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~~FOURTH~~ THIRD SEMESTER — III — 41 — B.Tech. [EP]

SUPPLEMENTARY EXAMINATION (February-2019)

EP- 205 Classical & Quantum Mechanics

Time: 3:00 Hours *Max. Marks : 50*

Note:	Answer *any FIVE* questions. All questions carry equal Marks. Assume suitable missing data, if any.

Q1(a) State and Prove the law of conservation of angular momentum for a system of interacting particles using Lagrangian method. Explain the concept of cyclic coordinates? (5)

(b) Set up the Lagrange's equation of a particle moving on the surface of earth using spherical polar coordinates. (5)

Q2(a) Derive the equation of orbit of a particle moving under the influence of a central force consistent with the inverse square law and discuss briefly the special cases depending upon the Energy and hence of eccentricity. (5)

(b) The Force on a particle of mass m and charge e, moving with a velocity v in an Electric field **E** and magnetic field **B** is given by

$$\mathbf{F} = e\,(\mathbf{E} + \mathbf{v} \times \mathbf{B}) \quad (5)$$

Obtain the Hamiltonian and Hamilton's equations for charged particle.

Q3(a) Discuss the stability condition for the central force field if the form of potential V(r) is ar^{n-1}, a being a constant and centrifugal energy is $V_c(r)$ is br^{-2}, being positive constant. (5)

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(b) The wave function of a particle of mass m moving in a potential V(x) is, $\varphi(x,t) = A\,exp\left[-ikt - \frac{kmx^2}{\hbar}\right]$, where A and k are constants. Find the explicit form of the potential V(x). (5)

Q4(a) Explain the concept of probability amplitude and probability density. Show that the wave equation $\psi_{(x,t)} = A\cos(kx - \omega t)$ doesnot satisfy time dependent Schrodinger equation for free particle. (5)

(b) Determine the transmission coefficient for a particle of energy E< V_0 for a rectangular barrier given by

V = 0 for x<-a and x>a

= V_0 for -a<x<a, Explain briefly its application to the observed phenomenon of alpha decay. (5)

Q5(a) Using the time independent perturbation theory, calculate the first order energy shift in the ground state by a perturbing potential ax^4 in the Hamiltonian of a linear harmonic oscillator ($V = 1/2kx^2$). (5)

(b) Write connection formulae for penetration through a barrier. Apply the method to obtain the quantization condition for a bound state. (5)

Q6(a) Develop the stationary perturbation theory for a non-degenerate case up to the second order. (5)

(b) If $H = \frac{1}{2}m\dot{q}^2 + V(q)$ then Show that $\frac{ih}{2\pi}\dot{q} = qH - Hq$ is satisfied if $qp-pq = \frac{ih}{2\pi}$. (5)