ST. ANN'S COLLEGE FOR WOMEN

(Affiliated to Acharya Nagarjuna University,
Recognized Under Section 2(f) of UGC Act 1956-New Delhi)
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B.Sc. PHYSICS SYLLABUS UNDER CBCS

For Mathematics Combinations

[2020-21 Batch onwards]

I Year B. Sc. -Physics : I Semester

Course I: MECHANICS, WAVES AND OSCILLATIONS

Work load:60 hrs per semester **4 hrs/week**

Course outcomes (COs) :

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

- ***CO1****: Understand Newton's laws of motion and motion of variable mass system and its application to rocket motion and the concepts of impact parameter, scattering cross section.*
- ***CO2****: Apply the rotational kinematic relations, the principle and working of gyroscope and it applications and the precessional motion of a freely rotating symmetric top.*
- ***CO3****: Comprehend the general characteristics of central forces and the application of Kepler's laws to describe the motion of planets and satellite in circular orbit through the study of law of Gravitation.*
- ***CO4:*** *Understand postulates of Special theory of relativity and its consequences such as length contraction, time dilation, relativistic mass and mass-energy equivalence.*
- ***CO5:*** *Examine phenomena of simple harmonic motion and the distinction between undamped,damped and forced oscillations and the concepts of resonance and quality factor with reference to damped harmonic oscillator.*
- ***CO6:*** *Appreciate the formulation of the problem of coupled oscillations and solve them to obtain normal modes of oscillation and their frequencies in simple mechanical systems.*
- ***CO7:*** *Figure out the formation of harmonics and overtones in a stretched string and acquire the knowledge on Ultrasonic waves, their production and detection and their applications in different fields.*

UNIT-I:

1. **Mechanics of Particles** **(5 hrs)**

Review of Newton's Laws of Motion, Motion of variable mass system, Motion of a rocket, Multistage rocket, Concept of impact parameter, scattering cross-section, RutherfordScattering-Derivation.

2. **Mechanics of Rigid bodies** **(7 hrs)**

Rigid body, rotational kinematic relations, Equation of motion for a rotating body, Angular momentum and Torque Moment of inertia tensor, Euler equations, Precession of a spinning top, Gyroscope, Precession of the equinoxes

Unit-II:

3. **Motion in a Central Force Field** **(12hrs)**

Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, Equation of motion under a central force, Kepler's laws of planetary motion-Proofs, Motion of satellites, Basic idea of Global Positioning System (GPS), weightlessness, Physiological effects of astronauts

UNIT-III:

4. **Relativistic Mechanics** **(12hrs)**

Introduction to relativity, Frames of reference, Galilean transformations, Michelson-Morley experiment, negative result, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction, variation of mass with velocity, Einstein's mass-energy relation

Unit-IV:

5. **Undamped, Damped and Forced oscillations:** **(07 hrs)**

Simple harmonic oscillator and solution of the differential equation, Damped harmonic oscillator, Forced harmonic oscillator – Their differential equations and solutions, Resonance, Logarithmic decrement, Relaxation time and Quality factor.

6. Coupled oscillations: (05 hrs)

Coupled oscillators-Introduction, Two coupled oscillators, Normal coordinates and Normalmodes- N-coupled oscillators and wave equation

Unit-V:

6. **Vibrating Strings: (07 hrs)**

Transverse wave propagation along a stretched string, General solution of wave equation and its significance, Modes of vibration of stretched string clamped at ends, Overtones and Harmonics,Melde's strings.

7. Ultrasonics: (05 hrs)

Ultrasonics, General Properties of ultrasonic waves, Production of ultrasonics by piezoelectric and magnetostriction methods, Detection of ultrasonics, Applications of ultrasonic waves, SONAR

REFERENCE BOOKS:

- B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad
- Fundamentals of Physics Vol. I - Resnick, Halliday, Krane ,Wiley India 2007
- College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
- University Physics-FW Sears, MW Zemansky& HD Young,Narosa Publications,Delhi
- Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.
- Waves and Oscillations. N. Subramanyam and Brijlal, VikasPulications.
- Unified Physics - Waves and Oscillations, Jai PrakashNath&Co.Ltd.
- Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy, OrientLongman.
- The Physics of Waves and Oscillations, N.K.Bajaj, Tata McGraw Hill
- Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004

Practical Course 1: Mechanics, Waves and Oscillations

Work load: 30 hrs per semester **2 hrs/week**

Course outcomes (Practical's):

On successful completion of this practical course, the student will be able to;

- Perform experiments on Properties of matter such as the determination of moduli of elasticity *viz.*, Young's modulus, Rigidity modulus of certain materials; Surface tension of water, Coefficient of viscosity of a liquid , Moment of inertia of some regular bodies by different methods and compare the experimental values with the standard values.
- Know how to determine the acceleration due to gravity at a place using Compound pendulum and Simple pendulum.
- Notice the difference between flat resonance and sharp resonance in case of volume resonator and sonometer experiments respectively.
- Verify the laws of transverse vibrations in a stretched string using sonometer and comment on the relation between frequency, length and tension of a stretched string under vibration.
- Demonstrate the formation of stationary waves on a string in Melde's string experiment.
- Observe the motion of coupled oscillators and normal modes.

Minimum of 6 experiments to be done and recorded:

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 errorof 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-decayconstant and damping correction of the amplitude.

RECOMMENDED CO-CURRICULAR ACTIVITIES:

MEASURABLE

- Assignments (in writing and doing forms on the aspects of syllabus content and outside the syllabus content. Shall be individual and challenging)
- Student seminars (on topics of the syllabus and related aspects (individual activity)
- Quiz (on topics where the content can be compiled by smaller aspects and data(Individuals or groups as teams)
- Field studies (individual observations and recordings as per syllabus content andrelated areas (Individual or team activity)
- Study projects (by very small groups of students on selected local real-time problems pertaining to syllabus or related areas. The individual participation and contribution of students shall be ensured (team activity)

GENERAL

Group Discussion

- Visit to Research Stations, Science Museum Centres to understand the basic principlesof mechanics with live examplesand related industries
- Visit to Satellite launching station at Sri Harikota.

RECOMMENDED ASSESSMENT METHODS

Some of the following suggested assessment methodologies could be adopted;

- The oral and written examinations (Scheduled and surprise tests)
- Problem-solving exercises
- Practical assignments and Observation of practical skills
- Individual and group project reports
- Efficient delivery using seminar presentations
- Viva voce interviews.

ANU MODEL QUESTION PAPER
First Year – First Semester
Physics
Paper I – Mechanics, waves and Oscillations

Time : 3 Hours **Maximum Marks : 75**

SECTION A— (5 x 10 = 50 marks)
Answer ALL questions.

1. (a) Define angular momentum. Explain the law of conservation momentum.

Or

(b) Explain impact parameter and scattering cross — section.

2.(a) Define rigid body. Derive an equation of motion for a rotating body.

Or

(b) Derive relations between elastic constants.

3.(a)Define central force. l)Deriveequation of motion for a body under a central force.

Or

(b)State Kepler's laws of planetary motion. Deduce Kepler's first law.

4.(a)Derive the differential equation for damped harmonic oscillator and find the solutions.

Or

(b) Obtain the expression for energy consideration and power dissipation in damped oscillation.

5.(a) Derive an expression for Transverse wave velocity along stretched string.

Or

(b).Discuss the modes of vibration of a stretched string at both ends. What are overtones?

SECTION B (5 x 5 = 15 marks)
Answer any FIVE questions

6. State and prove Stokes theorem.
7. Derive the equation of motion of a rocket.
8. Explain the elastic moduli and Poisson's ratio of a rigid body.
9. Show that central force is conservative in nature.
10. Derive Einstein's mass energy relation.
11. Explain the characteristics of simple harmonic motion.
12. Define the terms Q-value and logarithmic decrement.
13. Explain the terms amplitude resonance and velocity resonance.
14. What are the limitations of Fourier's theorem? Explain.
15. Explain Saw tooth wave.

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