RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIRST SEMESTER EXAMINATION, DECEMBER 2015

FIRST YEAR [BATCH 2015-18]

Date : 19/12/2015 **PHYSICS [Gen]**

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

[Use a separate Answer Book for each Group]

Group - A

(*Answer **any four** questions*)

1. a) Define bending moment of a beam. [2]
   b) Find an expression for the depression at the free end of a light beam fixed horizontally at one end and loaded at the free end. [3]

2. a) Explain the factors influencing the surface tension of a liquid. [2]
   b) A piece of copper wire has twice the radius of a piece of steel wire. One end of the copper wire is joined to one end of the steel wire so that both can be subjected to the same longitudinal force. By what fraction of its length will the steel wire have stretched when the length of copper wire has increased by 1%.Y for the steel is twice that for copper. [3]

3. a) Describe the way in which different parts of a viscous liquid move when flowing through a fine tube. What changes takes place if the motion is increased? [2+1]
   b) A sphere of water of radius 1 mm, is sprayed into a million drops, all of the same size. Find the energy expended in doing so. Given, surface tension of water = 72 dynes/cm. [2]

4. a) State Bernoulli's theorem for the flow of liquid through a horizontal tube. [2]
   b) Two drops of water of the same size are falling through air with terminal velocities of 10cm/s. If the two drops coalesce to form a single drop, what will be the new terminal velocity? [3]

5. a) Deduce an expression for the energy of bending of bended beam. [3]
   b) A circular bar one metre long and 8 mm diameter is rigidly clamped at one end in a vertical position. A couple of magnitude 2·5 Nm is applied at the other end. As a result a mirror fixed at this end deflects a spot of light by 0·15 m on the scale one metre away. Calculate the modulus of rigidity of the bar. [2]

6. a) What do you understand by Neumann's triangle. Explain how does water rise in a capillary tube and obtain an expression for height of water column in the tube. [1+2]
   b) Calculate the horizontal force required to move a metal plate of area $2\times10^{-2}m^2$ with velocity of $7\cdot5\times10^{-2}$ m/s when it rests on a layer of oil $1\cdot5\times10^{-3}$ m thick. Coefficient of viscosity of oil is 2 N.s/m^2. [2]

Group - B

(*Answer **any three** questions*)

7. a) State Fermat's principal in geometrical optics. [1]
   b) Establish the laws of reflection at plane surface using Fermat's principle. [2]
   c) Two mirrors are inclined to each other at an angle of 16°. Calculate the angle of incidence at which a ray incident on one of the mirrors retraces its path after 5 reflections. [2]

8. a) Explain the terms dispersion and dispersive power in optics. [2]
   b) The refractive indices of crown glass for red and violet lights are 1·517 and 1·523 respectively and the corresponding values for dense flint glass are 1·650 and 1·664. Design a plano-convex achromatic doublet of 50 cm focal length. [3]

9. a) Two thin lenses of focal length f_1 and f_2 are separated by a distance 'd'. Find the focal length of the combination. [3]
   b) A convex lens of focal length 40 cm is placed in contact with a concave lens of focal length 60 cm. An object is held at a distance of 240 cm on the axis of combination. Find the position of image. [2]

10. What is spherical aberration? What are the methods of minimizing the spherical aberration? [5]

11. a) Explain the working principle of a compound microscope with neat and clean ray diagram. [3]
    b) Distinguish between Ramsdin's eyepiece and Huygen's eyepiece. [2]

Group - C

(*Answer **any three** questions*)

12. A particle is subjected to two simple harmonic motions at right angle to each other, having the same frequency. Show that in general the locus of the particle is an ellipse. Hence find the locus when the two motions are (i) in phase and (ii) in opposite phase. [4+1]

13. What is damped vibration? Show that amplitude of damped vibration decays exponentially with time. What is critical damping? [1+3+1]

14. Show that the velocity of accoustic wave travelling along a solid rod is given by $\sqrt{\frac{Y}{\rho}}$ where Y is the Young's modulus and ρ is the density of the material of the rod. [5]

15. a) Distinguish between intensity and loudness in acoustic. Define 'Bel' and 'Phon'. [2+2]
    b) What is the intensity of 60db sound? [1]

16. a) Find the expression for energy density of progressive wave and hence the intensity from it. [2+1]
    b) Find the intensity of sound produced by an acoustic wave of frequency 256 Hz and amplitude 5mm, given the velocity of sound in air = 340 m/s and the density of air = 1·293 kg/m^3. [2]

———— × ————