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HPAS (Main)—2013

PHYSICS

Paper I

Time : 3 Hours

Maximum Marks : 150

Note :— Question No. 1 is compulsory. Attempt any Four questions from the rest. All questions carry equal marks.

1. Answer the following :

(a) What is Bernoulli's equation ? Show that pressure has the units of energy density. 6

(b) What is physical significance of entropy ? Explain that during a carnot cycle the entropy of a system remains unchanged. 6

P.T.O.

(c) State and explain damped harmonic motion using the equation $x(t) = Ae^{-bt/2m} \cos(\omega t + \phi)$ where symbols have their usual meaning. 6

(d) If in Newton's ring experiment, diameter of third dark ring is 6.4 mm. Find radius of curvature of the lens if λ of light used is 5890 Å. 6

(e) For laser source radiating at mean wavelength $\lambda = 600$ nm, the coherence time τ is 2×10^{-10} sec. Find out the coherence length in meter. 6

2. (a) The rest mass of proton is 1.6×10^{-27} kg, what will be its mass while in motion with velocity $0.1 c$ where c is velocity of light. 10

(b) What is surface tension ? Explain the Laplace's theory of surface tension of a liquid. Discuss the effect of temperature on surface tension. 10

(c) Establish the relation between the elastic constants K , η and σ . 10

3. (a) A Carnot engine has its source at 100°C and sink at 0°C . If it is working at the rate of 100 watts, how much ice will melt away in one minute ? (Given, $1 \text{ cal} = 4.2 \text{ Joule}$, $L = 80 \text{ kcal/kg}$). 10

(b) Explain Bose-Einstein statistics. How is it different from Fermi-Dirac statistics ? 10

- (c) Find the relative emittance of the filament of 40 W electric lamp working at 273 K if its length is 10 cm and diameter is 0.1 mm. (Assume that all heat is lost by radiation). 10
4. (a) Establish the relation for velocity and acceleration of an object in simple harmonic motion. 10
- (b) Obtain expression for amplitude of a standing wave for fixed length. 10
- (c) A particle is moving according to $x = x_0 \sin^2 \omega t$. Find the time period of particle oscillation. 10
5. (a) The ratio of intensities of two waves is 1 : 9. If the two waves interfere, find the ratio of maximum and minimum intensities. 10

(b) Describe the working of a plane transmission Grating. Discuss the condition to obtain principal maxima and minima. 10

(c) Explain the meaning of plane polarised light, circularly polarised and elliptically polarised light. Show that the plane polarised and circularly polarised light are the special cases of an elliptically polarised light. 10

6. (a) What are important features of stimulated emission ? Explain the principle of population inversion and hence discuss the essential requirement for producing laser action. 10

P.T.O.

(b) Describe briefly the working of a ruby laser. 10

(c) What are the main section of an optical fibre ? Explain the function of each section. 10

7. (a) The output power of a gas laser is 1 mW and the emitted wavelength is 630 nm. Calculate the number of photons emitted per second. 10

(b) What do you understand by resolving power of a prism ? Obtain an expression for it. 10

(c) What do you understand by the diffraction of light ? Distinguish between the Fresnel and Fraunhofer class of diffraction. 10

8. (a) State and explain the third law of thermodynamics in detail. 10
- (b) Describe the phenomenon of Rutherford Scattering. 10
- (c) "Solar energy is an alternative source of energy." Explain this statement in detail. 10