C.U.SHAH UNIVERSITY
Summer Examination-2018

Subject Name: Classical mechanics
Subject Code: 5SC04CLM1   **Branch: M.Sc. (Mathematics)**
Semester: 4   **Date: 01/05/2018**   **Time: 10:30 To 01:30**   **Marks: 70**

Instructions:
   (1)   Use of Programmable calculator and any other electronic instrument is prohibited.
   (2)   Instructions written on main answer book are strictly to be obeyed.
   (3)   Draw neat diagrams and figures (if necessary) at right places.
   (4)   Assume suitable data if needed.

SECTION – I

Q-1   Answer the Following questions: **(07)**
   a.   Define: velocity of moving particle.   **(01)**
   b.   What is cyclic coordinate .   **(01)**
   c.   Define : Dirac delta function   **(01)**
   d.   What is degree of freedom?   **(01)**
   e.   Define: Angular momentum.   **(01)**
   f.   Write the Lagrange's equation of motion.   **(01)**
   g.   What do you mean by conservation?   **(01)**

Q-2   Attempt all questions   **(14)**
   a.   What is constraint? Write any three types of constraints with proper examples.   **(07)**
   b   State and prove conservation theorem of energy.   **(07)**

OR

Q-2   Attempt all questions   **(14)**
   a.   State and prove principle of virtual work.   **(04)**
   b.   State and prove Lagrange's equation of motion.   **(10)**

Q-3   Attempt all questions   **(14)**
        Write the generalized force for motion of single particle in space in
   a.   (1) Cartesian co-ordinate   **(07)**
               (2) plane polar coordinate
   b.   What is Atwood's machine? Prove that the Lagrange's equation of motion for   **(07)**
           Atwood's machine is $\ddot{x} = \frac{m_1 - m_2}{m_1 + m_2}g$.

OR

Q-3   Attempt all questions   **(14)**

a. Show that Lagrange's equation of motion is invariant under co-ordinate transformation. **(07)**

b. Show that the Lagrange's equation of motion for simple pendulum is **(07)**
$\ddot{\theta} + \frac{g}{l}\theta = 0$.

SECTION - II

Q-4 Answer the Following questions: **(07)**

a. Define :Hamiltonian **(01)**

b. What is phase space? **(01)**

c. Define: Canonical transformation. **(01)**

d. What is generating function? **(01)**

e. Define: Routhian of motion. **(01)**

f. What is dual transformation? **(01)**

g. What is homogeneity of space? **(01)**

Q-5 Attempt all questions **(14)**

a. State and prove Hamilton's principle **(04)**

b. Show that distance of shortest curve between two points in a plane is a straight line. **(06)**

c. Compare Canonical transformation with Dual transformation with help of example. **(04)**

OR

Q-5 Attempt all questions **(14)**

a. State and prove Hemilton's equation of motion. **(07)**

b. Find Hamiltonian and Hamilton's equation of motion for simple pendulum. **(07)**

Q-6 Attempt all questions **(14)**

a. State and prove Routhian equation equation of motion **(07)**

b. For the following find Lagrangian find the corresponding Hamiltonian and Hamilton's equation of motion. **(07)**
$L = a\dot{x}^2 + \frac{b\dot{y}}{x} + c\dot{x}\dot{y} + F y^2\dot{x}\dot{z} + g\dot{y} - k\sqrt{x^2 + y^2}$.

OR

Q-6 Attempt all Questions **(14)**

a. Show that the transformation $Q = \log(1+\sqrt{q} \cos p)$ and $P = 2(1+\sqrt{q} \cos p) \sqrt{q} \sin p$ is canonical transformation and hence find generating function. **(07)**

b. If $L = \frac{m}{2}(\dot{r}^2 + r^2\dot{\theta}^2) + \frac{k}{r^n}$,Then obtain Routhian equation of motion. **(07)**