ADUSUMILLI GOPALA KRISHNAIAH & SUGAR CANE GROWERS
SIDDHARTHA DEGREE COLLEGE OF ARTS & SCIENCE, VUYYURU
(An Autonomous College in the Jurisdiction of Krishna University, Machilipatnam)
NAAC reaccredited with "A" Grade
ISO 9001-2015

DEPARTMENT OF PHYSICS

BOARD OF STUDIES MEETING

ACADEMIC YEAR : 2024-2025

EVEN SEMESTERS (II,IV)

Dt : 13-02-2025

ADUSUMILLI GOPALA KRISHNAIAH & SUGAR CANE GROWERS SIDDHARTHA DEGREE COLLEGE OF ARTS & SCIENCE, VUYYURU-521165, KRISHNA Dt., A.P. (AUTONOMOUS).

DEPARTMENT OF PHYSICS

BOARD OF STUDIES MEETING :- 13th February 2025

The Board of studies meeting of Department of **PHYSICS** was convened at 11:30 AM on 13/02/2025 in **on-line mode** under the chairmanship of Sri J. Hareesh Chandra, Head of the Department. The members present have discussed various aspects such as changes to be made in the syllabi, scheme of Evaluation and Blue print both for theory and practical papers for II, IV semesters for the academic year 2024-2025.

The following members were present.

S.No	Name	Designation	signature
1.	**Sri J. Hareesh Chandra** Head, Department of Physics A.G & S.G.S Degree College Vuyyuru .	**Chairman**	
2	**Dr. T. Srinivasa Krishna,** Associate Professor , Head, Department of Physics, P.B. Siddhartha College, Vijayawada	**University Nominee**	
3.	**Dr. P.Venkata Ramana** H.O.D, Dept. of Physics Sri DNR Govt Degree college for women, Palakol,West Godavari .	**Subject Expert**	
4.	**Smt.K.Padmaja Rani** Lecturer in charge, S.K.S.D.MAHILA KALASALA UG AND PG (AUTONOMOUS), TANUKU.	**Subject Expert**	
5.	**Sri I. Chitti Babu** Representative from Industry, Sub Divisional Engineer, BSNL, Vijayawada .	**Industrialist**	
6.	**Sri B. Dileep Kumar** Lecturer in Physics, IIIT, NUZIVID.	Alumini	
7.	**Sri M. Sateesh** Lecturer in Physics , A.G&S.G.S Degree College, Vuyyuru	Member	

Agenda of B.O.S Meeting

1. To Recommend the Syllabus and Model Question Papers for II semester of I Degree B.Sc, Physics Major and Minor for the academic year 2024-25.
2. To Recommend the Syllabus and Model Question Papers for IV semester of II Degree B.Sc, Physics Major and Minor for the academic year 2024-25 .
3. To recommend the guidelines to be followed by question paper setters in Physics for II, IV semester – end exams.
4. To recommend the teaching and evaluation methods to be followed under Autonomous status
5. Any other suggestions regarding Certificate Courses, Seminars, Workshops, Guest Lectures to be organized.
6. Any other matter.

Chairman
(J. Hareesh Chandra)

RESOLUTIONS

The following Resolutions are made in Board of studies in Physics for UG Programs of even semesters to recommend to the Academic Council for its approval. It is resolved to follow the syllabus of APSCHE (theory and practical) for II nd, IV th semesters of Physics major and minors for the academic year 2024-25 .

- It is resolved and recommended the "**Mechanics and Properties of Matter**" with course code **23PHMAL121** in II semester of I **B.Sc (H) Physics** for the students admitted in academic year 2024-25 and onwards.
- It is resolved and recommended the "**Mechanics and Properties of Matter LAB"** with course code **23PHMAP121** in II semester of I **B.Sc (H) Physics** for the students admitted in academic year 2024-25 and onwards.
- It is resolved and recommended the "**WAVES AND OSCILLATIONS"** with course code **23PHMAL122** in II semester of I **B.Sc (H) Physics** for the students admitted in 2024-25 and onwards.
- It is resolved and recommended the "**WAVES AND OSCILLATIONS LAB**" with course code **23PHMAP122** in II semester of I **B.Sc (H) Physics** for the students admitted in academic year 2024-25 and onwards.
- It is resolved and recommended the "**Mechanics, waves and Oscillations"** as **Minor subject** with course code **23PHMIL121** in II semester of I **B.Sc (H) Computer science** for the students admitted in academic year 2024-25 and onwards.
- It is resolved and recommended the **"Mechanics, waves and Oscillations Lab**" as **Minor** with course code **23PHMIP121** in II semester of I **B.Sc (H) of Computer science** for the students admitted in academic year 2024-25 and onwards.
- It is resolved and recommend to introduce **23PHMAL241**: ELECTRICITY & MAGNETISM in IV semester of II B.Sc Physics (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMAL242** : MODERN PHYSICS in IV semester of II B.Sc Physics (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMAL243** : INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS in IV semester of II B.Sc Physics (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMIL241** : ELECTRICITY & MAGNETISM as **minor** in IV semester of II B.Sc Computers (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMIL242** : MODERN PHYSICS as **minor** in IV semester of II B.Sc Computers (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMAP241** : ELECTRICITY & MAGNETISM lab in IV semester of II B.Sc Physics (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMAP242** : MODERN PHYSICS Lab in IV semester of II B.Sc Physics (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMAP243** : INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS lab in IV semester of II B.Sc Physics (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved and recommend to introduce **23PHMIP241** : ELECTRICITY & MAGNETISM Minor Lab in IV semester of II B.Sc Computers (H) for the batch of students admitted in 2023-24 and onwards.

- It is resolved and recommend to introduce **23PHMIP242** : MODERN PHYSICS Minor Lab in IV semester of II B.Sc Computers (H) for the batch of students admitted in 2023-24 and onwards.
- It is resolved to follow the guidelines to be followed by question paper setters of Physics for II, IV Semesters of Degree B.Sc major and minor students for the academic year 2024-25.
- It is resolved to implement the following Teaching and Evaluation methods to be followed under Autonomous status for the academic year 2024-25.

Evaluation procedure:

Internal Assessment Examination:

- ❖ Out of maximum 100 marks in each paper for I B.Sc. Physics Major of B.Sc. Honours, 30 marks are allocated for internal assessment.
- ❖ Out of these 30 marks, 20 marks are allocated for Announced tests (IA-1& IA-2). Two announced tests will be conducted and average of these two tests shall be deemed as the marks obtained by the student, 5 marks are allocated on the basis of candidate's percentage of attendance and remaining 5 marks are allocated for the assignment/seminar.
- ❖ Out of maximum 100 marks in each paper for IV Semester of II B.Sc, Physics Major of B.Sc. Honours, 30 marks shall be allocated for internal assessment.
- ❖ Out of these 30 marks, 20 marks are allocated for announced tests (IA-1& IA-2). Two announced tests will be conducted and average of these two tests shall be deemed as the marks obtained by the student, 5 marks allocated on the basis of candidate's percentage of attendance and reaming 5 marks for seminar/ assignment for IV semester. There is no pass minimum for internal assessment for II, IV Semesters.

Semester – End Examination :

- ❖ The maximum mark for Second semester End examination shall be 70 marks and duration of the examination shall be 3 hours.
- ❖ 70 marks are allocated for II Semester of First B.Sc. Physics Major and Minor of B. Sc. Honours in Semester end Examination. Even through the candidate is absent for two IA exams /obtain zero marks the external marks are considered (if the candidate gets 40/70) and the result shall be declared as "PASS".
- ❖ 70 marks are allocated for IV Semester of second B.Sc. PHYSICS Major and Minor of B. Sc. Honours in Semester End Examination. Even through the candidate is absent for two IA exams /obtain zero marks the external marks are considered (if the candidate gets 40/70) and the result shall be declared as "PASS".

Chairman

(J. Hareesh Chandra)

DEPARTMENT OF PHYSICS

COURSE STRUCTURE

SEMESTER – II

Course Code	Title of the Course	Instruction Hours per week	Credits	Evaluation		
				CIA MARKS	SEE	
					MARKS	Core/LSC/ SDC/MDC Elective/ Cluster
23PHMAL121	Mechanics and properties of matter	3	3	30	70	CORE
23PHMAP121	Mechanics and properties of matter **LAB**	2	1	15	35	LAB
23PHMAL122	Waves and oscillations	3	3	30	70	CORE
23PHMAP122	Waves and oscillations **LAB**	2	1	15	35	LAB
23PHMIL121	Mechanics, Waves and oscillations **(MINOR)**	3	3	30	70	CORE
23PHMIP121	Mechanics, Waves and oscillations **LAB (MINOR)**	2	1	15	35	LAB

SEMESTER – IV

Course Code	Title of the Course	Instruction Hours per week	Credits	Evaluation		
				CIA MARKS	SEE	
					MARKS	Core/LSC/ SDC/MDC Elective/Cluster
23PHMAL241	ELECTRICITY & MAGNETISM	3	3	30	70	CORE
23PHMAP241	ELECTRICITY & MAGNETISM **Lab**	2	1	15	35	LAB
23PHMAL242	MODERN PHYSICS	3	3	30	70	CORE
23PHMAP242	MODERN PHYSICS **Lab**	2	1	15	35	LAB

23PHMAL243	Introduction to Nuclear and Particle Physics	3	3	30	70	CORE
23PHMAP243	Introduction to Nuclear and Particle Physics **lab**	2	1	15	35	LAB
23PHMIL241	Electricity & magnetism (**Minor)**	3	3	30	70	CORE
23PHMIP241	Electricity & magnetism **(Minor) Lab**	2	1	15	35	LAB
23PHMIL242	Modern physics**(Minor)**	3	3	30	70	CORE
23PHMIP242	Modern physics **(Minor) Lab**	2	1	15	35	LAB

A.G & S.G. SIDDHARTHA DEGREE COLLEGE OFARTS & SCIENCE, Vuyyuru-521165

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Title of the Paper: Mechanics and Properties of matter

Semester : II

Course Code	23PHMAL121	**Course Delivery Method**	Class Room / Blended Mode
Credits	3	CIA Marks	30
No. of Lecture Hours / Week	3	Semester End Exam Marks	70
Total Number of Lecture Hours	60	Total Marks	100
Year of Introduction : 2023 - 24	Year of Offering: 2023 - 24	Year of Revision :-----	Percentage of Revision:--

Course objectives

1. The primary objective of the Mechanics and Properties of Matter course is to furnish students with a comprehensive comprehension of the dynamics exhibited by physical systems.
2. This encompasses a thorough exploration of mechanical motion as well as an in-depth examination of the diverse properties inherent in different forms of matter.
3. The course seeks to establish a solid foundational knowledge that enables students to grasp the intricate interplay between the behavior of physical systems and the intrinsic characteristics defining the nature of matter.

Course outcomes:

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

CO1	Distinguish between scalar and vector quantities.
CO2	Gain the knowledge of planetary motion
CO3	Understand laws of motion, reference frames, and their applications
CO4	Understand the basics of material properties like elasticity, elastic constants, and their relation
CO5	Develop an understanding of the special theory of relativity and its applications

Syllabus

Unit	Learning Units	Lecture Hours
I Vectors	**A**) Scalar and vector fields, Gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. **B**) Vector integration (line, surface, and volume), Statement and proof of Gauss and Stokes theorems.	12
II Mechanics of particles	**A**) Review of Newton's Laws of Motion, Motion of variable mass system, Multistage rocket, Conservation of energy and momentum, Elastic collisions in one dimension, Elastic & Oblique collisions in two dimensions. **B**) Concept of Impact parameter, Cross section , Rutherford scattering-derivation.	12
III Mechanics of rigid bodies and continuous media	**A**)Rigid body, rotational kinematic relations, equation of motion for a rotating body, Angular momentum and Inertial Tensor, Euler equations, Precession of a top, Precession of the equinoxes. **B**) Elasticity, Stress and strain, Hooke's law, Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio.	12

IV Central forces	**A**) Central forces - definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy. **B**) Equations of motion under a central force, Derivation of Kepler's I, II & III laws, Motion of satellites – escape velocity and orbital velocity.	12
v Special Theory of Relativity	**A**) Galilean relativity, Absolute frames. Michelson-Morley experiment -the negative result. Postulates of the special theory of relativity. **B**) Lorentz transformation and its applications (i) time dilation (ii) length contraction (iii) mass-energy relation.	12

TEXTBOOKS

1. B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad

Model Question Paper

Mechanics and Properties of matter

SECTION-A

Answer the following: 5 x 10 = 50 M

1. A) Define the divergence of a vector field. Derive an expression for the divergence of a vector field (L3. CO1)

   (OR)

   B) State and prove Gauss divergence theorem (L3, CO1)

2. A) Define a system of variable mass. Explain the motion of the rocket, Derive an expression for the velocity of the rocket at any time. (L3, CO3)

   (OR)

   B) Discuss the Rutherford scattering and derive an expression for the scattering angle. (L3, CO2)

3 A) What is processional motion? Find the angular velocity of the precession of a spinning top. (L3, CO3).

(OR)

B)Define the three elastic constants y, η, and k. Derive the relation between them. (L3, CO3)

4. A) What is conservative force? Show that central forces are conservative. (L2, CO4).

(OR)

B) State Kepler's third law of motion. And prove that the square of the period of revolution of a planet moving in a circular orbit around the sun is proportional to the cube of its distance from the sun. (L2, CO4)

5 A) Describe the Michelson-Morley experiment and explain the physical significance of negative results. (L2, CO5)

(OR)

B) State the fundamental postulates of the special theory of relativity and deduce the Lorentz transformations. (L2, CO5)

SECTION-B

Answer any **THREE** of the following questions: 3x4=12M

6. Explain the gradient scalar field and give its physical significance (L2, CO1)
7. State Newton's laws of motion and give two examples each. (L1, CO2)
8. Write a short note of precession of the equinoxes (L2, CO3)
9. Explain central forces with examples. (L1, CO4)
10. Explain time dilation. (L1, CO5)

Section – C 2X4=8M

Answer any **TWO** of the following:

11. If $\overline{A} = xy\hat{i} - 2x^2y\hat{j} + 2yz\hat{k}$ then find curl $\vec{A}$ at (1,1,0) (L4, CO1)

12. A rocket burns 0.1 kg of fuel per seconds. If force exerted by ejecting gases on rocket is 200N, find the exhaust velocity of gases. (L4, CO3)

13. If the Earth is one-half of its present distance from the sun, what will be the number of days in a year (L3,CO4)

14. If the total energy of a particle in motion is exactly thrice its rest energy, what is the velocity of the particle? (L3,CO5)

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Title of the Paper: Mechanics and Properties of Matter (LAB)

Semester: II Offered to : I B.Sc. (H)

Course Code	23PHMAP121	**Course Delivery Method**	Class Room / Blended Mode
Credits	1	CIA Marks	15
No. of Lecture Hours / Week	2	Semester End Exam Marks	35
Total Number of Lecture Hours	30	Total Marks	50
Year of Introduction : 2023 - 24	Year of Offering: 2023-24	Year of Revision: NIL	Percentage of Revision: NIL

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for measuring properties of matter and analyzing mechanical systems

Course outcomes : On successful completion of this course, the students will be able to:

CO 1 Understand the use of vernier calipers, screw gauge, and traveling microscopes.
CO 2 Learn the concept of Moment of Inertia.
CO 3 Understand the usage of basic laws and theories to determine various properties of the materials given.
CO 4 Analyze the application side of the experiments
CO 5 Interpret the difference between theoretical and experimental values.

List of Experiments

1. Viscosity of liquid by the flow method (Poiseuille's method)
2. Young's modulus of the material of a bar (scale) by uniform bending
3. Young's modulus of the material a bar (scale) by non-uniform bending
4. Surface tension of a liquid by capillary rise method
5. Determination of radius of capillary tube by Hg thread method
6. Viscosity of liquid by Searle's viscometer method
7. Bifilar suspension - the moment of inertia of a regular rectangular body.
8. Determination of moment of inertia using Fly-wheel
9. Determination of the height of a building using a sextant.
10. Rigidity modulus of the material of a wire-dynamic method (torsional pendulum)

Note :

- 8 (Eight) Experiments are to be done and recorded in the lab. These experiments will be evaluated by the CIA.
- For certification minimum of 6 (Six) experiments must be done and recorded by students who had put in 75 % of attendance in the lab.
- The best 6 experiments are to be considered for the CIA.
- 10 + 5 (RECORD) = 15 marks for CIA
- 35 marks for the practical exam.

The marks distribution for the Semester End practical examination is as follows:

Formula/ Principle / Statement with an explanation of symbols	05
Diagram/Circuit Diagram / Tabular Columns	05
Setting up of the experiment and taking readings/Observations	10
Calculations (explicitly shown) + Graph + Result with Units	05
Procedure and Precautions	04
Result	01
Viva-voce	05
Total Marks:	**35**

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Title of the Paper: WAVES AND OSCILLATIONS

Semester: II Offered to : I B.Sc. (H)

Course Code	23PHMAL122	**Course Delivery Method**	Class Room / Blended Mode
Credits	3	CIA Marks	30
No. of Lecture Hours / Week	3	Semester End Exam Marks	70
Total Number of Lecture Hours	60	Total Marks	100
Year of Introduction : 2023 - 24	Year of Offering: 2023-24	Year of Revision: NIL	Percentage of Revision:---

Course objectives

CO1	Define and explain the basic concepts of waves and oscillations, including terms such as amplitude, frequency, wavelength, and phase.
CO2	Gain the knowledge ofwave propagation and oscillatory motion
CO3	Demonstrate an understanding of wave propagation by solving real-world problems.
CO4	Relate the principles of waves and oscillations to practical applications in fields such as physics, engineering, and communication
CO5	Critically assess the applications of wave and oscillation principles in various scientific and technological contexts

Unit	Learning Units	Lecture Hours
I Simple Harmonic oscillations	**A**) Simple harmonic oscillator and solution of the differential equation- Physical characteristics of SHM, Torsion pendulum-measurements of rigidity modulus, Compound pendulum- measurement of 'g' **B**) Principleof superposition, the combination of two mutually perpendicular simple harmonic vibrations of the same frequency and different frequencies, applications of Lissajous figures	12
IIDamped and forced oscillations	**A)**Simple harmonic oscillator, damped harmonic oscillator - differential equations and its solutions, Logarithmic decrement, Relaxation time, and Quality factor. **B**) forced harmonic oscillator - differential equations and its solutions, amplitude resonance.	12
III Complex vibrations	**A)**Fourier theorem (Statement & limitations), evaluation of the Fourier coefficients using Fourier's theorem **B**) Analysis of periodic wave functions - square wave, saw tooth wave.	12
IV Vibrating Strings and Bars	**A)**Transverse wave propagation along a stretched string, Velocity of a transverse wave along a stretched string, modes of vibration of stretched string clamped at ends, overtones and harmonics. **B**) General solution of the Longitudinal wave equation. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end.	12

V Ultrasonics	Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezo-electric and magnetostriction methods, detection of ultrasonics, Applications and uses of ultrasonic waves.	12

TEXTBOOKS

1. B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad

Model Question Paper

Waves and Oscillations

SECTION-A

Answer the following : **5 x 10 = 50 M**

1. A) Define simple harmonic motion. Derive the equation of a simple harmonic oscillator and obtain its solution (L3. CO1)

(OR)

B) Discuss the combination of two mutually perpendicular simple harmonic vibrations (L3, CO1)

2. A) What are damped oscillations? Derive the equation of motion of a forced oscillator and find its solution (L3, CO3)

(OR)

B) What are forced oscillations? Derive the equation of motion of a forced oscillator and obtain its solution (L3, CO2)

3 A) State Fourier's theorem and evaluate the Fourier coefficients. (L3, CO3).

(OR)

B)Analyse a square wave using the Fourier theorem. (L3, CO3)

4. A) Derive an expression for the velocity of a transverse wave along a stretched string. (L3, CO4).

(OR)

B) Deduce the modes of vibration of a rod clamped at one end and free at the other end (L2, CO4)

5 A) Describe the Magnetostriction method of producing ultrasonic waves. (L2, CO5)

(OR)

B) Describe the Piezo-electric method of producing ultrasonic waves(L2, CO5)

SECTION-B

Answer any **THREE** of the following questions: **3x4=12M**

6. Explain briefly the physical characteristics of simple harmonic motion (L1, CO1)
7. Define relaxation time and drive an expression for it. (L2, CO2)
8. Mention the limitations of Fourier's theorem (L1, CO3)
9. Explain overtones and harmonics. (L1, CO4)
10. Write any five applications of ultrasonics. (L1, CO5)

Section – C

Answer any **TWO** of the following: **2X4=8M**

11.A spring of force constant $20NM^{-1}$ is loaded with a mass of 0.1 kg and allowed to oscillate. Calculate the time period and frequency of oscillation of the string(L4, CO1)

12. The amplitude of an oscillator of frequency 200Hz falls to $1/10^{th}$ of its initial value after a time of 10s. Calculate its relaxation time and Q-factor. (L4, CO2)

13. A steel wire of length 50cm has a mass of 5gm. It is stretched with a tension of 400N. Calculate the frequency of the wire in the fundamental mode of vibration (L3,CO4)

14. Calculate the fundamental frequency of a quartz crystal of thickness 0.003m given Y-$8X10^{10}$Pa and density is $2500kgm^{-3}$ for quartz (L3,CO5)

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Title of the Paper: WAVES AND OSCILLATIONS (LAB)

Semester: II Offered to : I B.Sc. (H)

Course Code	23PHMAP122	**Course Delivery Method**	Class Room / Blended Mode
Credits	1	CIA Marks	15
No. of Lecture Hours / Week	2	Semester End Exam Marks	35
Total Number of Lecture Hours	30	Total Marks	50
Year of Introduction : 2023 - 24	Year of Offering: 2023-24	Year of Revision: NIL	Percentage of Revision: ---

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for measuring properties of matter and analyzing mechanical systems

Course outcomes:

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

CO 1 Gain hands-on experience in setting up and conducting experiments related to waves and oscillations.

CO 2 Investigate and analyze the behavior of different types of waves, such as mechanical waves, sound waves, and electromagnetic waves.

CO 3 Examine resonance phenomena in various systems and understand the conditions that lead to resonance.

CO 4 Enhance skills in presenting findings through graphical representations and written reports.

CO 5 Develop critical thinking skills by solving problems related to wave mechanics and oscillatory systems.

List of Experiments

1. Volume resonator experiment
2. Determination of 'g' by compound/bar pendulum
3. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
4. Determination of the force constant of a spring by static and dynamic methods.
5. Determination of the elastic constants of the material of a flat spiral spring.
6. Coupled oscillators
7. Verification of laws of vibrations of stretched string –sonometer
8. Determination of frequency of a bar –Melde's experiment.
9. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
10. Formation of Lissajous figures using CRO.

Note :

- 8 (Eight) Experiments are to be done and recorded in the lab. These experiments will be evaluated bythe CIA.
- For certification minimum of 6 (Six) experiments must be done and recorded by students who had put in 75 % of attendance in the lab.
- The best 6 experiments are to be considered for the CIA.
- 10 + 5 (RECORD) = 15 marks for CIA
- 35 marks for the practical exam.

The marks distribution for the Semester End practical examination is as follows:

Formula/ Principle / Statement with an explanation of symbols	05
Diagram/Circuit Diagram / Tabular Columns	05
Setting up of the experiment and taking readings/Observations	10
Calculations (explicitly shown) + Graph + Result with Units	05
Procedure and Precautions	04
Result	01
Viva-voce	05
Total Marks:	**35**

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Title of the Paper: MECHANICS, WAVES AND OSCILLATIONS (Minor)

Semester: II Offered to : I B.Sc. (H)

Course Code	23PHMIL121	**Course Delivery Method**	Class Room / Blended Mode
Credits	3	CIA Marks	30
No. of Lecture Hours / Week	3	Semester End Exam Marks	70
Total Number of Lecture Hours	60	Total Marks	100
Year of Introduction : 2023 - 24	Year of Offering: 2023-24	Year of Revision: NIL	Percentage of Revision: ---

Course Objectives:

1. provide an in-depth understanding of the principles of Newtonian mechanics and apply them to solve problems involving the dynamic motion of classical mechanical systems
2. explain the limitations of Newtonian mechanics for motion at very high velocities, and thus introduce the special theory of relativity
3. provide hands-on experience to perform experiments to study some properties of matter and oscillations

4. By Learning Fourier analysis, students can analyze different mechanical, optical, and electromagnetic waves
5. To attain knowledge of Ultrasonic waves and apply it to different fields

Course outcomes:

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

CO1: Application of Newton's laws of motion to solve various problems related to day-to-daylife

CO2: Understand the application of central force to the stability of circular orbits, Kepler's lawsof planetary motion, Orbital Precession, and Rutherford scattering

CO3: Develop an understanding of the special theory of relativity and its applications

CO4: Ability to recognize and use a mathematical oscillator equation and wave equation, andderive these equations for certain systems

CO5: Gain knowledge on Ultrasonic waves, their production and detection, and their applications in different fields.

Unit	Learning Units	Lecture Hours
I	A.**Mechanics of Particles** (5 hrs) Review of Newton's Laws of Motion, Motion of variable mass system, Multistage rocket, Concept of impact parameter, scattering cross-section, Rutherford Scattering-Derivation. B. **Mechanics of Rigid bodies** (7 hrs) Rigid body, rotational kinematic relations, Equation of motion for a rotating body, Angular momentum, Euler equations, Precession of a spinning top, Precession of the equinoxes.	12
II	A. **Celestial mechanics** Central force - definition and examples, characteristics of central forces, conservative nature of central forces, Equation of motion under a central force B.**Orbital mechanics** Kepler's laws of planetary motion- Proofs, Motion of satellites – escape velocity, orbital velocity	12
III	A. **Frames of reference and transformation** (5hrs) Galilean transformations, Michelson-Morley experiment & negative result. Postulates of Special theory of relativity, B.**Consequences of relativistic transformations** (7 hrs) Lorentz transformation, time dilation, length contraction, Einstein's mass-energy relation	12
IV	A. **Undamped, Damped, and Forced oscillations**: (07 hrs) Simple harmonic oscillator, damped harmonic oscillator, forced harmonic oscillator - differential equations and its solutions,	12

	Resonance, Logarithmic decrement, Relaxation time and Quality factor. B. **Fourier analysis (05 hrs)** Fourier theorem (Statement & limitations), evaluation of the Fourier coefficients using Fourier's theorem, analysis of periodic wave functions - square wave	
V	A. **Vibrating Strings**: (07 hrs) Transverse wave propagation along a stretched string, General solution of the wave equation and its significance, Modes of vibration of stretched string clamped at ends, Overtones, and Harmonics. B. **Ultrasonics**: (05 hrs) Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectric and magnetostriction methods, Applications of ultrasonic waves	12

TEXT BOOKS

1. B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad

REFERENCE BOOKS:

1. Fundamentals of Physics Vol. I - Resnick, Halliday, Krane, Wiley
2. Waves and Oscillations. N. Subramanyam and Brijlal, VikasPulications.
3. Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004

Model Question Paper

Mechanics, Waves and Oscillations

SECTION-A

Answer the following: 5 x 10 = 50 M

1 A) What is Rutherford scattering? Obtain an expression for the number of particles scattered per unit area. (L1, CO1).

(OR)

B) What is precessional motion? Find the angular velocity of the precession of a spinning top. Show that the rate of precession is independent of mass but depends on the distribution of mass. (L1, CO2).

2. A) What is conservative force? Show that central forces are conservative. (L2, CO2).

(OR)

B) State Kepler's third law of motion. And prove that the square of period of revolution of a planet moving in a circular orbit round the sun is proportional to the cube of its distance from the sun. (L2, CO2)

3 A) State the fundamental postulates of special theory of relativity and deduce the Lorentz transformations. (L2, CO3)

(OR)

B) Describe the Michelson-Morley experiment and explain the physical significance of negative results. (L2, CO3)

4 A) What are damped oscillations? Derive the differential equation of the damped Harmonic oscillator and discuss the case of under-damping. (L2, CO3).

(OR)

B) Statethe Fourier Theorem and evaluate Fourier coefficients. (L2, CO4).

5 A) What are transverse waves? Obtain the equation of velocity of a transverse wave in a wire kept under tension. (L3. CO5).

(OR)

B) What are ultrasonics? Describe the Magnetostriction method of producing ultrasonics (L3, CO5).

SECTION-B

Answer any **THREE** of the following questions: 3x5=15M

6. State Newton's laws of motion and give two examples each. (CO1, L1)
7. Explain central forces with examples. (CO2, L1)
8. Explain time dilation. (CO3, L1)
9. What is logarithmic decrement and relaxation time? (CO4, L1)
10. Explain overtones and harmonics. (CO5, L1)

Section – C 2x5=10M

Answer any **TWO** of the following:

11. The kinetic energy of metal disc rotating at a constant speed of 5 revolutions per second is joules. Find the angular momentum of the disc. (CO2, L3)

12. If the Earth be one-half of its present distance from the sun, what will be the number of days in a year (CO2, L3)

13. If the energy note of frequency 100Hz decreases to one half of tis original value in one second, calculate the Q-factor, (CO4, L3)

14. A piezoelectric crystal has a thickness of 0.002m. If the velocity of sound wave in crystal is 5750m/s, calculate the fundamental frequency of crystal. (CO5, L3)

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NAAC reaccredited at "A" level

Autonomous -ISO 9001 – 2015 Certified

Title of the Paper: Mechanics, Waves and Oscillations (LAB)

Semester: II Offered to : I B.Sc. (H)

Course Code	23PHMIP121	**Course Delivery Method**	Class Room / Blended Mode
Credits	1	CIA Marks	15
No. of Lecture Hours / Week	2	Semester End Exam Marks	35
Total Number of Lecture Hours	30	Total Marks	50
Year of Introduction : 2023 - 24	Year of Offering: 2023-24	Year of Revision: NIL	Percentage of Revision: ---

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for measuring properties of matter and analyzing mechanical systems

Course outcomes : On successful completion of this course, the students will be able to:

CO 1 Understand the use of vernier calipers, screw gauge, and traveling microscopes.
CO 2 Learn the concept of Moment of Inertia.
CO 3 Understand the usage of basic laws and theories to determine various properties of the materials given.
CO 4 Verify the laws of transverse vibrations in a stretched string using sonometer
CO 5 Interpret the difference between theoretical and experimental values.

List of Experiments

1. Young's modulus of the material of a bar (scale) by uniform bending
2. Young's modulus of the material a bar (scale) by non- uniform bending
3. Surface tension of a liquid by capillary rise method
4. Viscosity of liquid by the flow method (Poiseuille's method)
5. Bifilar suspension –Moment of inertia of a regular rectangular body.
6. Fly-wheel -Determination of moment of inertia
7. Rigidity modulus of material of a wire-Dynamic method (Torsional pendulum)
8. Volume resonator experiment

9. Determination of ‘g’ by compound/bar pendulum
10. Simple pendulum- normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
11. Determination of the force constant of a spring by static and dynamic method.
12. Coupled oscillators
13. Verification of laws of vibrations of stretched string –Sonometer
14. Determination of frequency of a bar –Melde’s experiment.
15. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude

Note :

- 8 (Eight) Experiments are to be done and recorded in the lab. These experiments will be evaluated bythe CIA.
- For certification minimum of 6 (Six) experiments must be done and recorded by students who had put in 75 % of attendance in the lab.
- The best 6 experiments are to be considered for the CIA.
- 10 + 5 (RECORD) = 15 marks for CIA
- 35 marks for the practical exam.

The marks distribution for the Semester End practical examination is as follows:

Formula/ Principle / Statement with an explanation of symbols	05
Diagram/Circuit Diagram / Tabular Columns	05
Setting up of the experiment and taking readings/Observations	10
Calculations (explicitly shown) + Graph + Result with Units	05
Procedure and Precautions	04
Result	01
Viva-voce	05
Total	**35**

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NAAC reaccredited at "A" level

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Course Code		**23PHMAL241 & 23PHMIL241**	
Title of the Course		**ELECTRICITY & MAGNETISM**	
Offered to: (Programme/s)		**II B.Sc Physics(H), II B.Sc Computers(H)**	
Year of Introduction:	**2024-25**	**Semester:**	**4**
Course Category:	**MAJOR , MINOR**	**Course Relates to:**	**L, R, N & G**
Year of Revision:	**NO**	**Percentage:**	**----**
Type of the Course:		**EMPLOYABILITY & SKILL DEVELOPMENT**	
Pre-requisites, if any		**BASIC KNOWLEDGE OF ELECTRICITY**	

COURSE OBJECTIVES

1. Explain the principles of electrostatics, magnetostatics, and electromagnetic induction with real-world applications.
2. Solve problems related to electric fields, potentials, magnetic fields, and energy density using mathematical laws.
3. Analyze circuits using Kirchhoff's laws, network theorems, and advanced techniques like star-delta transformations.
4. Evaluate electromagnetic wave propagation using Maxwell's equations and the Poynting vector concept.
5. Using advanced theories, Design efficient electrical and magnetic systems for practical use, like circuits and sensors.

COURSE OUTCOMES

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO 1	Remember key electromagnetic laws and principles, including Gauss's law, Ampere's law, Faraday's law, and Maxwell's equations, and recall their application to various physical systems.	K1	1	1
CO 2	Understand the behaviour of electric and magnetic fields in static and dynamic situations, and explain how they interact with matter in both theoretical and experimental contexts.	K2	2	1
CO 3	Apply circuit analysis techniques, including Ohm's law, Kirchhoff's laws, and network theorems (Thevenin's, Norton's) to solve complex electrical circuit problems.	K3	3	1
CO 4	Analyse electromagnetic wave propagation in different media, using Maxwell's equations and concepts like the Poynting vector, to interpret and solve problems related to wave transmission and energy transfer.	K4	2	1
CO 5	Evaluate the performance and limitations of electrical circuits and electromagnetic devices, using principles of resonance, power transfer, and the behaviour of AC circuits.	K5	3	1

Unit	Learning Units	Lecture Hours
I	**A) Electrostatics: (6hrs)** **A) Gauss's Law and Electric Field** 1. **Statement and Proof of Gauss's Law** 2. **Electric Field Intensity** • Due to a uniformly charged solid sphere • Due to an infinite conducting sheet of charge 3. **Electrical Potential** • Equipotential surfaces • Potential due to a point charge • Potential due to a uniformly charged sphere **B) Dielectrics** 1. **Polar and Non-Polar Dielectrics** • Effect of electric field on dielectrics 2. **Dielectric Properties** • Dielectric constant and electric susceptibility • Electric displacement (D), electric polarization (P) 3. **Relation Between D, E, and P**	12
II	**2) Magnetostatics** **A) Magnetic Field and Applications** **1. Biot-Savart's Law** ➢ **Calculation of B:** • Due to a long straight wire • Inside a solenoid **2. Ampere's Circuital Law** • Application to solenoids **3. Hall Effect** • Determination of Hall coefficient • Applications of Hall effect **B) Electromagnetic Induction** **1. Faraday's Laws of Electromagnetic Induction** • Lenz's law **2. Self-Induction and Mutual Induction** • Self-inductance of a long solenoid • Mutual inductance of two coils	12

	3. Energy Density in a Magnetic Field **4. Coupling of Two Coils with Flux Linkage**	
III	**3) Electrical Conduction** **A) Fundamentals and Applications** **1. Electrical Conduction** • Drift velocity and current density • Equation of continuity **2. Ohm's Law and Its Limitations** **3. Kirchhoff's Laws** • Branch current method • Nodal analysis **4. Star-Delta Conversions** • Star to delta and delta to star conversions **B) Circuit Theory: Advanced Concepts and Theorems** **1. Wheatstone Bridge** • Balancing condition and sensitivity **2. Network Theorems** • Thevenin's theorem • Norton's theorem • Maximum power transfer theorem	12
IV	**4) Electromagnetic Waves and Maxwell's Equations** **A) Fundamental Laws of Electricity and Magnetism** **1. Basic Laws of Electricity and Magnetism** **2. Maxwell's Equations** • Integral and differential forms (derivations) • Concept of displacement current **B) Electromagnetic Waves: Theory and Applications** **1. Equation of Electromagnetic Wave** **2. Nature of Electromagnetic Waves** • Transverse nature • Wave equation in conducting media **3. Poynting Vector** • Propagation of electromagnetic waves 4. **Hertz Experiment**	12
V	**5) Varying and Alternating Currents** **A) Growth and Decay of Currents**	12

	1. Growth and Decay in LR and CR Circuits **2. AC Circuits Containing LR and CR Circuits** • Phasor and vector diagrams **B) Resonance and Power in AC Circuits** **1. LCR Circuits** • Series and parallel resonance **2. Quality Factor (Q-Factor)** 3. **Power in AC Circuits**	

TEXT BOOKS

1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.

2. Electricity and Magnetism, D. N. Vasudeva. S. Chand & Co.

REFERENCE BOOKS

1. Electricity, Magnetism with Electronics, K. K. Tewari, R. Chand& Co.,

2. Principles of Electronics, V.K. Mehta, S. Chand& Co.,

3. Digital Principles and Applications, A. P. Malvino and D. P. Leach, Mc Graw Hill Edition.

MODEL QUESTION PAPER

Title of the Paper: ELECTRICITY, MAGNETISM & ELECTRONICS

SEMESTER -END QUESTION PAPER STRUCTURE

Course Code & Title of the Course:	**23PHMAL241 & 23PHMIL241 (Electricity&Magnetism)**
Offered to:	**II B.Sc Physics (H), II B.Sc Computers(H)**
Category:	**SEMESTER: 4**
Max. Marks	**70**
Max.Time	**3 Hrs**

SECTION-A

Answer ALL Questions 5X4=20M

1) a) Define electric potential. Write a note on equipotential surfaces. (CO1, L1)

(OR)

b) What is the Hall effect? Write its applications. (CO2, L1)

2) a) Explain energy density in a magnetic field (CO2, L2)

(OR)

b) What are the limitations of Ohm's Law? (CO3, L2)

3) a) What is the maximum power transfer theorem? Write its formula. (CO4, L1)

(OR)

b) What is a resonant circuit's quality factor (Q-factor)? (CO5, L1)

4) a) A liquid drop of radius 1 mm is charged with +5μc charge. Find electric potential on its surface. (CO1, L4)

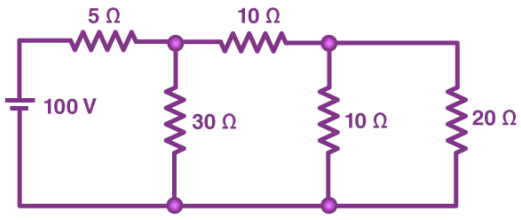
(OR)

b) A current of 10A passes through a coil of 200 turns. If the magnetic flux produced in the coil is 20weber, find the energy stored in the magnetic field. (CO2, L4)

5) a) Find the resonant frequency of the LCR series with L = 2mH, C=0.8μf and R = 100KΩ (CO5, L4)

(OR)

b) Determine the voltage at each node of the given circuit using nodal analysis (CO3, L4)



SECTION-B

Answer **ALL** questions 5X10=50M

6) a) State Gauss law in electrostatics. Obtain an expression for potential due to point charge. (CO1, L1)

(OR)

b) Define D, E and P. Derive the relation between them. Hence deduce the relation between dielectric constant and susceptibility (CO3, L1)

7) a) Explain Biot-Savart Law. Derive an expression for the magnetic induction for infinite long straight wire. (CO2, L2)

(OR)

b) State Faraday's and Lenz's Law. Derive an expression for a long solenoid. (CO2, L2)

8) a) Explain drift velocity and current density. Derive the equation of continuity. (CO3, L3)

(OR)

b) What is the Wheatstone Bridge? Derive the balancing condition and discuss its sensitivity. (CO 3, L3)

9) a) Derive Maxwell's equations in differential form. (CO1, L3)

(OR)

b) Derive the electromagnetic wave equation and evaluate the velocity of light in free space. (CO 4, L3)

10) a) Derive an expression for the current flowing in an LCR series circuit. Explain resonance condition (CO 5, L3)

(OR)

b) Explain the growth and decay of current in CR circuit. Derive an expression. (CO 5, L3)

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Title of the Paper: ELECTRICITY & MAGNETISM

Semester: IV Offered to : II B.Sc. (H)

Course Code		**23PHMAP241 & 23PHMIP241**	
Title of the Course		**ELECTRICITY & MAGNETISM**	
Offered to: (Programme/s)		**II B.Sc Physics(H) & II B.Sc Computers (H)**	
Year of Introduction:	**2024-25**	**Semester:**	**4**
Course Category:	**MAJOR & MINOR**	**Course Relates to:**	L, R, N & G
Year of Revision:	**NO**	**Percentage:**	
Type of the Course:		**EMPLOYABILITY & SKILL DEVELOPMENT**	
Pre-requisites, if any		**BASIC KNOWLEDGE OF ELECTRICITY**	

Course Objectives

1. Understand principles of electrical/magnetic fields, resonance, and circuit theorems, and apply them in experiments with electrical components.
2. Analyze circuit behaviour (galvanometer, LCR circuits, AC impedance) to determine characteristics like Q factor, frequency, and power.
3. Evaluate circuit theorems (Kirchhoff's laws, Thevenin's, Norton's, max power transfer) through experimental verification and comparison with theory.
4. Investigate electromagnetic fields, especially the field along the axis of a current-carrying coil, using Stewart & Gee's apparatus.
5. Quantify electrical properties like time constant, resistance, and power factor using measurements and calculations.

COURSE OUTCOMES

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO 1	Students will define key concepts like the galvanometer's figure of merit, LCR resonance, and time constant, and explain their practical importance.	K1	1	1
CO 2	Students will set up and perform experiments such as frequency determination with a sonometer, and verify Kirchhoff's laws and CR circuit behaviour.	K3	2	1
CO 3	Students will analyze data to find parameters like the Q factor, power factor, and specific resistance while identifying errors.	K4	3	1
CO 4	Students will combine data from different experiments to understand circuit behaviour and design.	K4	2	1

CO 5	Students will compare experimental results to theory, evaluating the validity of circuit theorems and phenomena.	K5	3	1

List of Experiments

1. Determination of ac-frequency - Sonometer.
2. Field along the axis of a circular coil carrying current - Stewart & Gee's apparatus.
3. Verification of Maximum Power Transfer theorem.
4. Verification of Thevenin's theorem
5. Verification of Norton's theorem
6. Charging and discharging of CR circuit-Determination of time constant
7. LCR circuit series resonance, Q factor.
8. LCR circuit parallel resonance, Q factor.
9. A.C Impedance and Power factor
10. Determination of specific resistance of given wire by using Carey Foster's bridge.

Note :

1. 8 (Eight) experiments are to be done and recorded in the lab. These experiments will be evaluated in CIA.
2. For certification minimum of 7 (Seven) experiments must be done and recorded by students who had put in 75 % of attendance in the lab.
3. 15 marks = 10 marks for CIA & 5 marks for Record
4. 35 marks for practical exam.

The marks distribution for the Semester End practical examination is as follows:

Formula/ Principle / Statement with an explanation of symbols	05
Diagram/Circuit Diagram / Tabular Columns	05
Setting up of the experiment and taking readings/Observations	10
Calculations (explicitly shown) + Graph + Result with Units	05
Procedure and Precautions	05
Viva-voce	05
Total Marks:	35

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NAAC reaccredited at "A" level

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Title of the Paper: MODERN PHYSICS

Semester: IV Offered to : II B.Sc. (H)

Course Code		**23PHMAL242 & 23PHMIL242**	
Title of the Course		**MODERN PHYSICS**	
Offered to: (Programme/s)		**II B.Sc Physics(H) & II B.Sc Computers(H)**	
Year of Introduction:	**2024-25**	**Semester:**	**4**
Course Category:	**MAJOR & MINOR**	**Course Relates to:**	**L, R, N & G**
Year of Revision:	**NO**	**Percentage:**	
Type of the Course:		**EMPLOYABILITY & SKILL DEVELOPMENT**	
Pre-requisites, if any		**BASIC KNOWLEDGE OF QUANTUM PHYSICS**	

Course Objectives

1. Understand the fundamental concepts of atomic structure, spectroscopy, and molecular spectra.
2. Apply quantum mechanical principles to solve problems involving matter waves, uncertainty principles, and Schrodinger wave equations.
3. Analyze the structure and properties of crystalline materials and superconductors to explain experimental phenomena.
4. Evaluate the significance of quantum theory in interpreting atomic, molecular, and condensed matter phenomena.
5. Create solutions to modern technological problems using the principles of spectroscopy and quantum mechanics.

COURSE OUTCOMES

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO 1	Recall fundamental atomic models (Bohr's and vector atom models) and their role in explaining atomic spectra.	K1	1	1
CO 2	Understand molecular behaviour in spectroscopic regimes (rotational, vibrational, and Raman) and their application to molecular structure studies.	K3	2	1
CO 3	Apply quantum mechanics (Schrödinger equation, de Broglie wavelength) to calculate atomic and molecular energy levels and transitions.	K4	2	1
CO 4	Apply quantum mechanics (Schrödinger equation, de Broglie wavelength) to calculate atomic and molecular energy levels and transitions.	K4	2	1
CO 5	Evaluate experimental results in atomic and molecular physics, suggesting improvements or new experimental designs.	K5	3	1

Unit	Learning Units	Lecture Hours
I	**1) Atomic Physics:** **A) Bohr's Model of the Hydrogen Atom** **1. Derivation of Bohr's Model** • Radius, energy, and wave number of hydrogen atom **2. Hydrogen Spectrum** • Series and spectral lines explanation **3. Vector Atom Model** ➢ **Concept of the Vector Atom Model** • Evolution from Classical to Quantum Descriptions of Atoms • Orbital and Spin Angular Momentum ➢ **Stern-Gerlach Experiment** • Experimental Setup and Observations • Significance in Electron Spin Discovery ➢ **Quantum Numbers and Their Significance** • Principal, Orbital, Magnetic, and Spin Quantum Numbers • Physical Interpretation and Applications **B) Spectroscopy Concepts and Phenomena** **1. Coupling Schemes** ➢ LS and JJ coupling, their significance in spectral terms **2. Spectral Terms and Selection Rules** ➢ Spectral notations and allowed transitions **3. Zeeman Effect** ➢ Normal and Anomalous Zeeman effect ➢ Experimental setup and theoretical explanation	12
II	**Molecular Physics** **1. Electronic Energy Levels and Transitions** • Electronic absorption and emission phenomena **2. Raman Effect** • Raman effect and its characteristics	12

	• Experimental study of Raman effect • Quantum theory of Raman effect • Applications of Raman effect	
III	**Matter waves & Uncertainty Principle** **A) Matter Waves** **1. Failures of Classical Mechanics** • Limitations in explaining microscopic phenomena **2. De Broglie Hypothesis** • Derivation of matter wavelength and properties of matter waves • Davisson and Germer's experiment **3. Phase and Group Velocities (Qualitative Explanation)** **B) Uncertainty Principle and Quantization** **1. Heisenberg's Uncertainty Principle** • **For** position-momentum and energy-time pairs **2. Illustrations of Uncertainty Principle** • Electron diffraction and gamma-ray microscope examples 3. **Bohr's Principle of Complementarity**	12
IV	**Quantum Mechanics:** **A) Postulates and Wave Equations** **1. Basic Postulates of Quantum Mechanics** • Principles and foundational concepts **2. Schrodinger Wave Equation** • Time-dependent and • time-independent forms **3. Physical Interpretation of Wave Function** • Probability density and significance **B) Eigenfunctions, Eigenvalues, and Applications** **1. Eigenfunctions and Eigenvalues** • Mathematical and physical meaning **2. Application to Infinite Potential Well** • Energy quantization and particle behavior in 1D boxes	12

	(Infinite Potential Well)	
V	**A) Structure of Materials** **1. Amorphous and Crystalline Materials** • Definitions and distinguishing features **2. Unit Cell and Miller Indices** • Representation and significance in crystal geometry **3. Reciprocal Lattice and Types of Lattices** • Crystallographic importance and classifications **4. Diffraction of X-rays by Crystals** • Bragg's law and its applications • Laue's method and powder diffraction method **B) Superconductivity** **1. Introduction to Superconductors** • Properties and fundamental concepts **2. Critical Temperature and Magnetic Field** • T_c and T_m definitions and implications **3. Meissner Effect** • Explanation of perfect diamagnetism **4. Type I and Type II Superconductors** • Characteristics and differences **5. BCS Theory (Qualitative Explanation)** • Basic principles and insight into superconducting states **6. Applications of Superconductors** • Use in technology and research fields	12

SEMESTER -END QUESTION PAPER STRUCTURE

Course Code & Title of the Course:	**23PHMAL242 & 23PHMIL242 (Modern Physics)**
Offered to:	**II B.Sc H Physics, II B.Sc H Computers**
Category:	**SEMESTER: 4**
Max. Marks	**70**
Max.Time	**3 Hrs**

SECTION-A

Answer **ALL** questions 5 x 4=20M

1. A) What are quantum numbers, and how are they related to the vector atom model? (K2)

   (OR)

   B) What is the significance of the Zeeman effect in atomic physics? (K2)
2. A) Define harmonic and anharmonic oscillators with their vibrational energy expressions. (K5)

   (OR)

   B) Write any four applications of Raman spectroscopy in chemical analysis. (K5)
3. A) State the basic postulates of quantum mechanics. (K1)

   (OR)

   What is an eigenvalue in the context of the Schrödinger equation? (K1)
4. A) Determine the De Broglie wavelength of an electron moving through an electric field having a potential difference of 100 volts

   (OR)

   B) If the uncertainty in the position of an electron is $4X10^{-10}$ m. Calculate the uncertainty in its momentum (Planck's constant: $6.6X10^{-34}$ J-Sec)
5. A) X-rays of wavelength 1.54A° strike a crystal and diffract at an angle 22.5° in the first order. Find the spacing between two adjacent planes.

   (OR)

   B) In a crystal, a lattice plane cuts intercepts of a, 2b and 3c along the three axes, where a, b and c are primitive vectors of the unit cell. Determine the miller indices of the given plane

SECTION-B

Answer the following: 5X10=50M

6. A) Explain the Stern-Gerlach experiment and describe how it demonstrated the quantization of angular momentum (K4)

   (OR)

   B) Compare LS and JJ coupling schemes. Explain how they determine spectral terms and describe the selection rules for electronic transitions. (K4)
7. A) Derive the rotational energy levels of a rigid rotator and explain the differences when considering a non-rigid rotator. (K2)

   (OR)

   B) Describe the Raman effect. Explain the experimental arrangement to observe it (K2)
8. A) Derive the de Broglie wavelength and discuss the results of Davisson and Germer's experiment. (K2)

   (OR)

   B) State Heisenberg's Uncertainty Principle. Illustrate it using the electron diffraction experiment and the gamma-ray microscope example (K2)
9. A) Derive the time-independent Schrödinger wave equation and explain the physical interpretation of the wave function in quantum mechanics. (K3)

   (OR)

   B) Solve the Schrödinger equation for a particle in a one-dimensional infinite potential well and discuss the quantization of energy levels. (K3)
10. A) Define Miller indices and explain their significance in crystallography. Derive Bragg's law for X-ray diffraction (K2)

    (OR)

    B) Describe the BCS theory qualitatively. Discuss its significance in understanding superconductivity (K2)

Course Code		**23PHMAP242 & 23PHMIP242**	
Title of the Course		**Modern Physics**	
Offered to: (Programme/s)		**II B.Sc Physics(H) & II B.Sc Computers (H)**	
Year of Introduction:	**2024-25**	**Semester:**	**4**
Course Category:	**MAJOR & MINOR**	**Course Relates to:**	**L, R, N & G**
Year of Revision:	**NO**	**Percentage:**	
Type of the Course:		**EMPLOYABILITY & SKILL DEVELOPMENT**	
Pre-requisites, if any		**BASIC KNOWLEDGE OF QUANTUM PHYSICS**	

Course Objectives

1. Understand experimental techniques to determine physical constants like e/m, Planck's constant, and work function.
2. Apply quantum principles to measure Planck's constant using photocells, LEDs, and energy gaps in semiconductors.
3. Verify the inverse square law of light using a photovoltaic cell.
4. Measure and analyze magnetic fields to determine magnetic field strength (M) and intensity (H).
5. Develop data analysis skills to synthesize results, evaluate accuracy, and identify errors in experiments.

COURSE OUTCOMES

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO 1	Remember and apply experimental techniques to measure e/m, Planck's constant, and work function.	K1	1	1
CO 2	Understand and apply quantum concepts to determine energy gaps and Planck's constant using LEDs.	K3	2	1
CO 3	Analyze and verify the inverse square law of light using a photovoltaic cell.	K4	2	1
CO 4	Apply experimental methods to measure and calculate magnetic field strength (M) and intensity (H).	K4	2	1
CO 5	Evaluate and synthesize experimental data to assess the accuracy and identify errors.	K5	2	1

List of Experiments

1. e/m of an electron by Thomson method.
2. Determination of Planck's Constant (photocell).
3. Verification of inverse square law of light using a photovoltaic cell.
4. Determination of the Planck's constant using LEDs of at least 4 different colours.
5. Determination of work function of material of filament of directly heated vacuum diode.
6. Determination of M & H.
7. Energy gap of a semiconductor using junction diode.
8. Energy gap of a semiconductor using thermistor
9. Bragg's Law

Note :

1. (Six) experiments are to be done and recorded in the lab. These experiments will be evaluated in CIA.
2. For certification minimum of 7 (Seven) experiments must be done and recorded by students who had put in 75 % of attendance in the lab.
3. 15 marks = 10 marks for CIA & 5 marks for Record
4. 35 marks for practical exam.

The marks distribution for the Semester End practical examination is as follows:

Formula/ Principle / Statement with an explanation of symbols	05
Diagram/Circuit Diagram / Tabular Columns	05
Setting up of the experiment and taking readings/Observations	10
Calculations (explicitly shown) + Graph + Result with Units	05
Procedure and Precautions	05
Viva-voce	05
Total Marks:	35

A.G & S.G. SIDDHARTHA DEGREE COLLEGE OF ARTS & SCIENCE, Vuyyuru-521165

NAAC reaccredited at "A" level

Autonomous -ISO 9001 – 2015 Certified

Title of the Paper: Introduction to Nuclear and Particle Physics

Semester: IV Offered to : II B.Sc. (H)

Course Code		**23PHMAL243**	
Title of the Course		**Introduction to Nuclear and Particle Physics**	
Offered to: (Programme/s)		**II B.Sc Physics(H)**	
Year of Introduction:	**2024-25**	**Semester:**	**4**
Course Category:	**MAJOR**	**Course Relates to:**	**L, R, N & G**
Year of Revision:	**NO**	**Percentage:**	
Type of the Course:		**EMPLOYABILITY & SKILL DEVELOPMENT**	
Pre-requisites, if any		**BASIC KNOWLEDGE OF NUCLEUS**	

Course Objectives

1. Describe the fundamental concepts of nuclear structure, nuclear forces, and nuclear decay processes.
2. Apply models like the liquid drop model and shell model to analyze nuclear reactions and stability.
3. Interpret experimental data using nuclear detectors and techniques like the Geiger-Muller counter and scintillation counter.
4. Assess the applications of particle physics in medical imaging, astrophysics, and energy generation.
5. Develop innovative solutions or tools leveraging nuclear and particle physics principles for industrial and scientific purposes.

Course Outcomes

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO 1	Recall properties of elementary particles (leptons, mesons, baryons) and nuclear structure..	K1	1	1
CO 2	Explain nuclear decay processes (alpha, beta) and energy release mechanisms.	K2	2	1
CO 3	Apply nuclear models (liquid drop, shell) and theories (Yukawa's meson theory) to analyze nuclear stability.	K4	2	1
CO 4	Analyze data from nuclear detectors (Geiger-Muller, scintillation counters).	K3	2	1
CO 5	Evaluate the applications of nuclear and particle physics in medicine, energy, and astrophysics, assessing their societal impact.	K5	2	1

Unit	Learning Units	Lecture Hours
I	**Introduction to Nuclear Physics** **A) Nuclear Structure** • General Properties of Nuclei (Protons and neutrons) • Mass defect, Binding energy • Nuclear Forces • Characteristics and range of nuclear forces • Yukawa's Meson Theory **B) Nuclear Models** • Liquid drop model- Semi empirical mass formula • Nuclear shell model. • Magic numbers	12
II	**Elementary Particles and Interactions** **A) Elementary Particles and Their Classification** • Discovery and classification of elementary particles • Properties of Leptons • Properties of Mesons, and Baryons **B) Fundamental Interactions and Conservation Laws** • Strong Interaction • Electromagnetic Interaction • Weak Interaction • Conservation laws – Isospin, parity, charge conjugation	12
III	**Nuclear Reactions and Nuclear Detectors** **A) Nuclear Reaction** • Types of Nuclear Reactions • Conservation Laws in Nuclear Reactions • Reaction Energetics, Threshold energy • Q-value calculations and significance • Nuclear Cross-Section **B) Nuclear Detectors**	12

	• Geiger-Muller Counter • Scintillation Counter • Cloud Chamber	
IV	**Nuclear Decays and Nuclear Accelerators** **A) Nuclear Decays** • Gamow's theory of alpha decay • Fermi's Theory of Beta Decay • Energy release in Beta decay • Selection Rules **B) Nuclear Accelerators** • Types- Electrostatic and electrodynamics accelerators • Cyclotron-construction, working and applications • Synchrocyclotron-construction, working and applications.	12
V	**Applications of Nuclear and Particle Physics** **A) Medical Applications of Nuclear Physics** • Medical Applications • Radiation therapy and imaging techniques (PET and SPECT) **B) Nuclear Energy and Particle Physics** • Nuclear reactors and power generation, • Particle physics in high-energy Astro Physics • Contributions to understanding cosmic phenomena • Particle physics and their role in simulating astrophysical processes	12

SEMESTER -END QUESTION PAPER STRUCTURE

Course Code & Title of the Course:	**23PHMAL243 (Introduction to Nuclear and Particle Physics)**
Offered to:	**II B. Sc Physics (H)**
Category:	**SEMESTER: 4**
Max. Marks	**70**
Max.Time	**3 Hrs**

SECTION-A

Answer **ALL** questions 5X4=20M

1) A) What are the characteristics of nuclear forces (K2)
   (OR)
   B) Explain the significance of magic numbers in the Nuclear Shell Model. (K2)
2) A) Explain the different types of interactions involved in particle physics (K2)
   (OR)
   B) Explain the properties of Leptons. (K2)
3) A) Explain the principle of cloud chamber (K2)
   (OR)
   B) What is threshold energy? Explain (K2)
4) A) Explain the difference between electrostatic and electrodynamic accelerators. (K2)
   (OR)
   B) Write the selection rules in Beta-decay (K2)
5) A) Explain the significance of PET scan in medical diagnostics (K2)
   (OR)
   B) Explain the significance of SPECT scan in medical diagnostics (K2)

SECTION-B

Answer **ALL** questions 5X10=50M

6) A) Explain the concept of mass defect and derive the expression for binding energy in a nucleus. (K2)
   (OR)
   B) Explain the Liquid drop model of the nucleus? (K2)
7) A) Classify elementary particles. Explain their roles in particle physics (K2)
   (OR)
   B) Explain the conservation laws in particle physics (K2)
8) A) Describe the construction and working principle of the Geiger-Muller counter (K2)
   (OR)
   B) Explain the nuclear reactions and conservation laws (K2)
9) A) Explain Gamow's theory of alpha decay. (K2)
   (OR)
   B) Explain the construction and working principle of a cyclotron. (K2)
10) A) Explain the different radiation therapies used in cancer treatment (K2)
   (OR)
   B) How particle physics help to study the cosmic events? (K2)

Course Code		**23PHMAP243**	
Title of the Course		**INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS**	
Offered to: (Programme/s)		**B.Sc Physics(H)**	
Year of Introduction:	**2024-25**	**Semester:**	**4**
Course Category:	**MAJOR**	**Course Relates to:**	**L, R, N & G**
Year of Revision:	**NO**	**Percentage:**	
Type of the Course:		**EMPLOYABILITY & SKILL DEVELOPMENT**	
Pre-requisites, if any		**BASIC KNOWLEDGE OF NUCLEUS**	

Course Objectives

1. Determine the Dead Time of a GM counter.
2. Analyze the GM counter's characteristic curve and optimal voltage.
3. Estimate gamma detection efficiency with a GM counter.
4. Verify the inverse square law using the GM counter.
5. Study Bremsstrahlung production and attenuation.

Course Outcomes

CO NO	COURSE OUTCOME	BTL	PO	PSO
CO 1	Recall the principles of GM counter operation, including dead time, efficiency, and characteristic curves.	K1	1	1
CO 2	Explain the relationship between the operating voltage and GM counter-response, and describe how radiation intensity follows the inverse square law..	K2	3	1
CO 3	Demonstrate using a GM counter to measure dead time, efficiency, and radiation intensity, and experimentally verify the inverse square law.	K4	2	1
CO 4	Interpret the characteristic curve of a GM counter, identify the optimal operating voltage, and assess the radiation detection efficiency for gamma and beta sources.	K3	2	1
CO 5	Critically evaluate the effects of Bremsstrahlung production and attenuation on radiation measurements using the GM counter.	K5	2	1

List of Experiments

1. GM counter – Determination of dead time
2. Study of the characteristic curve of GM counter and estimation of its operating voltage
3. Estimation of efficiency for a gamma source of the GM counter
4. To verify inverse square law using GM counter
5. Production and attenuation of bremsstrahlung
6. Estimation of efficiency for a beta source of the GM counter
7. Study of back scattering of beta particles

Note:

1. (Six) experiments are to be done and recorded in the lab. These experiments will be evaluated in CIA.
2. For certification minimum of 7 (Seven) experiments must be done and recorded by students who had put in 75 % of attendance in the lab.
3. 15 marks = 10 marks for CIA & 5 marks for Record
4. 35 marks for practical exam.

The marks distribution for the Semester End practical examination is as follows:

Formula/ Principle / Statement with an explanation of symbols	05
Diagram/Circuit Diagram / Tabular Columns	05
Setting up of the experiment and taking readings/Observations	10
Calculations (explicitly shown) + Graph + Result with Units	05
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Viva-voce	05
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