

April 2014
M.Sc Mathematics
Semester – II , Paper No : 08
Classical Mechanics

code No : 3118

- (1) Each question carry equal marks
(2) All questions are compulsory

- Q.1 (a) Derive conservation theorem for linear momentum for a system of particle. [7]
(b) Derive Kepler's third law of motion. [7]

OR

- Q.1 (a) Show that the angular momentum is conserved in motion under central force. [7]
(b) Find the nature of force if $W = x^2y - xz^3 - z$. [7]
Q.2 (a) Discuss with all details ' principle of virtual work '. [7]
(b) Derive D'Alembert's principle. [7]

OR

- Q.2 Explain how the problem of two bodies, moving under the influence of a mutual central force can be reduced to a one – body problem. [14]
Q.3 (a) Find the central of force under the action of which a particle will follow an orbit described by $r = a(1 + \cos\theta)$. [7]
(b) Derive Kepler's second law of motion. [7]

OR

- Q.3 (a) In the case of particle's motion define (i) linear momentum (ii) Angular momentum (iii) Torque about a point (iv) Work done by a force field (v) Conservative force field. [7]
(b) Discuss Atwood's machine. [7]
Q.4 In usual notations prove $\sum_j \left[\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{q}_j} \right) - \frac{\partial L}{\partial q_j} \right] = 0$. [14]

OR

- Q.4 (a) Show that if q_k is cyclic then p_k is conserved. [7]
(b) Find the equation of motion of one dimensional harmonic oscillator using Langrangian. [7]
Also solve it. [7]

- Q.5 (a) Discuss the Hamiltonian function H and state Hamilton's principle. [7]
(b) Define poission's brackets and in usual notation prove the following results [7]
(i) $[x, y+z] = [x, y] + [x, z]$
(ii) $[x, yz] = y[x, z] + [x, y]z$

OR

Q.5 (a) Show that the transformations $P = \frac{1}{2}(p^2 + q^2)$, $Q = \tan^{-1} \frac{q}{p}$ is canonical. [7]

(b) Find the value of α and β so that the equations [7]

$$Q = q^\alpha \cos \beta p$$

$$P = q^\alpha \sin \beta p$$

represent a canonical transformation.