RAMAKRISHNA MISSION VIDYAMANDIRA
(Residential Autonomous College under University of Calcutta)
FIRST YEAR
B.A./B.SC. SECOND SEMESTER (January – June) 2014
Mid-Semester Examination, March 2014

Date   : 24/03/2014

Time   : 11 am – 1 pm

PHYSICS (Honours)

Paper : II

Full Marks : 50

[Use a separate Answer Book for each group]

(*Answer **five questions** taking at least **one** from each group*)

Group – A

1. a) A non-inertial coordinate system Oxyz is accelerating with unit acceleration along the x-axis, and is also rotating with constant unit angular velocity about that axis. Determine the absolute acceleration of a particle moving with unit speed along the y-axis, in terms of the distance y from the origin. [3]

   b) A pendulum is carried along in a moving train. If m is the mass of the bob, find the position in the cord and the deflection from the vertical, if i) the train is moving in a straight track with constant acceleration , f   and ii) the train is rounding curve of radius R with constant speed v_o . [Neglect rotation of the earth.] [5]

   c) Find the magnitude and direction of the coriolis force on a racing car of mass 10^4 kg travelling due south at a speed of 400 km/hr, at latitude 45° N. [2]

2. a) Define a central force. For a particle moving under a central force, show that the particle has a constant total energy and its path is confined to a fixed plane. [5]

   b) If the central force is $f(r) = -\frac{k}{r^2}$ ($k > 0$), show that the motion is equivalent to a one dimensional radial motion under an effective potential, $U_{eff}(r) = \frac{1}{2}\frac{m h^2}{r^2} - \frac{k}{r}$, where h is twice the areal velocity. [5]

3. a) Find the Fourier co-efficients corresponding to the function [3]
$$f(x) = 0 \ \ for \ -5 < x < 0$$
$$= 3 \ \ for \ \ \ 0 < x < 5$$

   b) Write the corresponding Fourier series. [2]

   c) How should *f(x)* be defined at x = −5, x = 0 and x = 5 in order that the Fourier series will converge to $f(x) \ for \ -5 \leq x \leq 5$? [3]

   d) Can *tanx* be expanded in Fourier series? [2]

Group – B

4. a) Define group velocity and phase velocity. Find the relation between them. Write down two physical examples of these two. [2+3+2]

   b) Find the group and phase velocities of the acoustic wave $w = \sqrt{\frac{\gamma P}{\rho}} K$ where the symbols have their usual meanings. [3]

5. a) Write down the boundary conditions of a plucked string. Derive the expression for vibration of a stretch string with above those conditions. [Do not evaluate the constants.] [2+3]

   b) Derive an expression of total energy of a vibrating stretched string. [5]

Group – C

6. a) Define shear stress, bulk modulus and Poison's ratio.   [3×2]

   b) Derive a relation between axial modulus and bulk modulus.   [4]

7. What do you mean by internal bending moment of beam ? Derive an expression for it. Using this, derive an expression for depression at the mid-point of a beam supported on knife-edges at both ends and loaded at the centre.   [2+3+5]

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