Lab Report
III	**Energy**								
	1	Forms of energy, conservation of energy and momentum, collisions	2	1	K2	Interactive Lecture	Numerical Solving, Animation View	Physics Galaxy, Energy.gov	MCQs, Application Questions
	2	Angular momentum, alternate energy sources, real-life energy examples	3		K3	Project-Based Learning	Field Survey, Presentation	MNRE India, Local Energy Surveys	Report & Presentation Rubrics
IV	**Motion**								
	1	Linear, projectile, circular, angular, SHM, satellite motion, banking	2	1	K2	Audio-Visual, Charting	Simulation, Model Building	PhET, NCERT Videos	Concept Test, Diagram Labelling

	2	Streamline & turbulent, wave motion, light vs. sound, oscillations	3		K2	Comparative Method	Role Play, Sound-Light Activity	Online Labs, Physics Classroom	MCQ, Comparative Chart
V	**Surface Tension and Viscosity**								
	1	Surface tension, angle of contact, shape of droplets, capillary action	2	1	K3	Experimental Demo	Lab Groups, Observation Table	Class Videos, YouTube	Lab Report, Viva Voce
	2	Viscosity, lubricants, diffusion, conductors & insulators – thermal/electric	3		K3	Hands-on & Activity-based	Sorting, DIY Tests, Debates	Lab Manual, Wikipedia	Performance Evaluation

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**

Activities (Em / En /SD): Create simple models to demonstrate energy and momentum

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): - Environment Sustainability activities related to Cross Cutting Issues:-

Sample questions

Part A (2 marks)

1. Define Newton's second law of motion.**(K1-R, CO-1)**
2. Define Coulomb's law**(K1-R, CO-1)**
3. Write any two examples for field forces**(K1-R, CO-1)**
4. Define the law of conservation of energy**(K1-R, CO-1)**
5. What is potential and kinetic energy ? **(K1-R, CO-1)**

Part B (4 marks)

1. Explain Coulomb's law**(K2-U, CO-2)**
2. Explain the applications of electromagnetic force in medical field**(K2-U, CO-2)**
3. Explain centripetal force with three examples**(K2-U, CO-2)**.
4. Explain momentum and types of momentum**(K2-U, CO-2)**.
5. Explain any four examples of surface tension in everyday life(**K3-Ap,CO-3)**

Part C (9 marks)

1. Explain the properties of nuclear force**(K2-U, CO-2)**
2. Explain molecular forces**(K2-U, CO-2)**
3. Compare centripetal and centrifugal force(**K4-An,CO-4)**
4. Compare and contrast linear momentum and angular momentum(**K4-An,CO-4)**
5. Explain the angle of contact and its significance(**K3-Ap,CO-3)**

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Head of the Department

Jenepha Mary

Course Instructor
Dr. S.J. Jenepha Mary

Department : **Physics**
Class : **II B.Sc. Physics**
Title of the Course : **Core Course III: General Mechanics and Classical Mechanics**
Semester : **III**
Course Code : **PU233CC1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU233CC1	5	–	–	–	5	5	75	25	75	100

Learning Objectives

1. To have a basic understanding of the laws and principles of mechanics and to apply the concepts of forces existing in the system;
2. To understand the forces of physics in everyday life and to apply Lagrangian equation to solve complex problems.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recognize Newton's Law of motion, general theory of relativity, Kepler's laws and the basic principles behind planetary motion.	**K1**
2.	infer the knowledge on the conservation laws.	**K2**
3.	relate conservation law and calculate energy of various systems, understand and differentiate conservative and non–conservative forces.	**K3**
4.	devise concepts of rigid body dynamics and solve problems.	**K4**
5.	defend Lagrangian system of mechanics and D' Alembert's principle.	**K5**

K1 - Remember; K2 - Understand; K3- Apply; K4 - Analyse; K5- Evaluate

Teaching Plan
Total Contact Hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive Level	Pedagogy	Student-Centric Method	E-Resources	Evaluation/ Assessment
I		**LAWS OF MOTION**							
	1.	Newton's Laws– Forces-Equations of motion –Motion of a particle in an uniform gravitational field	2	1	K1(R)	Introductory session, Lecture using Chalk and talk , PPT, Constructivist Learning**:** understanding through hands-on activities and reflections.	Think-Pair-Share, Brainstorming, Reflective Journaling	YouTube Lectures	Short test, MCQ using Google forms, True/False, Formative Assessment using CIA I.

	2.	Kepler's laws- Newton's law of gravitation– Determination of G by Boy's method	3		K2(U)	Problem solving using Chalk and talk, Collaborative Learning: Promote group discussions.	Group Activity, Peer Teaching, Concept Mapping		Short test, MCQ using Google forms, Concept definitions, Assessment using CIA I.
	3.	Earth–moon system– Earth satellites –Earth density – mass of the Sun	3		K3(Ap)	Problem Solving using Chalk and talk , Conceptual Change Model: demonstrating energy transformation instead of loss.	Debate, Collaborative Learning, Poster Making	NPTEL	Short test, MCQ using Google forms, True/False, Formative Assessment using CIA I.
	4.	Gravitational potential – Velocity of escape – Einstein's theory of gravitation- Introduction	3	1	K3(Ap)	Problem Solving, using Chalk and talk , Interactive PPT.	Peer Teaching, Role Play, Simulation	Animated videos	Short test, MCQ using Google forms, Concept definitions, Assessment using CIA I.

	5.	Principle of equivalence– Gravitational red shift – Bending of light.	2		K4(An)	Interactive PPT, Problem Solving, Inquiry-Based Learning	Presentation , Inquiry-Based Learning, Group Discussion	Online Articles	Short test, MCQ using Google forms, True/False, Formative Assessment using CIA I.
II		**CONSERVATION LAWS OF LINEAR AND ANGULAR MOMENTUM**							
	1.	Conservation of linear and angular momentum– Internal forces and momentum conservation – Centre of mass – Examples	3	1	K1(R)	Lecture	Think-Pair-Share, Brainstorming, Reflective Journaling	YouTube Lectures	Short test, MCQ using Google forms, Concept definitions, Assessment using CIA I.
	2.	General elastic collision of particles of different masses– System with variable mass–	3		K2(U)	Interactive	Group Activity, Peer Teaching, Concept Mapping		Short test, MCQ using Google forms, True/False, Formative Assessment using CIA I.

		Examples							
	3.	Conservation of angular momentum– Torque due to internal forces	3	1	K2(U)	Discussion	Debate, Collaborative Learning, Poster Making	NPTEL	Short test, MCQ using Google forms, Concept definitions, Assessment using CIA I.
	4.	Torque due to gravity Angular momentum about centre of mass	2		K3(Ap)	Introductory session, Lecture using Chalk and talk, PPT**:** understanding through hands-on activities and reflections.	Peer Teaching, Role Play, Simulation	Animations	Short test, MCQ using Google forms, True/False, Formative Assessment using CIA I.
	5.	Proton scattering by heavy nucleus.	2		K4(An)	Problem solving using Chalk and talk, Collaborative Learning: Promote group discussions.	Presentation , Inquiry-Based Learning, Group Discussion	Online Articles	Short test, MCQ using Google forms, Concept definitions, Assessment using CIA I.

III		**CONSERVATION LAWS OF ENERGY**							
	1.	Introduction – Significance of conservation laws – Law of conservation of energy .	3	1	K2(U)	Introductory session, Lecture using Chalk and talk , PPT, Constructivist Learning**:** understanding through hands-on activities and reflections.	Interactive Simulations : Utilize tools like PhET to visualize energy conservation and transformations.	PhET Interactive Simulations : Work & Energy Simulations	Short test, MCQ using Google forms, True/False, Formative Assessment using CIA I.
	2.	Work – Power – Work – Kinetic energy theorem– Work done in lifting and lowering an object .	3		K3(Ap)	Problem solving using Chalk and talk , Collaborative Learning**:** Promote group discussions.	Laboratory Experiments: Conduct experiments measuring work and energy, such as using spring scales and inclined planes.	Khan Academy: Work and Energy	Short test, MCQ using Google forms, Concept definitions, Assessment using CIA I.
	3.	Conservative forces – Work done by spring force – Work done by the gravitational force.	3		K3(Ap)	Problem Solving using Chalk and talk , Conceptual Change Model**:** demonstrating	Project-Based Learning: students create models to	HyperPhysics: Work, Energy, and Power The Physics Classroom:	Short test, MCQ using Google forms, Demonstrating application of concepts,

						energy transformation instead of loss.	demonstrate energy principles.	Work and Energy	Assessment using CIA I.
	4.	Gravitational potential energy and elastic potential energy	2	1	K3(Ap)	Problem Solving, using Chalk and talk , Interactive PPT.	Flipped Classroom: Provide video lectures for homework and use class time for discussions and problem-solving.	YouTube Lectures	Short test, MCQ using Google forms, Demonstrations of experiments, Assessment using CIA I.
	5.	Examples Non–conservative forces	2		K2(U)	Interactive PPT, Problem Solving, Inquiry-Based Learning: What happens to energy when friction is involved?	Interactive Simulations : Utilize tools like PhET to visualize energy conservation	YouTube Lectures	Short test, MCQ using Google forms, Short essays,Assessment using CIA I.

IV		**RIGID BODY DYNAMICS**							
	1.	Translational and rotational motion – Angular momentum.	3	1	K2(U)	Introductory session, Lecture using PPT, Analogy-based learning**:** link translational motion to rotational concepts.	Demonstration and Discussion on rotating wheels	CK–12**:** Angular momentum fundamentals.	Quizzes using Google Forms, formative assessment CIA II, Quick problem-solving, short test.
	2.	Moment of inertia – General theorems of moment of inertia – Examples	3		K4(An)	Lecture using videos, Problem solving, Conceptual change**:** rotation is different from translation, Demonstration.	Moment of Inertia Lab experiments**.**	Nagwa Lesson Plan**:** Focused on L=IωL	Quizzes using Google Forms, formative assessment CIA II, Quick problem-solving, short test.
	3.	Rotation about fixed axis – Kinetic energy of rotation – Examples	2	1	K4(An)	Lecture using Problem solving, Demonstration,	Demonstration on Rotation about fixed axis	Wikipedia**:** Articles on rotation about fixed axis, angular momentum, inertial tensors.	Quizzes using Google Forms, formative assessment CIA II, Quick problem-solving, short test.
	4.	Body rolling along a plane surface – Body rolling down	3		K4(An)	Lecture using videos, Problem solving,	Rolling Motion Experiment**:**	Exploratorium**:** Bicycle-	Quizzes using Google Forms, formative

		an inclined plane				Demonstration, Inquiry based learning**:** Why does a bicycle wheel resist tilting?	Objects roll down.	wheel gyro classroom demo.	assessment CIA II, Quick problem-solving, short test.
	5.	Gyroscopic precision – Gyrostatic applications.	2		K4(An)	Lecture using videos, Collaborative labs**:** hands-on experiments with gyroscopes.	IOP Precession**:** Gyroscopic precession activities.	YouTube Demo**:** Gyroscopic precession with fidget spinner for visual explanation.	Quizzes using Google Forms, formative assessment CIA II, short test.
V		**LAGRANGIAN MECHANICS**							
	1.	Generalized Coordinates and Degrees of Freedom	2	1	K2(U)	Lecture, Illustration , Analytical Mechanics Introduction: Highlight benefit vs Newtonian for constrained systems	DOF for multi-particle systems.	Lecture Videos.	Quizzes using Google Forms, formative assessment CIA I, Quick problem-solving, short test.
	2.	Constraints – Types	2		K3(Ap)	Interactive PPT,Conceptual	Constraints Identificatio	Caltech Lecture	Quizzes using Google Forms,

						Clarification: Use diagrams to distinguish different constraints . Comparative Analysis: Examine simple vs complex constraints.	n and its types.	Notes: Definitions of holonomic, non-holonomic, scleronomic , rheonomic	formative assessment CIA II, Quick problem-solving, short test.
	3.	Principle of Virtual Work	3		K4(U)	Derivation Walkthrough: Step-by-step from virtual work → D'Alembert → Lagrange using supporting slides .	Guided derivation for virtual work	MIT OCW Slides: Virtual work examples & derivation	Quizzes using Google Forms, formative assessment CIA II, Quick problem-solving, short test.
	4.	D'Alembert's Principle	3	1	K3(Ap)	Derivation Walkthrough: Step-by-step	Peer Teaching, Role Play, Simulation	YouTube Lectures	Quick problem-solving, short test
	5.	Lagrange's Equation – Application	3		K4(An)	Derivation Walkthrough: Step-by-step from D'Alembert supporting slides	Presentation , Inquiry-Based Learning, Group Discussion	YouTube Lectures	Quick problem-solving, short test

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**

Activities (Em / En /SD): Create simple models to demonstrate energy principles.

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): - Environment Sustainability activities related to Cross Cutting Issues:-

Assignment: Compute the work done=1/2 kx^2 and cross check with work done in stretching. (Last date to submit-1.08.2025)

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. A ball thrown vertically upwards falls at the same place. What is the displacement of the ball. **(K4-An, CO-4)**
2. In the electromagnetic spectrum ----- has the high penetrating power **(K2-U, CO-2)**
3. Which of the following is not a conservative force? **(K1-R, CO-1**)
   a) Gravitational b) Frictional c) Electrostatic d) Nuclear
4. What will be the radius of gyration of a circular plate of diameter 10cm? **(K4-An, CO-4)**
   a) 1.5cm b) 2.0cm c) 2.5cm d) 3cm
5. Evaluate the number of degrees of freedom for a system consisting of N number of particles (**K5-E, CO4)**

Part B (6 marks)

1. Briefly explain Newton's laws of motion. **(K1-R, CO-1)**
2. Explain motion and derive an expression for the equations of motion. **(K2-U, CO-1)**
3. Calculate the work done by a spring force. **(K3-Ap, CO3)**
4. Compare translational and rotational motion. **(K4-An, CO-4)**

5. Evaluate Lagrange's Equation. **(K5-E, CO-5)**

Part C (12 marks)

1. Determination the gravitational constant G by Boy's method (**K1-R, CO-1)**
2. Derive an expression between torque and moment of inertia. **(K2-U, CO-2)**
3. Calculate the work done in lifting and lowering an object by applying kinetic energy theorem. **(K3-Ap, CO-3)**
4. Analyse the concept "Body rolling down an inclined plane" and find out its Kinetic energy. **(K4-An, CO-4)**
5. Explain the principle of virtual work and D' Alembert's Principle **(K2-U, CO-1)**

Head of the Department **Dr. S.J. Jenepha Mary & Dr.M. Abila Jeba Queen**

Course Instructors

Department : **Physics**
Class : **II B.Sc. Physics**
Title of the Course : **Core Lab Course III: General Physics Lab III**
Semester : **III**
Course Code : **PU233CP1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU233CP1	-	-	3	-	3	3	45	25	75	100

Learning Objectives:

1. To understand electricity, current, resistance, and circuit parameters by constructing different circuits.
2. To apply the concepts of electricity, current, resistance, and circuit parameters for setting up experiments, and then observe, analyse and assimilate the concepts.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	remember and understand the scientific method to construct simple circuits.	**K1 & K2**
2.	apply basic skills and attitudes enabling application in the physics field.	**K3**
3.	analyse the physical principle involved in the various instruments such as potentiometer, galvanometer, electrical bridge etc.	**K4**
4.	evaluate a record of experiments in a clear and structured written format augmented with relevant figures and graphs wherever needed.	**K5**
5.	develop prototypes by utilizing physics concepts in practical situations.	**K6**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Total Contact hours: 45 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Calibration of low range voltmeter using potentiometer	6	1	K2	Demonstration and guided inquiry-based lab	Hands-on experimentation, collaborative learning, reflective journaling	Virtual Lab Simulations (IIT Kharagpur), NPTEL video on potentiometers, simulation tools like PhET	Viva-voce, Observation record, Lab report, Error analysis
2	Compare the capacitances of two capacitors by forming De Sauty's bridge.	6	1	K3	Problem-solving approach with schematic analysis	Peer discussion, group analysis of bridge circuits, drawing circuit diagrams	Online circuit simulators (Every Circuit, Tinkercad), YouTube demo videos	Lab notebook submission, Quiz on bridge principles, Viva-voce
3	Determine the resonant frequency, inductance of the coil, band width, voltage magnification factor and quality factor (Q) of the LCR - Series resonance circuit.	7	1	K2	Experimental approach with theoretical correlation	Predict-Observe-Explain, Group presentations, Graphical analysis using real-time data	Online resonance circuit simulator, NPTEL lectures on resonance, Oscilloscope tutorials	Assessment of graph plots, Conceptual questions, Practical performance
4	Construct Zener Diode circuit in Forward and Reverse bias and analyze V-I Characteristics of Zener diode.	7	1	K3	Constructivist approach with analog circuit modeling	troubleshooting circuits, Hands-on wiring, Pair programming for simulations	Interactive simulators (Falstad, Multisim), Video lectures on diode characteristics	Analysis of V-I graph, Lab file review, Oral Q&A
5	Construct a Zener diode voltage regulator and measure its DC output.	6	1	K4	Constructivist approach with analog circuit modeling	troubleshooting circuits, Hands-on wiring, Pair programming for simulations	Interactive simulators (Falstad, Multisim), Video lectures on diode characteristics	Analysis of V-I graph, Lab file review, Oral Q&A

6	Determine absolute value of the magnetic dipole moment (M) of the given dipole and earth's horizontal magnetic induction (BH) using deflection and vibration magnetometer.	7	1	K3	Inquiry-based pedagogy with integrated field concepts	Case study on Earth's magnetism, Experimental journaling, Peer instruction	GeoGebra models, Earth field mapping tools, Magnetometer working videos	Observation sheet, Graphical analysis, Viva and oral explanation

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training , Project

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): NIL

Environment Sustainability activities related to Cross Cutting Issues: NIL

Sample Questions

1. Standardize the given potentiometer for fall of potential of 1/6 volt per meter using alow range voltmeter.
2. Compare the capacitances of two capacitors by forming De Sauty's bridge.
3. Determine absolute value of the magnetic dipole moment (M) of the given dipole andearth's horizontal magnetic induction (B H) using vibration magnetometer.
4. Construct a Zener diode voltage regulator and measure its DC output.
5. Construct Zener Diode in Forward and Reverse bias. Draw Voltage-Amperecharacteristics of Zener diode.
6. Determine the resonant frequency, inductance of the coil, band width, voltage magnification factor and quality factor (Q) of the LCR - Series resonance circuit.

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Head of the Department **Course Instructor**

Department : Physics
Class : II B.Sc. Chemistry
Title of the Course : Elective Lab Course III: Allied Physics Practical for Chemistry – I
Semester : III
Course Code : PU233EP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU233EP1			2		2	2	30	25	75	100

Learning Objectives:

1. To make the students more innovative, in hands on experiments.
2. To elucidate theory through simple experiments in physics.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1	understand the basic principles of Physics through experiments.	**K2**
2	measure and determine the various physical parameters.	**K3**
3	develop an idea about the handling of various instruments.	**K2**
4	get an idea about basic Scientific knowledge and implications of its broad working principle	**K2 & K3**
5	analyze, interpreting and evaluate data.	**K3 & K4**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

Total Contact hours: 30 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Young's modulus by non-uniform bending using optic lever, scale and telescope	4	1	K2	Inquiry-Based Learning, Project-Based Learning	Real world application of skills, Peer Learning through group tasks	Virtual labs by MHRD vlab.co.in	concept explanation, teamwork, result accuracy, Model Exam
2	Determine the resonant frequency, inductance of the coil	4	1	K3	Experimental approach with theoretical correlation	Predict-Observe-Explain, Group presentations, Graphical analysis using real-time data	Online resonance circuit simulator, NPTEL lectures on resonance, Oscilloscope tutorials	Assessment of graph plots, Conceptual questions, Practical performance
3	Calibration of low range voltmeter using potentiometer	4	1	K2	Blended Learning, Demonstration method	Hands-on circuit construction and real-time experimentation	Amrita virtual labs amritavlab.amrita.edu	Oral Q&A ,Troubleshooting questions, circuit construction, Model Exam
4	Surface tension and interfacial Surface tension – drop weight method.	4	1	K3	Constructivist Pedagogy, Activity-Based Learning	Peer Teaching (exchanging roles during circuit building), Think-Pair-Share (for truth table generation and circuit design)	Physics galaxy Youtube channel, Lab manuals	Result accuracy, Lab report with calculation, team work
5	Coefficient of viscosity of the given liquid by Variable pressure head using a graduated burette.	5		K4	Experiential Learning, Inquiry-Based Pedagogy	Lab work, Peer Learning through group tasks	NPTELnptel.ac.in, Amrita virtual labs amritavlab.amrita.edu	Concept-based oral questions, Lab report with calculated vs observed values, Model Exam
6	Verification of truth tables of basic logic gates using ICs	4	1	K3	Project-Based Learning, Problem-Based	Peer Teaching (exchanging roles during circuit building),	Video lectures on ICs	Viva on truth table, logic equations, Circuit

					Learning	Think-Pair-Share (for truth table generation and circuit design)		functionality test, Model Exam.

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training, Project

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): NIL

Environment Sustainability activities related to Cross Cutting Issues: NIL

Sample Questions

1. Determine the young's modulus of the material of the given bar by non-uniform bending. Scale and telescope are given.
2. Calibrate the given low range voltmeter using potentiometer. Draw the calibration curve.
3. Verify the truth tables of OR, AND, NAND, NOR and NOT gates using ICs.
4. Form a series resonant circuit and obtain its frequency response curve. Find the resonance frequency. Also find L of the coil.
5. Determine the Coefficient of viscosity of the given liquid by Variable pressure head using a graduated burette.
6. Determine the surface tension and interfacial tension of the given liquid by the drop weight method.

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Head of the Department

S. Sebastiammal Jenepha Mary

Dr. Sr. S. Sebastiammal & Dr. S. J. Jenepha Mary

Course Instructors

Department : **Physics**

Class : **II B.Sc. Chemistry**

Title of the Course : **Elective Course III: Allied Physics for Chemistry-I**

Semester : **III**

Course Code : **PU233EC1**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU233EC1	4	-	-	-	3	4	60	25	75	100

Learning Objectives:

1. To gain a comprehensive understanding of the fundamental principles in Physics.
2. To develop skills for interpreting physical phenomena beneficial for students who have taken programmes other than Physics.

Course outcomes

On the successful completion of the course, students will be able to:		
1.	identify the basic concepts in waves, characteristics of matter, electricity and magnetism, as well as electronics.	**K1**
2.	Interpret the principles of ultrasonics and surface tension, and explore their practical applications within the medical domain.	**K2**
3.	articulate real-world solutions leveraging the principles of electricity, magnetism, and electronics within the framework of Digital India.	**K3**
4.	Categorize physics principles in everyday situations.	**K4**
5.	Prioritize Boolean algebraic concepts in practical scenarios.	**K5**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact Hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive Level	Pedagogy	Student-Centric Method	E-resources	Evaluation/ Assessment
I	**Properties of Matter**								
	1	Elasticity: elastic constants – bending of beam – theory of non- uniform bending	2	1	K1(R)	Concept Mapping, experiential learning, reflective approach	Think-Pair-Share, working through problems	YouTube lecture videos, physics galaxy channel, libre text	Assignment, conceptual MCQs, table analysis task, CIA-I
	2	Determination of Young's modulus by non-uniform bending	2		K2 (U)	Inquiry based learning, peer teaching	Lab Analysis	Video Lecture	rmative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	3	Determination of rigidity modulus by torsional pendulum	1	1	K3(Ap)	Active learning, Flipped classroom	Brainstorming, Group discussions	Video Lectures, Simulations, web tools	Formative Quiz using Google Forms, CIA I
	4	Viscosity: streamline and turbulent motion – critical velocity – coefficient of viscosity	2		K3(Ap)	Lecture with Visual Aids such as PPT,Conceptual Demonstration, Flipped Classroom.	Think-Pair-Share, Concept Mapping	Youtube lecture videos, Interactive PPT	Assignment, conceptual MCQs, short test, CIA-I

	5	Surface tension: definition – Interfacial surface tension - Drop weight method	2	1	K4(An)	Active learning, Flipped classroom, concept based discussions	Peer teaching , Quiz, Explaining concepts and derivations	Interactive Notes, Online Tutorials and Notes: Hyper Physics	Problem-Solving Assignments, Open Book Exam Questions, CIA I
II	**Heat and Thermodynamics**								
	1	Joule-Kelvin effect – Joule-Thomson porous plug experiment	2	1	K2 (U)	Conceptual Demonstration, Flipped Classroom	Peer Teaching, Gamified Quiz, Concept Mapping.	NPTEL Lectures, Khan Academy Physics – Conceptual videos	Poster/chart Presentation, Short-answer conceptual questions, CIA I
	2	Temperature of inversion – liquefaction of Oxygen– Linde's process of liquefaction of air	2		K1(R)	Core Conceptual Approach, Application -Based Teaching	Debate, answering questions from peers	Hyper Physics, Visual and animated tutorials	Quick quizzes - Concept check MCQs, CIA-II
	3	Liquid Oxygen for medical purpose	1	1	K3(Ap)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-II
	4	Laws of thermodynamics – entropy	2	1	K5(E)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-II

	5	Heat engine – Carnot's cycle – efficiency	2		K3(Ap)	Conceptual Demonstration, Flipped Classroom	Peer Teaching, Gamified Quiz, Concept Mapping.	NPTEL Lectures, Khan Academy Physics – Conceptual videos	Poster/chart Presentation, Short-answer conceptual questions, CIA II
III	**Electricity and Magnetism**								
	1	Potentiometer – principle – measurement of thermo emf using potentiometer	2	1	K3(Ap)	Conceptual Demonstration, Flipped Classroom	Peer Teaching, Gamified Quiz, Concept Mapping.	NPTEL Lectures, Khan Academy Physics – Conceptual videos	Poster/chart Presentation, Short-answer conceptual questions, CIA II
	2	Magnetic field due to a current carrying conductor – Biot-Savart's law	2		K2 (U)	Core Conceptual Approach, Application -Based Teaching	Debate, answering questions from peers	Hyper Physics, Visual and animated tutorials	Quick quizzes - Concept check MCQs CIA-II
	3	Peak, average and RMS values of ac current and voltage	1	1	K3(Ap)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-II
	4	Power factor and current values in an AC circuit	2		K3(Ap)	Diagram-Based, reflective pedagogical approach	Group Presentation, peer feedback on reflective practices	Thermo Simulators, Youtube video lectures	Problem-Solving Assignments, Open Book Exam Questions, CIA II
	5	Types of switches in household and factories	2	1	K4(An)	Inquiry-Based Learning,	Animation-based learning, Think-pair-	Hyper Physics, NPTEL	Peer-assessed derivation, conceptual

						Visual/Graphical Pedagogy	share	lectures	quiz, CIA-II
IV	**Waves, Oscillations and Ultrasonics**								
	1	Simple harmonic motion (SHM) – compositionoftwo SHMs at right angles (periods in the ratio 1:1)	2	1	K1(R)	Experiential Learning, inquiry based learning, flipped classroom	Brainstorming, Discussion of experiences, group activities	Video Lectures, Interactive notes	Conceptual Quiz, Formative worksheet, Peer discussion, CIA-I
	2	Laws of transverse vibrations of strings – determination of AC frequency using sonometer	2		K2 (U)	Experiential learning, problem-based learning, active learning	Formulating questions, solving challenges and puzzles	Desmos, Interactive PPT, Youtube videos	Problem-Solving Assignments, Open Book Exam, short oral test, CIA-I
	3	Ultrasound – production	2	1	K3 (Ap)	Lecturing, flipped classroom	Think-pair-share, group activities	Physics libre texts, youtube visual models	Matching exercises, diagram based MCQs, CIA-II
	4	Piezoelectric method	2	1	K3(Ap)	Experiential Learning, inquiry based learning, flipped classroom	Brainstorming, Discussion of experiences, group activities	Video Lectures, Interactive notes	Conceptual Quiz, Formative worksheet, Peer discussion, CIA-I
	5	Application of ultrasonics	1		K4(An)	Reflective pedagogical approach, peer teaching	Group discussion and activities, debates	Lab Videos, Libre texts, Interactive PPT	Oral quiz, activity worksheet, conceptual MCQ, CIA-II
V	**Digital Electronics**								
	1	Logic gates, OR, AND, NOT logic	2	1	K2 (U)	Experiential Learning,	Brainstorming, Discussion of	Video Lectures,	Conceptual Quiz,

		gates				inquiry based learning, flipped classroom	experiences, group activities	Interactive notes	Formative worksheet, Peer discussion, CIA-I
	2	Boolean Algebra, De Morgan's theorem-verification	2		K3 (Ap)	Experiential learning, problem-based learning, active learning	Formulating questions, solving challenges and puzzles	Desmos, Interactive PPT, Youtube videos	Problem-Solving Assignments, Open Book Exam, short oral test, CIA-I
	3	Overview of Government initiatives: software technological parks under MeitY	2	1	K3 (Ap)	Lecturing, flipped classroom	Think-pair-share, group activities	Physics libre texts, youtube visual models	Matching exercises, diagram based MCQs, CIA-I
	4	NIELIT-semiconductor laboratories under Dept. of Space	2		K3(An)	Reflective pedagogical approach, peer teaching	Group discussion and activities, debates	Lab Videos, Libre texts, Interactive PPT	Oral quiz, activity worksheet, conceptual MCQ, CIA-I
	5	An introduction to Digital India	1	1	K5(E)	Inquiry-Based Learning, Visual/Graphical Pedagogy	Animation-based learning, Think-pair-share	Hyper Physics, NPTEL lectures	Peer-assessed derivation, conceptual quiz, CIA-I

Course Focusing on Employability/Entrepreneurship/Skill Development: **Skill Development**

Activities (Em/En/SD): **Model making on simple harmonic motion**

Course Focusing on Cross Cutting Issues (Professional Ethics/Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues:-

Assignment: **Overview of government initiatives in digital electronics**

Sample questions

PartA (1 mark)

1. The figures used for the accurate determination of the frequency of a tuning fork are _____. **(K1-R,CO-1)**
2. Within elastic limit, the stress is directly proportional to strain. State True / False **(K4-An,CO-4)**
3. The device used for measuring potential differences is **(K2-U,CO-2)**
   a) Meter Bridge b) Potentiometer c) Carey Foster Bridge.
4. The maximum value of alternating current in any direction is called its _____value. **(K3-Ap,CO-3)**
   a) Peak b) Mean c)Maximum d) RMS
5. When NOT gate follows an AND gate, the combination is called as _____ **(K3-Ap,CO-3)**
   a) NAND b) AND c) EX-OR d) NOR

Part-B (6 marks)

1. Interpret the production of ultrasonic waves using piezoelectric crystal method. **(K4- An , CO-4)**
2. Derive the expression for the bending moment. **(K3-Ap,CO-3)**
3. Explain the change of entropy in reversible and irreversible process. **(K2-U,CO-2)**
4. How will you measure the thermo emf using potentiometer? Explain. **(K5-E,CO-5)**
5. Show that the NAND gate is an universal building block. **(K4-An,CO-4)**

PartC (12 marks)

1. Describe the applications of ultrasonic waves. **(K2-U,CO-2)**
2. Determine the Rigidity modulus by Torsion pendulum by Dynamic torsion method. **(K4-An,CO-4)**

3. Obtain the efficiency of Carnot's cycle with suitable phase diagram. **(K2-U,CO-2)**
4. Define Biot-Savart's law and obtain an expression for field along the axis of the coil carrying current. **(K3-Ap, CO-3)**
5. State and Verify the DeMorgan's theorem.**(K5-E,CO-5)**

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Course Instructors

Department : Physics
Class : II B.Sc. Physics
Title of the Course : Skill Enhancement Course SEC -II (IKS) Astrophysics
Semester : III
Course Code : PU233SE1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU233SE1	2	-	-	-	2	2	30	25	75	100

Learning Objectives

1. To introduce principles of astrophysics describing the science of formation and evolution of stars and interpretation of various heavenly phenomena.
2. To provide an understanding of the physical nature of celestial bodies.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall the total and annular solar and lunar eclipses.	**K1**
2.	summarize the different layers of the Sun and its phenomenon.	**K2**
3.	articulate the basic concepts of Solar systems on planetary motion.	**K3**
4.	relate the distinct properties of planets revolving around the sun.	**K4**
5.	grade the principle of planetary motion towards science and technology.	**K5**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours: 30 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Method
I	**THE SUN**								
	1	The Sun – A typical star – Photosphere – Limb darkening .	1	1	K2(U)	Lecture, Illustration with PPT and videos, Inquiry Based learning	**Model Creation**: create 3D models of the Sun	Video Lectures, Simulations,	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	2	Chromosphere – Spicules – Plages and filaments .	2		K2(U)	Illustration with PPT and videos, Collaborative Learning	Think-pair-share: compare images of chromospheric features.	Video Lectures,Simulations, Notes/Slides,	Quizzes Concept check polls during class using Slido, CIA I
	3	Solar corona – The inner corona – The outer corona – The emission corona - prominences – sunspots - solar flares	2		K4(Ap)	Illustration with PPT and videos,,	Foldable model: class discussion on heating mystery	Stellarium App	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
II	**SOLAR SYSTEM**								
	1	Comets – Nucleus –	2	1	K4(An)	5E model: Engage via	Collaborative concept	Lecture	group model presentations,

		Coma – Hydrogen cloud – Dust tail – Ion tail - Asteroids – Debris – Meteors .				comet images/videos, explore structure through diagrams, explain concepts collaboratively, elaborate with simulations, evaluate through reflection	mapping; peer-instruction about tail dynamics	Slides	Formative assessment CIA-1, Quiz using Google Forms
	2	Shooting stars – Falling stars – Meteoroids – Crater - Kuiper belt.	2		K3(Ap)	Hands-on experimentation simulating entry effects and crater formation	Small-group investigation comparing composition and orbits	Lecture Slides Interactive PPT	Star Identification, Formative assessment CIA-1, Quiz using Google Forms
	3	Oort cloud - Bode's law of planetary distances	1		K3(Ap)	Conceptual role-play and spatial modeling of solar system outer zones	Playground model: place markers and calculate predicted distances	You Tube Videos	Formative assessment CIA-1, Quiz using Google Forms
III	**ECLIPSES**								
	1.	Types of eclipses – Solar eclipse – Solar eclipse geometry - Total and annular solar	3	1	K1(R)	Introductory session, Concept-based explanation of Earth's shadow zones and phases of lunar	Hands-on shadow cone modeling (e.g., light source, ball for Moon, globe)	Video Lectures,Simulations, Notes/Slides,	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I

		eclipse .				eclipse			
	2.	Lunar eclipse – Umbra – Penumbra - Total and partial lunar eclipse	2		K1(R)	Guided inquiry using scale models to reveal umbra, penumbra, antumbra and eclipse paths	"Shadow puppetry": demonstrate movement through umbra and penumbra zones	Britannica lunar eclipse geometry ; Earth shadow article	Draw sequence frames showing Moon's passage through penumbra/umbra, Formative assessment CIA-II, Quiz using Google Forms
IV	**INNER PLANETS**								
	1.	Mercury: Planet closest to the sun – Venus: Earth's twin.	2	1	K4(An)	Case-comparison with Earth: guided discoveries of atmosphere.	Collaborative modeling of the hydrosphere	Lecture Slides	fact-file comparisons; quiz on geological features and orbital characteristics, Formative assessment CIA-II, Quiz using Google Forms
	2.	Earth: The water planet – Mars: The red planet	3		K4(An)	Problem-based learning: students evaluate evidence for water and habitability, compare to Earth/Venus,	"Mars mission" project: Teams analyze terrain, water evidence, propose rover features	Lecture Slides Interactive PPT	Group poster on water planet traits, Formative assessment CIA-II, Quiz using Google Forms

						propose rover investigation plans			
V	**OUTER PLANETS**								
	1	Jupiter: The largest planet – Saturn: The ringed planet – Uranus:	2	1	K2(U)	Lecture using videos, **Comparative Analysis**: Compare ring composition & magnetic field.	Hands-on ring simulation (ice/rock)	Simulations	Model explanation, Formative assessment CIA-II, Quiz using Google Forms
	2	Neptune's twin – Neptune: The blue planet – Pluto – Dwarf planet.	3		K2(U)	**Conceptual Modeling**: Construct model to illustrate tilt & faint rings.	Build tilted-planet model	Lecture Slides Interactive PPT	Poster rubric assessing accuracy of diameter of outer planet,Formative assessment CIA-II, Quiz using Google Forms

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Skill Development**

Activities (Em / En /SD): Stellar identification using stellarium mobile app

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): - Environment Sustainability activities related to Cross Cutting Issues:-

Assignment: Identify the Inner and Outer planets using stellarium mobile app.

Seminar Topic: (if applicable):-

Sample questions (minimum one question from each unit)

Part A (2 marks)

1. Name the outermost layer of the sun.**(K1-R, CO-1)**
2. What is the gap between the orbit of mars and Jupiter called? **(K2-U, CO-2)**
3. Mention the shape of the cross-section for objects involved in an astronomical eclipse. **(K3-Ap, CO-3**)
4. Which is the brightest planet in the universe? **(K4-An,CO-4)**
5. Which is the nearest planet to the sun? (**K5-E, CO4)**

Part B (4 marks)

1. Write short note on solar flares. **(K1-R, CO-1)**
2. State Bode's law of planetary distances.**(K2-U, CO-2)**
3. Explain the Solar eclipse geometry. **(K3-Ap,CO3)**
4. Compare red and water planet. **(K4-An, CO-4)**
5. Evaluate why Pluto is called dwarf planet. **(K5-E, CO-5)**

Part C (9 marks)

1. With neat sketch, explain the layers present in the sun. (**K1-R, CO-1)**
2. Differentiate Shooting stars from Falling stars.**(K2-U, CO-2)**
3. Calculate the Total and partial lunar eclipse. **(K3-Ap, CO-3)**
4. Analyse the concept "Earth's twin". **(K4-An, CO-4)**
5. Compare the physical properties of largest and ringed planet. **(K5-E, CO-5)**

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Head of the Department
Dr.V.Shally

Course Instructors
Dr.V.Shally & Dr.M. Abila Jeba Queen

Department : Physics
Class : III B.Sc Physics
Title of the Course : CORE COURSE V: ATOMIC PHYSICS AND LASERS
Semester : V
Course Code : PU235CC1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU235CC1	5	-	-		4	5	75	25	75	100

Learning Objectives:

1. To understand the relativistic model, vector atom model and practical applications of photoelectric cells
2. To get knowledge on the working principles of lasers and to analyze spectral line splitting

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	understand the different types of crystal imperfections and their effects on material properties	**K1**
2.	interpret the concepts of elastic and inelastic behavior of materials at an atomic level.	**K2**
3.	utilize non-linear optical (NLO) materials in designing optical communication and laser systems.	**K3**
4.	analyze the working principles of NLO materials, LEDs and LCDs for display applications	**K3&K4**
5.	assess the suitability of various testing techniques for evaluating material properties	**K5**

K1-Remember;**K2**-Understand;**K3** -Apply;**K4** -Analyze;**K5** -Evaluate;**K6**–Create

Teaching plan
Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**THE ELECTRON AND POSITIVE RAYS**								
	1	Introduction**,** e/m of electron by Dunnington's method - charge of electron by Millikan's oil drop method	3	1	K1(R)	Lecture with Visual Aids such as PPT, Conceptual Demonstration**,** Flipped Classroom.	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching	Video Lectures,Simulations,	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	2	properties of positive rays – e/m of positive rays by Thomson's parabola method (problems calculation of e/m ratio of positive rays)	3		K3(Ap)	Lecture with visualization, Concept-based discussion ,	Collaborative Learning, Concept Mapping	PowerPoint with graphical representations ,	Quizzes Concept check polls during class using Slido, CIA I
	3	mass spectrographs and uses	3	1	K5(E)	Visual Lecture with Graphical Derivation	Think-Pair-Share, Inquiry-Based Learning	Video Lecture, Simulations, web tools	Formative Quiz using Nearpod / Kahoot / Google Forms, CIA I
	4	Bainbridge and Dempster's	4		K4(An)	Derivation based teaching,	Study Analysis Peer Learning,	Video Lecture, web tools	Formative Quiz using Nearpod /

		mass spectrographs				Analogical Pedagogy	Real-World Application		Kahoot / Google Forms, CIA I
II	**ATOMIC STRUCTURE**								
	1	Sommerfield's relativistic atom model – vector atom model	3	1	K2(U)	Lecture with Visual Aids such as PPT, Simulation-Based Learning, Conceptual Demonstration, Flipped Classroom.	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching, Gamified Quiz, Concept Mapping.	Video Lectures,Simulations, Notes/Slides,	Formative Quiz using Nearpod / Kahoot / Google Forms, Conceptual Questions, CIA I
	2	various quantum numbers – L-S and J-J coupling – Pauli's exclusion principle	4		K3(A)	Lecture with visualization, Concept-based discussion , Derivation based teaching	Collaborative Learning, Concept Mapping	PowerPoint with graphical representations ,	Quizzes Problem-solving worksheets CIA I
	3	magnetic dipole moment of an electron due to orbital and spin motion	3	1	K4(An)	Lecture with Visual Aids such as PPT, Derivation based teaching, Blended Learning	Think-Pair-Share, Inquiry-Based Learning, simulations	Video Lecture, Simulation Tool, Interactive Notes,	Formative Worksheet, Visualization Task, Conceptual Quiz, Group Presentation, CIA II
	4	Bohr magneton - Stern and Gerlach experiment – Lande 'g' factor.	3		K5(E)	Active learning, Flipped classroom, concept based discussions, problem solving sessions	Peer teaching Quiz, Brain storming, Explaining concepts and derivations	Youtube Videos of Learn Engineering – Animation-based concepts,	Project based Presentation, Problem-Solving Assignments, Open Book Exam Questions, CIA II

								Online Tutorials and Notes	
III	**SPLITTING OF SPECTRAL LINES**								
	1	Excitation, ionization and critical potentials – Davis and Goucher's method	4	1	K2(U)	Lecture with Visual Aids such as PPT, Simulation-Based Learning, Conceptual Demonstration, Flipped Classroom.	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching, Gamified Quiz, Concept Mapping.	Video Lectures, Simulations, Notes/Slides,	Formative Quiz using Nearpod / Kahoot / Google Forms, Written Assignment-Problem-based worksheet, Oral Presentation, Conceptual Questions, CIA II
	2	optical spectra – spectral notation and selection rules – fine structure of sodium D-line	3		K3(Ap)	Lecture with visualization, Concept-based discussion, Problem-solving sessions using real-world applications.	Collaborative Learning, Concept Mapping	PowerPoint with graphical representations, - 3D simulations for visualizing Reciprocal Lattice	Quizzes Concept check polls during class using Slido, Problem-solving worksheets CIA II
	3	Zeeman effect – experimental arrangement - Larmor's theorem	3	1	K5(E)	Derivation based teaching, Visual Lecture with Graphical Derivation, Mini-Lecture Segments	Peer teaching Quiz, Brain storming, Explaining concepts and derivations	Video Lecture, Simulation Tool, Interactive Notes	Formative Worksheet, Visualization Task, Conceptual Quiz, Group Presentation, CIA II
	4	anomalous	3		K4(An)	Spiral Curriculum	Problem-Based	Youtube	Short questions

		Zeeman effect– Paschen Back effect - Stark effect (Qualitative only).				Approach, Constructivist Learning Analogical Pedagogy,	Learning, Real-World Application Projects	Videos of Learning based concepts, Online Tutorials and Notes	Open Book Exam Questions, CIA II
IV	**LASERS**								
	1	general principles of lasers – properties of lasers action – spontaneous and stimulated emission	4	1	K1(R)	Lecture with Visual Aids such as PPT, Simulation-Based Learning, Conceptual Demonstration.	Think-Pair-Share, Inquiry-Based Learning, Peer Teaching, Gamified Quiz, Concept Mapping.	Powerpoint, Video Lectures,Simulations	Formative Quiz using Nearpod / Kahoot / Google Forms, Conceptual Questions, CIA I
	2	population inversion – optical pumping – He-Ne laser (principle and working)	3		K3(Ap)	Visual and Conceptual Pedagogy using energy level diagrams - Flipped Classroom with pre-reading/videos	Collaborative Learning, Concept Mapping	PowerPoint with graphical representations and Youtube videos	Short oral explanation by students: one-minute concept drill, CIA I
	3	semiconductor laser – solid state laser: ruby laser,	3	1	K5(E)	Lecture with visualization, Concept-based discussion	Collaborative Learning, Concept Mapping	Youtube Videos, Online Tutorials and Notes	Conceptual Quiz, Group Presentation, Assignments, CIA I
	4	Nd: YAG laser –laser	3		K4(An)	Lecture with Visual Aids such as	Think-Pair-Share, Inquiry-	Powerpoint, Video	Open Book Exam, CIA I

		applications – holography				PPT,Simulation-Based Learning, Conceptual Demonstration.	Based Learning, Peer Teaching, Gamified Quiz, Concept Mapping.	Lectures,Simulations	
V	**Applications of LASER**								
	1	application of laser in metrology – optical communication	3	1	K2(U)	ApplicationOriented Teaching, Real-World Examples and Case Studies, Demonstration-Based Explanation	Think-Pair-Share, Group Discussion, Role Play	IEEE Spectrum articles on modern laser-based metrology	Role play presentation, CIA II
	2	material processing: laser instrumentation of material processing, powder feeder	3		K1(R)	Lecture with visualization, Concept-based discussion	Collaborative Learning, Concept Mapping	NPTELmodules, Youtube Videos	Conceptual Quiz, Group Presentation, CIA II
	3	laser heating, laser welding, laser melting – medical application	3	1	K3(Ap)	Application-Based Learning, Demonstration through Videos & Industrial Use Cases	Case-Based Learning: Analyze real-world medical laser uses	NPTEL modules, Youtube Videos	Formative Quiz using Nearpod / Kahoot / Google Forms, Conceptual Questions, CIA II
	4	Laser instrumentation for surgeries–	4		K5(E)	Evaluation-Based Pedagogy using Comparative Analysis	Case study comparison, Peer Review	Youtube Videos, Online Tutorials and Notes	Conceptual Quiz, Group Presentation, CIA II

		laser in astronomy							

Course Focussing on Employability/ Entrepreneurship/ Skill Development :**Employability**
Activities (Em/ En/SD):**Practical and Project**
Course Focussing onCross Cutting Issues(Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -
Activities related to Cross Cutting Issues :-
Assignment : (Mention Topic and Type): **problems calculation of e/m ratio of positive rays -descriptions through Google Classroom**(Last date to submit – 05-09-2025)
Seminar Topic: (if applicable):

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. Millikan's oil drop experiment is used to determine: **(K4- An, CO 5)**
   a) Speed of light
   b) Charge of the electron
   c) Mass of proton
   d) Value of Planck's constant
2. Which quantum number determines the shape of an orbital? **(K2- U, CO 1)**
   a) Principal quantum number
   b) Magnetic quantum number
   c) Azimuthal quantum number
   d) Spin quantum number
3. The fine structure of the sodium D-line arises due to: **(K4- An, CO3)**
   a) Spin-orbit coupling
   b) Zeeman effect
   c) Stark effect
   d) Hyperfine splitting
4. Which of the following is necessary to achieve population inversion in a laser medium?
   (K1 – R, CO 4)
   a) Optical transmission
   b) Optical pumping
   c) Diffraction
   d) ReflectionThe superconducting transition temperature was experimentally found to vary with the isotope mass. Say true or false. (K2- U, CO 1)

5. Which of the following best demonstrates the precision of lasers in industrial applications?
   (K5 – E, CO5)
   a) Optical amplification
   b) Surface polishing
   c) Laser welding of micro components
   d) Beam splitting

Part B (6 marks)

1. Infer about properties of positive rays.**(K5- E, CO 3)**
2. Analyze the L-S and J-J coupling.**(K4- An, CO 5)**
3. What do you understand by Davis and Goucher's method?**(K2- U, CO 1)**
4. Illustrate the energy level transitions in a He-Ne laser and explain how laser emission occurs.**(K4- An, CO 4)**
5. Evaluate the effectiveness of lasers in optical communication systems in terms of data rate, loss, and bandwidth.**(K5- E, CO 5)**

Part C (12 marks)

1. Estimate the expression for charge of electron by Millikan's oil drop method. **(K5- E, CO 3)**
2. Explain magnetic dipole moment of an electron due to orbital and spin motion**. (K2- U, CO 1)**
3. Define optical spectra and derive spectral notation,selection rules and fine structure of sodium D-line.**(K4- An, CO 5)**
4. Analyze the construction and working of Nd:YAG and semiconductor lasers. Highlight the differences in terms of energy level diagrams, excitation techniques, and applications. Support your answer with labeled diagrams.**(K4- An, CO 4)**
5. Evaluate the advantages and limitations of lasers in metrology, material processing, medical applications, and astronomy. Support your answer with examples.**(K5- E, CO 5)**

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Head of the Department

C.Nirmala Louis A.Lesly Fathima

Dr.C.Nirmala Louis & Dr.Lesly Fathima
Course Instructor

Department : Physics
Class : III B.Sc. Physics
Title of the Course : Core Course VI: Relativity and Quantum Mechanics
Semester : V

Course Code : PU235CC2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU235CC2	5	–	–	–	4	5	75	25	75	100

Learning Objectives

1. To learn the importance of transformation equations and also to differentiate between special and general theory of relativity.
2. To interpret the wave theory of matter with various theoretical and experimental evidences.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	gain knowledge in the concepts of relativity and quantum mechanics	**K1**
2.	understand the various theory of relativity, transformation relation, matter waves, operators and Schrodinger equations.	**K2**
3.	realize the wave nature of matter, use of operators the relativity theories and Schrödinger equation to simple problems.	**K3**
4.	appreciate the importance of transformation equations, theory of relativity, wave nature and operators in quantum mechanics	**K4**
5.	derive Schrodinger equation and transformation relations for the system	**K5**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching Plan
Total Contact hours: 75 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**SPECIAL THEORY OF RELATIVITY**								
	1	Michelson-Morley experiment	2	1	K2 (U)	Lecture with Visual Aids such as PPT, Flipped Classroom.	Inquiry-Based Learning	*Michelson Interferometer Simulator* – Real-time beam path visual	Google Classroom for quizzes and discussions CIA I
	2	Frames of reference – Galilean Relativity- postulates of special theory of relativity	2	1	K1 (R)	Activity-Based Learning	Role-play - special theory of relativity	YouTube	MCQs on Galilean vs. Einstein transformations via Google Forms CIA I
	3	Lorentz transformation – consequences – time dilation–concept of simultaneity	3		K3 (Ap)	Concept-based discussion , Problem-solving sessions using real-world applications.	Collaborative Learning, Concept Mapping	"Relativity: Light Clock Simulation"	Conceptual quizzes via Kahoot / Google Forms.CIA I.
	4	Doppler effect – length contraction–variation of mass with velocity	2		K4 (An)	Inquiry-Based Learning- Collaborative Learning	Peer teaching using sound demos.	Notes-Microsoft word	Problem-solving assignments on relativistic velocity CIA I.

	5	Einstein's mass-energy relation– Relativistic momentum–energy relation	3	1	K5 (E)	Problem-Based Learning	Peer teaching	YouTube – Minute Physics	CIA I
II	**TRANSFORMATION RELATIONS:**								
	1	Transformation of velocity, mass, energy and momentum	3	1	K1 (R)	Interactive PPT, Lecture ,discussion	Whiteboard Activity- find rest mass from total energy and momentum	GeoGebra- *Lorentz Transformation*, *Velocity Addition Graphs*	MCQ via Hot potatoes CIA I
	2	Four vector– Invariance under transformation	2		K2 (U)	Inquiry-Based Learning , Flipped classroom	Think-Pair-Share	E-notes	Derivation-Based Question CIA I
	3	Lorentz transformation and velocity addition equations in terms of hyperbolic functions.	3	1	K3 (Ap)	Lecturing, Problem solving	Creating a map linking: velocity → rapidity → hyperbolic functions → Lorentz boost.	Brilliant.org – Special Relativity	Problem Solving Assignment CIA I
	4	General theory of relativity: Inertial and Gravitational mass– Principle of equivalence	2		K2 (U)	Collaborative learning	Visual pages on mass-energy and momentum-energy relationships	-	Probing Questions CIA I
	5	Experimental evidences for General theory of Relativity	2	1	K5 (E)	Inquiry-Based Learning	Formulating questions, Discussing the concepts	YouTube – Veritasium: How Einstein's General Relativity Was Proven	CIA I

III	**PHOTONS AND MATTER WAVES**								
	1	Difficulties of classical physics and origin of quantum theory –black body radiation	3		K1 (R)	Active Learning	Chart and model making	You-tube video	Probing Questions CIA I
	2	Planck's law – Einstein's photoelectric equation	2	1	K2 (U)	Inquiry-Based Learning	Think-Pair-Share	Notes: Microsoft word	Slip test CIA I
	3	Compton effect – pair production	2	1	K3 (Ap)	Reflective Pedagogical Approach	Data Analysis Task	E-notes	MCQ via Slido CIA I
	4	De Broglie waves–phase velocity and group velocity	1		K2 (U)	Peer Teaching/Peeragogy	Graph Plotting : plot phase and group velocity versus wavelength or momentum from given formulas and interpret the results	PBS Space Time	CIA II
	5	Davisson and Germer's experiment	2		K5 (E)	Inquiry-Based Learning	Flipped classroom, KWL Chart	-	Numerical Problem CIA II

	6	Uncertainty principle – consequences – illustration of Gamma ray microscope.	2	1	K2 (U)	Flipped Classroom	Gamma Ray Microscope Illustration	You-tube Video	Group Discussion CIA II
IV	**OPERATORS AND SCHRÖDINGER EQUATION**								
	1	Postulates of quantum mechanics – Wave function and its interpretation	2		K1 (R)	Inquiry-Based Learning	Concept Map : Postulates → Wave Function → Probability Interpretation → Measurement → Collapse	Khan Academy - Quantum Mechanics: Wave-Particle Duality	Probing Questions CIA II
	2	Schrödinger‘s equation – linear operators – Eigen value – Hermitian operator – properties of Hermitian operator	3	1	K2 (U)	Inquiry-Based Learning	In-class Problem Solving	YouTube – Looking Glass Universe	MCQ through Nearpod CIA II
	3	Observable – operators for position, linear Momentum, angular momentum components	2	1	K3 (Ap)	Problem-Based Learning (PBL)	Brainstorming Section, KWL Chart	-	Class test CIA II
	4	Commutator algebra– commutator between these operators – expectation values of position and momentum	3		K2 (U)	Inquiry-Based Learning	Jigsaw Technique	E-notes	MCQ via google forms CIA II
	5	Operators –expectation values of position and momentum – Ehrenfest theorem	2	1	K5 (E)	Reflective Pedagogical Approach	Collaborative Derivation	YouTube videos	CIA II

V	**SOLVING SCHRÖDINGER EQUATION FOR SIMPLE PROBLEMS**								
	1	One-dimensional problems : particle in a box	3	1	K2 (U)	Problem-Based Learning (PBL)	Concept Mapping & Discussion	Interactive Tutorials : Brilliant.org – Particle in a Box	Leading Questions CIA II
	2	Barrier penetration problem – quantum mechanical tunneling,	3		K3 (Ap)	Reflective Pedagogical Approach	Problem Solving	PhET Quantum Tunneling and Wave Packets	MCQ CIA II
	3	Linear harmonic oscillator	2	1	K3 (Ap)	Problem-Based Learning (PBL)	Think-pair - Share	E-notes	Descriptive Answer Test CIA II
	4	Higher dimensional problems: Rigid rotator	2		K2 (U)	Problem-Based Learning (PBL)	Energy Level Sketching	PhET or 3D Viewer	Slip Test CIA II
	5	Hydrogen atom	2	1	K5 (E)	Problem-Based Learning (PBL)	Spectroscope kits or virtual labs to analyze hydrogen emission spectrum	YouTube video	Open Book Exam CIA II

CourseFocussingonEmployability/Entrepreneurship/SkillDevelopment: Entrepreneurship Activities (En): Problem solving in relativity.

Course Focusing on Cross Cutting Issues (Professional Ethics/HumanValues/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues :-

Assignment: Elementary ideas of general relativity.

Seminar Topic: -

Sample questions

Part A (1 marks)

1. Which experiment disproved the existence of the luminiferous ether? **(K1-R,CO-1)**

a) Davisson-Germer experiment

b) Michelson-Morley experiment

c) Compton effect

d) Photoelectric effect

2. Choose the correct De Broglie wavelength of a 46 gm gold ball moving with velocity 36m/m. **(K2-U, CO-2)**

a) $4x10^{-34}m$ b)$5x10^{-34}m$ c)$4x10^{-32}m$ d)$5x10^{-32}m$

3. Which of the following is a Hermitian operator in quantum mechanics? **(K1-R, CO-4)**

a) Time operator

b) Probability operator

c) Position operator

d) Transformation operator

4. Angular momentum is the rotational analog of linear momentum. State True/False**(K2-U, CO-5)**

5. What is the qualitative result of the rigid rotator solution? **(K2-U, CO-3)**

a) Discrete energy levels

b) Continuous energy spectrum

c) Infinite potential

d) No solution

Part– B (6 Marks)

1. State and explain the postulates of general theory of Relativity.**(K2-U,CO-1)**
2. Calculate the deBroglie wavelength of the charge particle of charge q and accelerated through the potential V. **(K5-E, CO-2)**
3. Obtain the Einstein's photoelectric equation.**(K2-U, CO-1)**
4. State and explain the general postulates of quantum mechanics.**(K2-U,CO-1)**
5. Determine the energy and momentum operators using Ehrenfest theorem. **(K3-Ap, CO-4)**

Part–C (12 Marks)

1. Explain in brief about the Michelson-Morley experimental setup and interpret the negative result. **(K2-U, CO-1)**

2. Derive a relation connecting group and phase velocity.**(K5-E,CO-2)**

3. Give a detailed account on linear operators and self adjoint operators.**(K2-U,CO-1)**

4. Separate three dimensional Schrodinger equation into radial and angular parts.**(K3-Ap, CO-4)**

5. Apply Schrodinger equation and find out the energy and wave function of a Linear Harmonic Oscillator. **(K3-Ap, CO-4)**

Head of the Department
Dr. V. Shally

Course Instructor
Dr. S. Sonia

Department : Physics
Class : III B.Sc. Physics
Title of the Course : CORE LAB COURSE V: GENERAL PHYSICS LAB V
Semester : V
Course Code : PU235CP1

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU235CP1	-	-	3	-	2	3	45	25	75	100

Learning Objectives:

1. To understand and analyze the principles of optics, electromagnetism, and thermal physics through experimental techniques, including spectrometry, diffraction grating, and ballistic galvanometer measurements.
2. To develop hands-on skills in precision measurements and data analysis for determining optical properties, inductance, sound velocity, and thermal conductivity of materials, enhancing experimental and analytical capabilities in physics.

Course Outcomes

On the successful completion of the course, students will able to:		
1.	recall fundamental principles of optics, diffraction, interference and thermal conductivity.	**K1&K2**
2.	apply experimental methods to determine optical parameters, measure inductance.	**K3**
3.	analyze experimental data to determine dispersive power, mutual inductance, and material properties.	**K4**
4.	assess and interpret experimental results to verify theoretical concepts and improve measurement accuracy in optical, electrical, and thermal systems.	**K5**
5.	develop prototypes using physics concepts.	**K6**

K**1**–Remember**; K2**–Understand**; K3-**Apply**; K4-**Analyze**, K5-** Evaluate**, K6-**Create

Total Contact Hours: 30 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Spectrometer: Diffraction grating-Normal incidence. Wavelength of Mercury spectral lines.	6	1	K1& K2	Project-Based Learning	Peer Learning through group tasks	OLabs: www.olabs.edu.in	Result accuracy, Spectral line focussing, teamwork, Model Exam
2	Spectrometer: Hartmann's Interpolation.	7	1	K3	Blended Learning	Think-Pair-Share	PhET Interactive Simulations: https://phet.colorado.edu	Project based Evaluation, Model Exam
3	Spectrometer: Oblique incidence	6	1	K3	Reciprocal Learning	Real-time experimentation	Amrita Virtual Labs : https://vlab.amrita.edu	Oral Q&A, concept explanation , Model Exam
4	Spectrometer: Dispersive power of plane diffraction grating.	7	1	K5&K6	Constructivist Pedagogy, Activity-Based Learning	Peer Teaching	YouTube: Physics Galaxy or LearnHub	Result accuracy, Lab report with observation and calculation Model Exam

5	Figure of Merit using B.G -Charge Sensitivity	7		K5&K6	Experiential Learning	Group Activity	PhET Interactive Simulations: https://phet.colorado.edu	Lab report with observation and calculation, Model Exam
6	Comparison of Mutual Inductance using B.G	7	1		Inquiry-Based learning	Group brainstorming	YouTube: Physics Galaxy or LearnHub	Concept-based probing questions, Result accuracy Model Exam

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training, Project

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): NIL

Environment Sustainability activities related to Cross Cutting Issues: NIL

Sample questions

1. Determine the wavelength of mercury spectral lines using a plane transmission grating in normal incidence position
2. Determine the dispersive power of the plane diffraction grating using spectrometer and mercury lamp.
3. With the given prism and a spectrometer, find the constants of Hartmann's interpolation formula assuming the wavelengths of 3 prominent lines in the mercury spectrum. Use the constants to find the wavelengths of other twolines in the same spectrum.
4. Find the number of lines per unit length of the plane transmission grating by placing it at oblique incidence position. Use mercury spectrum. Assume λ_g=5461Å. Determine the wavelength of atleast four bright lines using the above arrangement.
5. Determine the resistance of a ballistic galvanometer by half-deflection method and to find its figure of merit.
6. Compare the mutual inductance of the given two pair of coils using using B.G.

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Course Instructor

Department : Physics
Class : III B.Sc. Physics
Title of the Course : CORE LAB COURSE VI: GENERAL PHYSICS LAB VI
Semester : V
Course Code : PU235CP2

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU235CP2	-	-	2	-	2	2	30	25	75	100

Learning Objectives:

1. To understand the role of different components in generating pulses and stable signals.
2. To observe the frequency generation and stability of the oscillator circuits.

Course Outcomes

On the successful completion of the course, students will able to:		
1.	recall the basic concepts of transistors, multivibrators and Operational amplifiers.	**K1&K2**
2.	design and analyze transistor-based oscillators, including Colpitt's and Hartley oscillators, and evaluate their frequency stability.	**K3& K4**
3.	construct and test astable, monostable, and bistable multivibratorsusingIC555timers	**K3&K5**
4.	verify De Morgan's theorem and implement NOR gate as a universal gate using digital ICs.	**K3**
5.	design and implement half adders, full adders, half subtractors, and full subtractors using basic logic gates.	**K4&K6**

K**1**–Remember**; K2**–Understand**; K3-**Apply**; K4-**Analyze**, K5-** Evaluate**, K6-**Create

Total Contact hours: 30 (Including Practical Classes and Assessments)

Unit	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
1	Astable multivibrator using IC555	4	1	K1& K2	Inquiry-Based Learning, Project-Based Learning	Hands-on Breadboarding	"Digital Electronics" & "Analog Circuits" by Prof. Anant Agarwal, Prof. S.C. Dutta Roy https://nptel.ac.in	Rubric-Based Evaluation- Circuit accuracy, waveform correctness, concept explanation, teamwork, Model Exam
2	Verification of De Morgan's theorem using ICs– NOT,OR,AND	4	1	K3	Peer Teaching, Reciprocal Learning, Reciprocal method	Group Activity, Think-Aloud Protocol	Digital Logic Design Lecture series https://ocw.mit.edu	Project based Evaluation, Model Exam
3	NOR as universal building block	4	1	K3	Blended Learning, Demonstration method	Hands-on circuit construction and real-time experimentation		Oral Q&A ,Troubleshooting questions, Model Exam
4	Half adder / Full adder using basic logic gate ICs	4	1	K5&K6	Constructivist Pedagogy, Activity-Based Learning	Peer Teaching (exchanging roles during circuit building),	NPTEL: Digital Circuits by Prof. S. C. Dutta Roy,	Viva on truth table, logic equations, Circuit

						Think-Pair-Share (for truth table generation and circuit design)	Logic circuit simulation, Interactive logic gate simulations, YouTube: All About Electronics, Ekeeda	functionality test, Model Exam.
5	Monostable Multivibrator using IC555	5		K5&K6	Experiential Learning, Inquiry-Based Pedagogy	Circuit Debugging Challenge, Peer Learning through group tasks	NPTEL: Analog Circuits by Prof. S. Janakiraman, YouTube: Electronics Hub, EEVblog	Pre-lab quiz on timing formula T=1.1RC, Oscilloscope waveform verification, Viva on IC 555 pin configuration, Lab report with circuit diagram and calculated vs observed timing, Peer evaluation on troubleshooting skills, Model Exam
6	Encoder using IC or Equivalent circuit	4	1		Project-Based Learning,	Group brainstorming & presentation	NPTEL: Digital Systems by	Functional circuit evaluation,

					Problem-Based Learning		Prof. Dinesh Patel, YouTube: Gate Smashers, Electronics Tutorials	Report on priority encoder logic, Oral presentation on real-world encoder uses, Concept-based MCQs on encoders and decoders, Model Exam

Course Focussing on Employability/ Entrepreneurship/ Skill Development: Employability, Skill Development

Activities (Em / En /SD): Hands on Training , Project

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): NIL

Environment Sustainability activities related to Cross Cutting Issues: NIL

Sample questions

1. In the lab, construct an astable multivibrator circuit using IC 555. Measure the output frequency using a CRO or frequency counter. Derive the expression for the time period using the values of resistors R1, R2 and capacitor C used in your circuit. Also, explain the role of each component based on your observation.
2. Using basic ICs (7404, 7432, 7408), implement both sides of De Morgan's second theorem: $(A + B)' = A' \cdot B'$. Construct the circuit on a breadboard, apply all input combinations, and verify the truth table by observing output using LEDs. Record your observation and interpret the results.
3. Design and construct a logic circuit on a breadboard to implement an AND gate using only NOR gate ICs (7402). Test the output for all possible input combinations and verify with the expected AND gate truth table. Draw the implemented logic diagram in your observation sheet.
4. Construct a full adder circuit on a breadboard using two half adders and one OR gate IC. Test the adder by applying all possible input combinations (A, B, Cin) and record the outputs for Sum and Carry. Verify with the theoretical truth table and comment on your results.
5. Set up a monostable multivibrator using IC 555 on the breadboard. Trigger the circuit using a push-button or waveform generator. Measure the output pulse width using a CRO or timer. Verify the output pulse width using the formula $T = 1.1 \times R \times C$, and explain how varying R and C changes the pulse duration.
6. Using a 4-to-2 encoder IC or its equivalent circuit using logic gates, construct the encoder on a breadboard. Activate one input line at a time (D0–D3) and observe the corresponding binary output using LEDs. Record and verify the output for each input line. Explain your observation.

Dr. V. Shally
Head & Associate Professor
Department of Physics

Dr. S. Sonia & Dr.M.Priya Dharshini

Head of the Department **Course Instructors**

Department : **Physics**
Class : **III B.Sc. Physics**
Title of the Course : **Discipline Specific Elective I:c) Electricity, Magnetism and Electromagnetism**
Semester : **V**
Course Code : **PU235DE3**

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU235DE3	4	–	–	–	3	4	60	25	75	100

Learning Objectives:

1. To classify materials based on their electrical and magnetic properties and to analyse the working principles of electrical gadgets.
2. To understand the behaviour of DC, AC and transient currents.

Course Outcomes

COs	Upon completion of this course, students will be able to:	
1	recall and define key concepts in Electromagnetic Theory	K1
2	understand the fundamentals of electrostatics and capacitors	K2
3	apply current electricity concepts in practical scenarios	K3
4	analyse magnetism and magnetic material properties	K4
5	evaluate different physical quantities used to explain magnetic properties of materials	K5

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**CAPACITORS AND THERMOELECTRICITY**								
	1	Capacitor-principle	1	1	K1(R)	Lecturing, Inquiry based Learning	Think-pair-share, Formulating Questions,	Notes and Lecture Slides	Evaluation through short test, Formative Quiz I using Google Forms, MCQ, True/False, Conceptual Questions, CIA I
	2	Capacitance of a parallel plate capacitor (with and without dielectric slab) - effect of dielectric	3		K2(U)	Lecturing, Collaborative Learning, Blended Learning	Think-pair-share, Group Discussions, Online discussions, Team Based Learning, Online problem sets	Video Lecture, Interactive PPT	Evaluation through short test, Formative Quiz I using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA I
	3	Carey Foster bridge - temperature coefficient of resistance - Seebeck effect	2	1	K2(U)	Lecturing, Collaborative Learning, Experiential Learning	Think-pair-share, Group Discussions Problem Solving- Pause and solve, Team	Video Lecture, Interactive PPT	Evaluation through short test, Formative Quiz I using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False,

							Based Learning, Lab work		Conceptual Questions, CIA I
	4	Laws of thermo emf - Peltier effect-Thomson effect	2		K2(U)	Lecturing, Collaborative Learning, Peer Teaching	Think-pair-share, Group Discussions, explaining concepts, Creating Teaching Aids Team Based Learning, Jigsaw method	Youtube Videos, Lecture Slides	Evaluation through short test, Formative Quiz I using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA I
	5	Thermoelectric diagrams and their uses- Thermodynamics of thermocouple	1	1	K2(U)	Lecturing, Collaborative Learning, Flipped Classroom	Think-pair-share, Group Discussions, In-class discussions, Problem Solving- Team Based Learning, Online problem sets	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz I using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA I
II	**MAGNETIC EFFECT OF CURRENT**								
	1	Biot and Savart's law- Magnetic induction due to circular coil	2	1	K1(R)	Lecturing, Inquiry based Learning, Peer	Think-pair-share, Formulating Questions,	Notes/ Slides	Evaluation through short test, Formative Quiz II using Google Forms, Written

						Teaching	explaining concepts, Creating Teaching Aids Problem Solving- Pause and solve, Jigsaw method		Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
	2	Force on a current element by magnetic field- force between two infinitely long conductors	2		K2(U)	Lecturing, Peer Teaching	Think-pair-share, explaining concepts, Experimental - Creating Teaching Aids Problem Solving- Pause and solve, Jigsaw method	Video Lecture, Interactive Notes	Evaluation through short test, Formative Quiz II using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
	3	Torque on- A current loop in a field-moving coil galvanometer-damping correction	2	2	K3(Ap)	Lecturing, Collaborative Learning, Flipped Classroom	Think-pair-share, Group Discussions, In-class discussions, Problem Solving- Team Based Learning,	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz II using Google Forms, MCQ, True/False, Conceptual Questions, CIA II

							Online problem sets		
	4	Ampere's circuital law-differential form–divergence of magnetic field	2		K2(U)	Lecturing, Active Learning, Blended Learning	Think-pair-share, Group Discussions, In-class discussions, Brain Storming, Problem Solving-Online problem sets	YouTube Videos, Lecture Slides	Evaluation through short test, Formative Quiz II using Google Forms, MCQ, True/False, Conceptual Questions, CIA II
	5	Magnetic induction due to toroid	1		K3(Ap)	Collaborative Learning, Peer Teaching, Reflective Pedagogical Approach	Group Discussions, Experimental - Creating Teaching Aids, Experimenting with different reflective techniques, Problem Solving-Team Based Learning	YouTube Videos of Learn Animation-based concepts on toroid	Evaluation through short test, Formative Quiz II using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
III	**MAGNETISM AND ELECTROMAGNETIC INDUCTION**								
	1	Magnetic induction B – Magnetization	2	1	K1(R)	Lecturing, Problem Based	Think-pair-share, Group Discussion,	Lecture Slides	Evaluation through short test, Formative Quiz I using Google

		M –relation between B, H and M				Learning, Peer Teaching	Explaining concepts, answering questions from peers, Problem Solving- Pause and solve, Jigsaw method		Forms, MCQ, True/False, Conceptual Questions, CIA I
0.5	2	magnetic susceptibility- magnetic permeability- experiment to draw B-H curve	2	1	K2(U)	Lecturing, Collaborative Learning	Think-pair-share, Group Discussion, Problem Solving- Pause-and-solve, Team-based Learning,	Lecture Slides Interactive PPT	Evaluation through short test, Formative Quiz II using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
0.5	3	energy loss due to hysteresis - importance of hysteresis curve	2		K4(An)	Lecturing, Flipped Class room	Think-pair-share, Collaborative Problem solving sessions	You Tube Videos	Evaluation through short test, Formative Quiz II using Google Forms, Written Assignment- Problem-based worksheet, MCQ, True/False, Conceptual Questions, CIA II
	4	Faraday and Lenz laws – self-inductance – coefficient of	2	1	K2 (U)	Lecturing, Inquiry-based learning	Group discussions, Derivation-focused	Lecture Slides	Quiz,Problem Solving, CIA I

		self-inductance of solenoid					problem solving		
	5	Anderson's method – mutual inductance – coefficient of mutual inductance between two coaxial solenoids – coefficient of coupling	1		K3 (Ap)	Team-based Learning, Peer Teaching	Experimental analogies, Derivation-based activity	Interactive PPT	Quiz,Problem Solving, CIA I
IV	**TRANSIENT AND ALTERNATING CURRENTS**								
	1	Growth and Decay of current in an RL circuit	2	1	K2 (U)	Lecturing, Visual Learning	Derivation with graphs, Interactive Board Activity	Simulations	Quiz, Short Problems
	2	Growth and Decay of charge in an RC circuit	2		K2 (U)	Collaborative Learning	Pause-and-solve, Formula Derivation	Lecture Slides	CIA II, MCQ
	3	Growth and decay of charge in an LCR circuit (expression for charge only)	2	1	K2 (U)	Flipped Class, Peer Explanation	Graph plotting, Interactive PPT	Circuit Diagrams	Short Test, CIA II
	4	Peak, average and RMS values of AC	2		K3 (Ap)	Problem-Solving Approach	Worksheet-based practice, MCQ Discussions	Animations	Written Assignment

	5	LCR Series and Parallel circuits – resonance – Q factor – power factor	1	1	K4 (An)	Inquiry-Based, Team-based Learning	Circuit analysis, Real-time simulation	YouTube Videos, Lab Demos	Quiz, Problem Set, CIA II
V	**MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVES**								
	1	Maxwell's equations in vacuum and material media	2	1	K1 (R)	Lecturing, Active Learning	Think-pair-share, Summary Mapping	PPT, Equation Sheets	Quiz, Conceptual Questions, CIA II
	2	Physical significance of Maxwell's equations	2		K2 (U)	Inquiry-Based	Peer Group Discussion	YouTube Lectures	MCQ, CIA II
	3	Displacement current – derivation and interpretation	2	1	K3 (Ap)	Collaborative Learning	Board Work + Interactive Quiz	Derivation Sheets	Written Test, CIA II
	4	Plane electromagnetic waves in free space – velocity of light	2		K3 (Ap)	Flipped Classroom	Derivation, Visualization of wave propagation	Video Animations	Problem Solving Assignment, CIA II
	5	Poynting vector – Electromagnetic waves in a linear homogeneous medium – refractive index	1	1	K4 (An)	Problem-Based Learning	Real-world Applications Discussion	PPT, Journal Articles	Quiz, CIA II, MCQ

Course Focussing on Employability/ Entrepreneurship/ Skill Development: **Employability, Skill Development**

Activities (Em / En /SD):

Course Focusing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Assignment: Problem solving on the topics Capacitor and its principle, Capacitance of a parallel plate capacitor (with and without dielectric slab) - effect of dielectric, Carey Foster bridge - temperature coefficient of resistance, (Last date to submit – 07-09-2025)

Sample questions (minimum one question from each unit)

Part A (1 mark)

1. Which factor is essential to increase capacitance in a parallel plate capacitor? **(K2-U, CO2)**
    a) Decreasing area
    b) Increasing plate distance
    c) **Inserting a dielectric**
    d) Reducing voltage
2. Magnetic field inside a long toroid is: **(K2-U, CO2)**
    1. Zero
    2. Infinite
    3. **Confined and uniform**
    4. External only
3. The relation between B, H, and M in a magnetic material is: **(K1-R, CO1**)
    a) B = M – H
    b) H = M / B
    c) **$B = \mu_0(H + M)$**
    d) $B = \mu M$
    e)

4. The term “displacement current” was introduced by **(K1-R, CO1**)

a) Michael Faraday
b) Heinrich Hertz
c) James Clerk Maxwell
d) André-Marie Ampère

5. In a plane electromagnetic wave traveling in free space, the electric field vector and magnetic field vector are **(K2-U, CO2**)

a) Perpendicular to each other and to the direction of propagation
b) Parallel to each other
c)Perpendicular to the direction of propagation but parallel to each other
d) Randomly oriented

Part B (6 marks)

1. Explain the effect of a dielectric on the capacitance of a parallel plate capacitor.**(K2-U, CO2)**
2. Discuss the damping correction in a galvanometer.**(K2-U, CO2)**
3. Write a short note on energy loss due to hysteresis. **(K3-Ap, CO3)**
4. Organize the concept of resonance in a series LCR circuit. Define Q-factor. **(K4-An, CO4)**
5. Evaluate displacement current and explain its necessity in modifying Ampere’s law. **(K5-E, CO5)**

Part C (12 marks)

1. Compare and contrast Seebeck and Peltier effects with proper justification using practical examples. **(K4-An, CO4)**
2. Examine the differential form of Ampere’s law and discuss the physical significance of divergence of magnetic field. **(K4-An, CO4)**

3. Explain the relation between magnetic induction B, magnetizing field H, and magnetization M. Discuss how these quantities vary for different magnetic materials. **(K2-U, CO2)**
4. Discuss the growth and decay of charge in an R-C circuit. Derive the necessary expressions. **(K4-An, CO4)**
5. Explain the propagation of a plane electromagnetic wave in a linear homogeneous medium. Derive the expressions for electric and magnetic fields and show how the Poynting vector represents energy transport. Also, define refractive index in this context. **(K5-E, CO5)**

Head of the Department
Dr.V.Shally

Course Instructors
Dr. M. Priya Dharshini & Dr. R. Krishna Priya

Department : Physics
Class : III B.Sc. Physics
Title of the Course : DISCIPLINE SPECIFIC ELECTIVE II: b) NANOSCIENCE
Semester : V
Course Code : PU235DE5

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PU235DE5	4	–	–	–	3	4	60	25	75	100

Learning Objectives:

1. To provide the basic knowledge about nanoscience and nanotechnology and to learn the structures and properties of nanomaterials.
2. To acquire the knowledge about synthesis methods and characterization techniques and its applications.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1.	recall fundamental concepts of nanoscience, including nanostructures, size effects and quantum confinement.	**K1**
2.	explore the mechanical, optical, electrical, magnetic, and electrochemical properties of nanomaterials.	**K2**
3.	apply various synthesis methods such as sol-gel, CVD, sputtering, and electrochemical deposition.	**K3**
4.	analyze the structural, morphological, and optical properties of nanomaterials using characterization techniques	**K4**
5.	evaluate the applications of nanomaterials in real-world technological advancements.	**K5**

K1 - Remember; **K2** - Understand; **K3**- Apply; **K4** - Analyse; **K5-** Evaluate

Teaching plan

Total Contact hours: 60 (Including lectures, assignments and tests)

Unit	Module	Topic	Teaching Hours	Assessment Hours	Cognitive level	Pedagogy	Student Centric Method	E-Resources	Assessment/ Evaluation Methods
I	**INTRODUCTIONTO NANOSCIENCE**								
	1	History of Nanotechnology-Nanoscale-nature and nanostructures -Nanostructures: 0D,1D, 2D	3	2	K1 (R)	Lecturing (Traditional)	In-class discussions, Q&A with instructor	Interactive PPT, video lectures, e-books	Written test, viva, MCQ CIA I
	2	surface to volume ratio-size effect excitons - quantum confinement-	2		K1 (R)	Active Learning	Pause-and-solve: pose conceptual problems mid-lecture	Interactive simulators, quizzes	Short quizzes, problem-solving exercises, CIA I
	3	Semiconductor Nanoparticles - nanocomposites (non-polymer based)	2	1	K1 (R)	Collaborative Learning	Group discussions, peer feedback	Online Quizzes, collaborative docs	Peer review, group reports CIA I
	4	carbon nanostructures - fullerene - SWCNT and MWCNT and its properties	2		K1 (R)	Project-Based Learning (PBL)	Hands-on creation, real-world application of skills	Youtube Videos	Presentation CIA I
II	**PROPERTIES OF NANOMATERIALS**								
	1	Introduction - mechanical behavior	2	2	K2 (U)	Lecturing (Traditional), Active Learning	In-class discussions, pause-and-solve conceptual questions	Interactive PPT, NPTEL lectures on nanomechanics	MCQ tests, short descriptive answers CIA I

	2	elastic properties - hardness and strength - ductility and toughness - superplastic behavior	2		K2 (U)	Collaborative Learning, Experiential Learning	Group discussions, mini-lab demos, field examples	Simulation videos, virtual material testing labs	Group report, viva voce CIA I
	3	optical properties - surface plasmon resonance	2	1	K2 (U)	Flipped Classroom, Inquiry-Based Learning	Pre-class video, in-class problem solving, formulating hypotheses on SPR behavior	Virtual labs (SPR simulation), online tutorials (NPTEL, MIT OCW)	Presentation CIA I
	4	electrical properties- dielectric materials and properties	2		K2 (U)	Problem-Based Learning (PBL), Blended Learning	Information gap activities, working through applied cases	Online simulators (dielectric properties measurement), e-books	Case study analysis, quizzes CIA I
	5	magnetic properties- superparamagnetism-electrochemical properties	1		K2 (U)	Project-Based Learning (PBL), Gamification	Team project (e.g. simulating superparamagnetism)	Virtual lab simulations of magnetic properties, nano-coating behavior	Leader board score for challenge CIA I
III	**PREPARATIONOF NANOMATERIALS**								
	1	Top-down and bottom-up approaches- electrochemical method	3	2	K3 (Ap)	Lecturing (Traditional), Experiential Learning	In-class discussions, hands-on demo using virtual tools	NPTEL videos, virtual lab electrochemical setup simulators	MCQ tests, short reports CIA I
	2	chemical vapour deposition- sputtering- ballmilling	2		K3 (Ap)	Active Learning, Inquiry-Based Learning	Pause-and-solve during lecture, design of virtual experiments	Youtube videos of CVD/sputtering, ball milling	Design report CIA I
	3	sol-gel Process- Electro deposition-	2	1	K3 (Ap)	Problem-Based Learning	synthesis plan, simulation-based activity	Virtual lab sol-gel process simulators,	Case analysis presentation CIA II

		Spray Pyrolysis				(PBL), Blended Learning		NPTEL tutorials	
	4	Solvo thermal Synthesis - Sonochemical Synthesis	2		K3 (Ap)	Project-Based Learning (PBL), Gamification	Team-based virtual synthesis simulation, competitive task on process design	Virtual nano-synthesis platforms	Prototype plan submissionCIA II
IV	**CHARACTERIZATION TECHNIQUES**								
	1	Powder XRD method: determination of structure and grain size analysis	2	2	K4 (An)	Lecturing (Traditional), Active Learning	In-class discussions, demonstration of XRD analysis using virtual tools	NPTEL lectures, virtual XRD simulation tools	MCQ tests, short reports on grain size analysis CIA II
	2	scanning electron microscopy - transmission electron microscopy - atomic force microscopy	3		K4 (An)	Active Learning, Inquiry-Based Learning	Pause-and-solve during explanation of SEM/TEM/AFM, design virtual microscopy experiments	virtual microscopy lab simulations (SEM/TEM/AFM)	Virtual experiment report CIA II
	3	UV-visible and photoluminescence spectroscopy	2	1	K4 (An)	Problem-Based Learning (PBL), Blended Learning	Group activity: optical measurement plan using UV-Vis/PL data	Virtual labs for UV-Vis and PL spectroscopy, NPTEL tutorials	Group report CIA II
	4	X-ray photoelectron Spectroscopy (XPS) - EDS analysis.	2		K4 (An)	Project-Based Learning (PBL), Gamification	Team project on analyzing a material's surface using XPS/EDS data	XPS/EDS simulation tools, data interpretation software, virtual analysis videos	Presentation of findings CIA II

V	**APPLICATIONS OF NANOMATERIALS**								
	1	Medicine: Targeted drug delivery	3	2	K5 (E)	Lecturing (Traditional), Active Learning	In-class discussions, concept application in targeted drug delivery	NPTEL videos on nanomedicine, interactive tutorials	MCQ tests, short essay on applications CIA II
	2	energy: fuel cells - rechargeable batteries - supercapacitors - photovoltaics	2		K5 (E)	Problem-Based Learning (PBL), Inquiry-Based Learning	Group problem-solving on fuel cell or supercapacitor design, formulating hypotheses on energy applications	Virtual labs on fuel cells and photovoltaics, Coursera energy modules	Case study analysis CIA II
	3	Sensors: nano sensors based on optical and physical properties	2	1	K5 (E)	Project-Based Learning (PBL), Blended Learning	Team project designing nano-sensor system, combining online and offline work	Virtual nano-sensor simulations, NPTEL sensor modules	Presentation, peer review CIA II
	4	electrochemical sensors– Nano biosensors - GMR-nanorobots	2		K5 (E)	Project-Based Learning (PBL), Gamification	Competitive task: designing a nano biosensor or nanorobot application	Simulation tools for biosensor/nano robot functions, case videos	Demo presentation CIA II

Course Focussing on Employability/ Entrepreneurship/ Skill Development : **Employability**

Activities (Em/ En/SD): **Virtual lab**

Course Focussing on Cross Cutting Issues (Professional Ethics/ Human Values/Environment Sustainability/ Gender Equity): -

Activities related to Cross Cutting Issues :-

Assignment : (Mention Topic and Type): **Application of nanomaterials – LMS**

Sample questions

Part A (1 mark)

1. Define nanoscale. **(K1-R, CO 1)**
2. What is ductility? **(K2-U, CO 2)**
3. What is the purpose of ball milling? **(K3-Ap, CO 3)**
4. Which microscopy technique provides atomic-level resolution? **(K4-An, CO 4)**
5. What is the primary goal of targeted drug delivery? **(K5-E, CO 5)**

Part B (6 marks)

1. Discuss the structure and properties of fullerenes. **(K1-R, CO 1)**
2. Briefly explain surface plasmon resonance and its applications. **(K2-U, CO 2)**
3. Explain the principle of the sol-gel process and mention its applications. **(K3-Ap, CO 3)**
4. Compare SEM and TEM techniques. **(K4-An, CO 4)**
5. Describe the working of nanobiosensors with an example.**(K5-E, CO 5)**

Part C (12 marks)

1. Discuss the size effect in nanomaterials with reference to surface-to-volume ratio, quantum confinement, and excitonic effects. **(K1-R, CO 1)**
2. Describe dielectric and electrochemical properties of nanomaterials. How do these properties differ from bulk materials? **(K2-U, CO 2)**
3. Discuss in detail top-down and bottom-up synthesis approaches. Illustrate with diagrams and examples. **(K3-Ap, CO 3)**
4. Describe XRD analysis in detail. How does it help determine structure and grain size? **(K4-An, CO 4)**
5. Discuss the role of nanomaterials in energy devices such as fuel cells, supercapacitors, and photovoltaics. **(K5-Ev, CO 5)**

Head of the Department

Dr. V. Shally & Dr. P. Aji Udhaya
Course Instructors