2011

510035

PHYSICS (Paper – I) (Optional)

Standard : Degree **Total Marks : 200**
Nature : Conventional (Essay) type **Duration : Three hours**

N.B. :

1) *Answers must be written in **English**.*
2) *Question No. 1 is **compulsory**. Of the remaining questions, attempt **any four** selecting one question from **each Section**.*
3) *Figures to the **RIGHT** indicate marks of the respective question.*
4) *Make suitable assumptions, wherever be necessary and state the same.*
5) *Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.*
6) *Credit will be given for orderly, concise and effective writing.*
7) *Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he / she will be penalised.*

1. Answer **any four** of the following : (**10 marks each**) **Marks**

   (a) What is linear momentum ? State and prove the principle of conservation of linear momentum with example. **10**

   (b) What is the phenomenon of magnetostriction ? Explain, with the help of a neat diagram, a method of generation of ultrasonic wave by magnetostriction effect. **10**

   (c) Explain quarter – wave and half-wave plate. State its uses.

   Calculate the minimum thickness of a quarter-wave plate of quartz for light of wavelength 6000A°, given that for quartz, $\mu_o = 1.544$ and $\mu_e = 1.553$. **10**

   (d) What is green house effect ? Discuss its causes and consequences. **10**

   (e) What do you mean by atmospheric pollution ? State four major pollutants of atmosphere and explain in brief their role in atmospheric pollution. **10**

SECTION – A

2. Answer the following sub-questions :

   (a) Explain the gravitational potential. Find the gravitational potential due to a spherical body at a point inside the shell. **15**

   (b) State Hooke's law of elasticity. Define the three moduli of elasticity of a material.
   Derive an expression for volume strain in a cube of homogeneous isotropic material due to extensional forces applied normal to the faces of the cube. **10**

P.T.O.

(c) Define : **15**

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(i) Coefficient of viscosity,

(ii) Critical velocity and

(iii) Reynolds number.

What do you understand by Surface Tension ? Explain surface tension on the basis of molecular theory.

3. Answer the following sub-questions :

(a) State Newton's law of motion. Derive the law of conservation of linear momentum from Newton's law of motion. **15**

(b) What is tortional pendulum ? Describe the method of measurement of the modulus of rigidity of a wire by a tortional pendulum. **10**

(c) State Stoke's theorem and express it in the rectangular component form.

A soap bubble is slowly enlarged from a radius of 0.01 m to 0.1 m. Calculate the workdone in the process. Surface tension of soap solution is $26 \times 10^{-3} \, \text{Nm}^{-1}$. **15**

SECTION – B

4. Answer the following sub-questions :

(a) Explain construction and working of Michelson – Morley experiment, and discuss its negative result. **15**

(b) Define simple harmonic motion. Derive a general differential equation of S.H.M. Show that a simple pendulum executes S.H.M.. Find its period.

A lift is ascending at acceleration of 3ms^{-2}. What is the period of oscillations of the simple pendulum of length one meter suspended in the lift ? **15**

(c) Explain in detail the principle and working of recording of sound on a magnetic tape. **10**

5. Answer the following sub-questions :

(a) Obtain the Galilean transformation of position, velocity and acceleration and show that the acceleration remain unchanged when transformed from one frame of reference to the other moving with uniform velocity.

The length of rocket ship is 100 m on the earth. When it is moving with velocity v, its length observed is 99 m, calculate its velocity. **15**

(b)   What are damped oscillations ? Obtain a differential equation of motion of a damped harmonic oscillator.

A mass of 25×10^{-3} kg is suspended from the lower end of a vertical spring having a force constant 25 N/m. The mechanical resistance of the system is 1.5 Ns/m. The mass is displaced and released. Find whether the motion is oscillatory ? If so, calculate its period of oscillation.   **15**

(c)   Explain in detail the principle and working of reproduction of sound from cine film.   **10**

SECTION – C

6. Answer the following sub-questions :

(a)   State the principle of superposition of light waves. How this principle explain the phenomen of interference of light experimentally.   **10**

(b)   What is interferometer ? Describe Michelson interferometer and show how it can be used to determine wavelength of light.   **10**

(c)   Explain diffraction phenomenon. Give Fresnel's theory of construction of half period zone.   **10**

(d)   Discuss the theory of plane diffraction grating. Derive the grating equation.   **10**

7. Answer the following sub-questions :

(a)   Explain the phenomenon of interference in thin film. Why interference fringes are observed only for thin film like soap bubble. What will be the effect if thin film is excessively thin ?   **10**

(b)   Describe the formation of fringes by Fabry-Perot interferometer. Discuss the intensity distribution in fringe system observed by it.   **10**

(c)   Explain Fraunhofer diffraction due to a single narrow slit.   **10**

A slit of width 3.42×10^{-2} cm is illuminated by light of wavelength 5460A°. If convex lens of focal length 50 cm is used to observed the Fraunhofer diffraction then find the distance of first minima from central maxima.

(d)   Why are concave grating preferred over plane grating ? Discuss the theory of concave grating.   **10**

Marks

SECTION – D

8. Answer the following sub-questions :

   (a) What is Brownian motion ? Give essential features of Brownian motion. Derive Einstein's relation for Brownian motion.   **10**

   (b) Describe Cornat's cycle and obtain an expression for the efficiency of an ideal heat engine in terms of temperature.   **10**

   (c) i) Using Maxwell's law of distribution of speed of molecule in a gas, obtain expression for most probable speed, average speed and root mean square speed.

   (ii) At what temperature will the mean speed of hydrogen molecule be the same as that of nitrogen molecule at 35°C.

   Molecular weight of Nitrogen (N_2) = 28 and that of (H_2) = 2.   **20**

9. Answer the following sub-questions :

   (a) Derive and discuss the Van der Waals' equation of state of a gas. State its limitation.   **10**

   (b) Define entropy. Discuss the physical meaning of entropy.

   Calculate the change in entropy when 5kg of water at 100°C is converted into steam at the same temperature, given that latent heat of steam = 540 cal/gram.   **10**

   (c) (i) What are Fermions ? Write down the postulates of Fermi-Dirac statistics. Derive an expression for the probability distribution of particles governed by Fermi- Diriac statistics.

   (ii) Classify the following particle according to B – E and F – D statistics : Proton, neutron, electron, photon, α -particle, β -partical, hydrogen atom, hydrogen molecule, positron and lithium.   **20**

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