

TDP (General) 2nd Semester Exam., 2015

PHYSICS

(General)

SECOND PAPER

Full Marks : 40

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

Answer four questions, taking two from each Unit

UNIT—I

1. (a) What are Lissajous figures?

(b) Two simple harmonic motions at right angles to each other act simultaneously on a particle. Show that the path of the particle will be an ellipse when the two motions have same period but different amplitudes and initial phase difference of 90° .

(c) What is resonance? Discuss sharpness of resonance.

2+5+(2+1)=10

M15—700/1537

(Turn Over)

(2)

2. (a) Obtain the differential equation of longitudinal wave using pressure distribution in a fluid medium.
- (b) What are stationary waves? Find the wavelengths of the first three modes of vibration in a string. $6+(1+3)=10$
3. (a) What is reverberation? On which factor does the reverberation time depend?
- (b) What are the requirements of a good auditorium?
- (c) What are live and dead rooms? $(2+2)+2+(2+2)=10$

UNIT—II

4. (a) State and prove Coulomb's theorem in electrostatics.
- (b) Derive an expression for mechanical force on a charged surface. $(2+3)+5=10$
5. (a) Find an expression of magnetic induction due to current in a long solenoid at an axial point.

(3)

(b) Obtain an expression for magnetic potential at a point at a distance x from the centre of a flat circular magnetic shell of uniform thickness.

(c) Define strength of a magnetic shell. $4+4+2=1$

6. (a) What is hysteresis? Define the terms retentivity and coercivity.

(b) Find the expression of energy loss in a hysteresis cycle.

(c) Write the two differences between dead beat and ballistic galvanometer.

$(2+1+1)+4+2=1$

PHYSICS
(General)

SECOND PAPER (Group-A)

Full Marks : 40

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

Answer **four** questions, taking **two** from each Unit

UNIT—I

1. ✓(a) Show mathematically how to generate a uniform circular motion from two simple harmonic motions.
- (b) Three simple harmonic motions of the same frequency act on a particle simultaneously in the same direction. Their amplitudes are 1.0 cm, 1.5 cm and 2.0 cm respectively. The phase angle of the second with respect to the first is 60° , and that of the third with respect to the second is 30° . Obtain the resultant amplitude.

- ✓ (c) On what factors the damping depends? Establish the differential equation of motion for a damped harmonic oscillator.
4+2+(2+2)=10
2. (a) Obtain the amplitude of different frequencies of a uniformly stretched string with two ends fixed when it is struck over a small region at a distance h from one end. Assume that the region moves with instantaneous velocity v at time $t = 0$.
- (b) Write down the differences in stationary waves in struck string and plucked string.
7+3=10
3. (a) ✓ State Sabine's law and explain reverberation time.
- (b) ✓ Write down the characteristic features of a good auditorium.
- ✓ (c) Explain with brief discussion the meanings of live room and dead room.
(2+2)+3+3=10

UNIT—II

4. ✓ (a) Show that energy density in an electrostatic field is given by $\frac{1}{2} \vec{E} \cdot \vec{D}$.
(Symbols have their usual meanings.)

✓(b) Derive the expression for capacitance of a spherical capacitor when the outer sphere is earthed and the inner one is given charge.

✓(c) What is cylindrical capacitor? $3+5+2=10$

5. ✓(a) Using Biot-Savart law, derive the expression for magnetic induction at a point on the axis of a finite solenoid in terms of boundary angles.

✓(b) What is magnetic shell? Write down the Ampere's equivalence theorem relating magnetic shell with a current-carrying loop. $7+(1+2)=10$

6. (a) Discuss the theory of a moving-coil ballistic galvanometer.

(b) Show how the observed throw can be corrected for damping in ballistic galvanometer.

✓(c) Define current sensitivity of a galvanometer. $6+3+1=10$

TDP (General) 2nd Semester Exam., 2017

PHYSICS

(General)

SECOND PAPER

(Group—A)

Full Marks : 40

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

Answer four questions taking two from each Unit

UNIT—I

1. (a) Write the differential equation of motion of a particle executing damped harmonic motion. Explain the meaning of each term. What is critical damping?
(b) What is sharpness of resonance? What are the effects of damping on sharpness of resonance? (1+2+2)+(2+3)=10

2. (a) What are Lissajous figures? Find the resultant of two simple harmonic vibrations at right angles when their periods are in the ratio of 2:1 and there is a phase difference of $\pi/2$.

- (b) What are stationary waves? Discuss analytically the formation of stationary waves in a string of fixed length and clamped rigidly at both ends.
(1+4)+(1+4)=10
3. (a) On which factors does the reverberation time depend?
- (b) Why the sound emitted from a struck string is richer in harmonics compared to that emitted from a plucked string?
- (c) A string has a linear mass density 0.25 kg/m and is stretched along x -axis with a tension 25 N. One end of the string ($x = 0$) is given a sinusoidal motion with a frequency 5 Hz and amplitude 0.1 m. At time $t = 0$, the end has zero displacement and it is moving in the positive y -direction.
- (i) Find the wave speed in the string.
- (ii) Write the differential wave equation for the wave.
- (iii) Find the displacement of a point at $x = 0.25$ m at $t = 0.1$ s.
2+2+(2+2+2)=10

UNIT—II

4. (a) Derive an expression for mechanical pressure on a charged surface.
- (b) What effect does a dielectric medium have on the action of a capacitor?

(c) Two cylindrical capacitors are of equal length and same dielectric. The radii of the inner and outer cylinders of one are 8 cm and 10 cm respectively and those of other are 7 cm and 9 cm. Find the ratio of their capacitances. $4+2+4=10$

5. (a) Using Biot-Savart law, derive an expression for the magnetic induction at a point on the axis of a circular current carrying coil.

(b) What is critical damping resistance of a ballistic galvanometer?

(c) The radius of a circular coil of wire is 25 mm and current in it is 750 mA. Calculate the intensity of magnetic field at the centre of the coil. $5+2+3=10$

6. (a) Show that the hysteresis loss per unit volume per cycle of magnetization is equal to the area enclosed by the $B-H$ loop.

(b) Draw the magnetization curves for soft iron and steel as they are taken through a complete cycle of magnetizing field. Which one of the two is suitable for the core of a transformer and why? $5+(2+1+2)=10$

TDP (General) 2nd Semester Exam., 2018

PHYSICS
(General)

SECOND PAPER (Group—A)

Full Marks : 40

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

Answer four questions, taking two from each Unit

UNIT—I

1. (a) Show that the resultant of two SHMs at right angles to each other and having equal periods and amplitudes but phase difference 90° is a circle.
- (b) Two particles execute SHM of same amplitude and frequency along the same straight line. They pass one another when going in opposite direction each time their displacement is half their amplitude. What is the phase difference between them?

- (c) Write down the differential equation of forced vibration and explain different terms 4+4+2=10
2. (a) Obtain the differential equation of longitudinal wave using pressure distribution in an air medium.
- (b) Deduce an expression for the velocity of transverse waves in a string. What are its frequencies when the string is plucked at its middle point? 5+(4+1)=10
3. (a) What are the requirements of a good auditorium?
- (b) State Sabine's law and explain the reverberation time.
- (c) Give the graphical representation of growth and decay of sound in a live room.
- (d) What is optimum reverberation? 2+(2+2)+2+2=10

UNIT—II

4. (a) State and prove Coulomb's theorem in electrostatics.
- (b) Show that the energy stored per unit volume in an electric field is $\frac{1}{2}\epsilon_0 E^2$ where the symbols have their usual meanings.

- (c) Calculate the capacitance of a spherical capacitor if the diameters of inner and outer spheres are 20 cm and 30 cm respectively. Also assume that the intervening space between spheres be filled with a liquid of dielectric constant 2. (1+3)+4+2=10
5. (a) Applying Biot-Savart law, show that the magnetic induction at the central part of a long, narrow solenoid is double to that at any end of the solenoid.
- (b) Prove that a current-carrying loop and a magnetic shell whose boundary coincides with the loop are equivalent.
- (c) A magnetic shell is in the form of a disc of radius 0.06 m. Its intensity of magnetization is $56\pi \times 10^{-4} \text{ Wb m}^{-2}$ and thickness is 0.002 m. Calculate the potential on the axis at a distance of 0.08 m from its centre. 5+3+2=10
6. (a) Explain the term 'hysteresis' of a ferromagnetic material.
- (b) Show that in the case of a ballistic galvanometer of suspended coil type, the

(4)

charge producing the first throw Q_1 is given by

$$q = \frac{\tau T}{2\pi n A H} Q_1 \left(1 + \frac{\lambda}{2} \right)$$

where the symbols have their usual meanings.

c) State the differences in the properties of soft iron and steel on the basis of their $B-H$ loop.

2+5+3=10

PHYSICS
(General)

SECOND PAPER (Group—A)

Full Marks : 40

Time : 2 hours

*The figures in the margin indicate full marks
for the questions*

Answer four questions, taking two from each Unit

UNIT—I

1. (a) What are Lissajous' figures? (4)
- (b) Show that the resultant of two SHMs of the same period but different amplitudes and phases in perpendicular direction is an elliptical motion. For what condition will the path of the resultant motion be a straight line?
- (c) In one-dimensional motion of a mass of 10 gm, it is acted upon by a restoring force of 10 dynes/cm and a resisting

M9/1152

(Turn Over)

force 2 dynes-sec/cm. Find whether the motion is oscillatory or non-oscillatory.

$$2+(4+1)+3=10$$

2. (a) What are stationary waves? Discuss analytically the formation of stationary waves in a string of fixed length and clamped rigidly at both ends.

(b) State Young's law. Why is the sound emitted from a struck string richer in harmonics compared to that emitted from plucked string?

(c) Discuss the phenomenon of forced vibration. $(1+4)+(1+2)+2=10$

3. (a) What is reverberation time? On which factors does the reverberation time depend? (5)

(b) What are live and dead rooms? (A)

(c) The reverberation time in a hall measuring 25 m × 15 m × 10 m is 1.3 sec when it is empty. What will be its reverberation time when an audience of 300 persons is present? Assume that sound absorption by each person is 4.5 sabin. $(1+2)+(2+2)+3=10$

(4)

- (b) Find the expression of energy loss in a hysteresis cycle.
- (c) Explain the meaning of critical damping resistance and log decrement of a ballistic galvanometer. $2+4+(2+2)=10$

RD

TDP (General) 2nd Semester Exam., 2020

PHYSICS
(General)

SECOND PAPER (Group—A)

Full Marks 40

Time 2 hours

*The figures in the margin indicate full marks
for the questions*

Answer four questions taking two from each Unit

UNIT—I

1. (a) A system executing damped simple harmonic motion is subjected to an external periodic force. Write down the differential equation of motion for it. Discuss the phenomenon of sharpness of resonance in this connection and show how it depends on damping factor

(b) Establish the mathematical expression for the distribution of pressure during the passage of longitudinal wave through a gaseous medium. Show that the pressure wave is ahead of the progressive longitudinal wave by a phase

angle $\frac{\pi}{2}$

(2+2+1)×5=10

2. (a) Define reverberation and reverberation time. Write down the requirements of a good auditorium.

(b) State Young's law. Consider two strings of same length and same material. Tensions in the two strings are in the ratio 4 : 1 and diameters of the wires are in the ratio 1 : 2. Compare the frequencies of the fundamental modes of vibration.

$$(2 \times 2 \times 2) \div (1 \times 3) = 10$$

3. (a) What are the differences between stationary and progressive waves?

(b) The reverberation time in a hall measuring 64 ft \times 40 ft \times 25 ft is 1.6 sec when it is empty. What will be its reverberation time when an audience of 250 persons is present? Assume that sound absorption by each person = 4 sabins.

(c) A string of length l , fixed at both the ends at $x = 0$ and $x = l$, is plucked with a bow at $x = \frac{l}{4}$. Find the displacement and velocity at any point x as a function of time t .

$$2 + 3 + 5 = 10$$

UNIT—II

4. (a) State and prove Coulomb's theorem.
- (b) A capacitance is formed by taking two co-axial long cylinders of radii a and b ($b > a$). Find the capacitance per unit length when the outer cylinder is earthed.
- (c) What should be the potential of a spherical conductor of radius 1 m so that the mechanical pressure on the sphere is twice the atmospheric pressure? Atmospheric pressure = 10^5 N/m² and $\epsilon_0 = 8.85 \times 10^{-12}$ F/m. (1+3)+4+2=10
5. (a) State Biot-Savart law. Using this law, derive an expression for the magnetic induction at a point on the axis of a long solenoid.
- (b) A square loop of wire of edge a carries a current i . Show that the value of the magnetic induction B at the centre of the loop is given by

$$B = \frac{2\sqrt{2}\mu_0 i}{\pi a}$$

where μ_0 is the permeability of free space.

(1+5)+4=10

6. (a) Define 'coercivity' and 'retentivity' of a magnetic material.
- (b) What is ballistic galvanometer? Derive an expression for the ballistic reduction factor of a moving-coil ballistic galvanometer.
- (c) A $0.5 \mu\text{F}$ capacitor is charged to 6 volt. It gives a deflection of 20 cm when discharged through a ballistic galvanometer. If the time period of the galvanometer is 20 sec, calculate the current sensitivity. $(1+1)+(1+4)+3=10$

+

TDP (General) 2nd Semester Exam., 2022

PHYSICS

(General)

SECOND PAPER (Group—A)

Full Marks : 40

Time : 2 hours

The figures in the margin indicate full marks for the questions

Answer **four** questions, taking **two** from each Unit

UNIT—I

1. (a) What are the uses of Lissajous figures?

(b) A particle is subjected to two mutually perpendicular simple harmonic motions having same period but different amplitudes and phases. Show that the resultant motion of the particle is elliptic. Hence discuss what would happen when the phase difference is (i) 0, (ii) π and (iii) $\frac{\pi}{2}$.

(c) The displacement of a particle at time t is given by

$$x = a \cos \omega t + b \sin \omega t$$

If $a = 3$ m, $b = 4$ m and $\omega = 2$ rad/sec, find the time period, amplitude and initial phase of the particle.

$$2+(2+1+1+1)+3=10$$

2. (a) Define (i) forced vibration and (ii) damped oscillation.
- (b) Establish the general expression for the velocity of longitudinal waves in gases.
- (c) Explain the term 'sharpness of resonance'. $(2+2)+4+2=10$
3. (a) Write Sabine's formula in connection with reverberation time.
- (b) State Young's law. Write the differences between a plucked and struck string.
- (c) Write two special features of a good auditorium.
- (d) Find reverberation time for a hall of dimensions 40 ft × 30 ft × 20 ft having average absorption coefficient of 0.15. $2+(2+2)+2+2=10$

UNIT—II

4. (a) State Coulomb's theorem.
- (b) Deduce an expression for the electric pressure developed on the surface of an insulated and charged conductor.
- (c) Calculate the capacitance of a cylindrical capacitor, when the outer cylinder is earthed and the inner one is charged and the space between them is being filled with a dielectric. $2+4+4=10$

5. (a) Explain the terms 'hysteresis' and 'hysteresis loss'.
- (b) What should be the characteristics of the material to be used for making (i) permanent magnet and (ii) electromagnet? Discuss with example.
- (c) Write the conditions for a galvanometer to be ballistic. $(2+2)+(2+2)+2=10$
6. ~~(a)~~ What is meant by strength of a magnetic shell?
- (b) Apply Biot-Savart law to find the intensity of magnetic field at a point distant a from a long straight conductor carrying current i .
- (c) Prove that $\mu_r = 1 + X_m$, where symbols have their usual meanings. $2+5+3=10$
