RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, DECEMBER 2016

FIRST YEAR [BATCH 2016-19]

Date : 17/12/2016 **PHYSICS [General]**

Time : 11 am – 1 pm **Paper : I** Full Marks : 50

[Use a separate Answer Book for each Group]

Group - A

(*Answer any four questions*) [4×5]

1. Show that the Young's modulus Y, modulus of rigidity η and Poisson's ratio σ, are related by the equation $Y = 2\eta(1+\sigma)$. [5]

2. Prove that the torsional couple per unit twist of a wire of length L and radius r is $\frac{\pi\eta r^4}{2L}$, where η is the rigidity modulus of the material. [5]

3. a) State the significance of Reynold's number. [2]
   b) A cylindrical vessel of radius 7 cm is filled with water to a height of 50 cm. It has a capillary tube 10 cm long, 0·2 mm radius, protruding horizontally at its bottom. If the viscosity of water is 0·01 C.G.S units. Find the time in which the level will fall to a height of 25 cm. [3]

4. a) Prove the relation between surface tension and surface energy. [3]
   b) Calculate the amount of energy needed to break a drop of water 2mm in radius into 10^6 droplets of equal size. Given surface tension of water is 0·073 N/m. [2]

5. a) The surface tension of mercury is about 0·55 N/m and of water is 0·075 N/m. Is it possible for drops of water to stand upon mercury. Explain you answer. [2]
   b) Find the expression for excess pressure in a curved film. [3]

6. Obtain an expression for the rise of liquid in a capillary tube in terms of surface tension and angle of contact. [5]

Group - B

(*Answer any three questions*) [3×5]

7. Establish Fermat's principle from the law of reflection at a plane surface. [5]

8. a) Derive the thin lens formula using Fermat's principle. [3]
   b) If the refractive index from air to glass is 3/2 and that from air to water is 4/3, find the ratio of the focal lengths of a glass lens in water and in air. [2]

9. a) What is aberration? What are the different types of aberrations formed by a lens? [2+1]
   b) Determine the condition in which a plane convex lens can minimize the spherical aberrations by calculating the refractive index of the medium of the lens. [2]

10. a) What is chromatic aberration of a lens? [2]
    b) Determine the condition of achromatism of two lensed in contact. [3]

11. a) Define dispersive power of the material of a prism. [2]
    b) Calculate the dispersive power of crown glass [Given, $\mu_r = 1{\cdot}52$ and $\mu_v = 1{\cdot}53$] [3]

Group - C

(*Answer any three questions*) [3×5]

12. Obtain an expression of Simple harmonic damped vibration executed by a particle. What is critical damping? [4+1]

13. A particle is subjected to two simple harmonic motion at right angle to each other, having equations $x = a\sin\omega t$ and $y = b\sin(\omega t + 0\cdot 1)t$. Find the resultant locus of the particle. Also find the time period by which pattern will rotate. [4+1]

14. Deduce one dimensional differential equation for plane progressive wave. [5]

15. a) Obtain an expression for equation of motion of transverse vibration of a string. [4]
    b) A string is stretched by suspending a load of 2 kg. The mass per unit length of the string is 1gm/m. Find the velocity of the transverse wave. [1]

16. Two coherent sources form interference fringes. Find the distance between two consecutive bright fringes. [5]

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