B.Sc.(Honours)Examination, 2017

Semester–I

Physics (Honours)

Course: BPC-12

(Mechanics & General Properties of Matter)

Time: Three Hours **Full Marks: 40**

Questions are of value as indicated in the margin.

Answer **any *four*** questions

1. a) Show dimensionally that the frequency "n" of transverse waves in a string of length "l" and mass per unit length "m" under a tension T is given by,
$$n = \frac{k}{l}\sqrt{T/m}.$$ 4

   b) Distinguish between "inertial" and "non-inertial" frames with relevant examples. What are Galilean transformations? Explain whether a rotational reference frame is an inertial frame or not with relevant expression. 2+1+3

2. a) What is Gravitational flux? State and prove Gauss's law as applicable to the gravitational field. 1+4

   b) Calculate the gravitational "potential" and "intensity" of an uniform hollow sphere of radius "R" for points "outside" and "inside" the sphere. 5

3. a) State and prove the parallel axes theorem. 3

   b) Show that the moment of inertia of a solid sphere of mass "M" and radius "r" about any of its diameter is $= \frac{2}{5}Mr^2$. 4

4. a) Define "surface tension" and "surface energy". 2

   b) Find the excess pressure inside a curved liquid surface due to the surface tension. Hence find out the excess pressure inside a soap bubble. What will be the excess pressure inside an air bubble in water and why? 4+1

   c) An U-tube whose ends are open and whose limbs are vertical, contains a liquid of specific gravity 0.8 and S.T. 28 dynes/cm. If one limb has a diameter of 0.8 mm and the other of radius 0.2 mm. What is the different in levels of the liquid in the limbs, assuming that the angle of contact between the oil and glass is zero. 3

5. a) Distinguish between "torsional rigidity" and "flexural rigidity" with the relevant expressions. 2

   b) Show that the internal bending moment of a cantilever loaded at its free end is YAK^2/R. (Where symbols have their usual meaning). 4

   c) What is Poisson's ratio and what are its limiting values? Derive the interrelationship between Rigidity Modulus 'n', Young's Modulus "y" and Poisson's Ratio "σ". 4

6. a) Compare the depressions produced at the free ends for two beams made up of the same material having the same length and area but having circular cross-section and square cross-section respectively, thus having different "Geometrical moments of Inertia". 3

   b) What is Reynold's number? How is it related with the "Critical Velocity"? If water flows through a tube of diameter 3 mm at 50 cm/sec, then is the flow streamline or turbulent? (η for water = 0.01 poise, Reynold's number = 1000) 2+2

   c) State Stokes' law. Find out the expression for terminal velocity for a small spherical body having radius "r" falling through a viscous medium. Also mention the Ladenburg correction factors. 1+2

P.T.O.

7. a) State Torricelli's theorem. A tank contains water upto a height H. A small hole is punched in the wall of the tank at a depth "h" below the water surface. Find the distance from the foot of the wall at which the stream of water strikes the floor, show that this distance will be maximum when $h = H/2$. 3

   b) Deduce Poiseuille's equation for streamline flow of an incompressible liquid through a capillary tube. 4

   c) Using Poiseuille's formula show that if two capillary tubes of radii a_1 and a_2 having lengths "l_1" and "l_2" are set in series, the rate of flow V' is given by,

$$V = \frac{\pi P}{8n}\left[\frac{l_1}{d_1 4} + \frac{l_2}{d_2 4}\right]^{-1}$$

   where P is the pressure difference across the arrangement. 3

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