MSC DEGREE END SEMESTER EXAMINATIONS – NOVEMBER 2015
SEMESTER- 1, SUBJECT: PHYSICS
COURSE: P1PHYT02 -CLASSICAL MECHANICS
(Regular, Supplementary / Improvement)

Time: Three Hours   Max. Marks : 75

Part A (Objective Type)
*(Answer **all** questions. Each question carries 1 Mark)*

1. Hamiltonian of a free particle is --------

    a) $\dfrac{p^2}{2m}$ b) $\dfrac{p^2}{2m} + \dfrac{1}{2}kq^2$ c) 0   d) $Sin(p+q)^2$

2. Two balls with mass m_1 and m_2 are joined together with a spring. The number of modes of vibration are

    a) 2   b) 1   c) $\dfrac{m_1 + m_2}{m_1 - m_2}$ d) $\dfrac{m_1 - m_2}{m_1 + m_2}$

3.   The number of degrees of freedom of a rigid body is ……..
    a) 2   b) 6   c) 9   d) 3

4. Which of the following is not an example of central force

    a) $F = -kx$ b) $F = \dfrac{GMm}{r^2}$ c) $F = \dfrac{kq_1q_2}{r^2}$ d) $F = kv$

5. Lyapunov exponent of a chaotic system is
    a) Always positive   b) Sometimes negative   c) Complex   d) Imaginary

                                                                                      (1 x 5 = 5)

Part B
Answer any **five** questions. Each question carries 2 marks.

6. What are the advantages of Hamiltonian formalism over Lagrangian formalism?
7. Explain gravitational red shift
8. Differentiate between a chaotic system and an attractor
9. What is a fixed point?
10. What is neutral equilibrium?
11. What are cyclic coordinates?
12. Discuss the nature of Coriolis' force
13. What are Euler angles?   (2 x 5 = 10)

Part C

(Answer any 3 questions. Each question carries 4 Marks)

14. Prove that the rotational kinetic energy is conserved in the torque free motion of a rigid body
15. In a spherical pendulum the bob of mass m is constrained to move on a spherical surface of radius R, R being length of the pendulum. Set up the Lagrangian for the spherical pendulum and obtain equations of motion.
16. Three masses m_1, m_2 and m_3 are attached with a spring with m_2 in the middle and with $m_1=m_3$. Obtain the modes of vibration of this system
17. Obtain a fixed point of a logistic map $x_{n+1}= m\, x_n(1- x_n)$ for m=2
18. Applying Variational principle find the curve joining two points for which area of surface of revolution is minimum.

$$(4 \times 3 = 12)$$

Part D

(Answer all question. Each question carries 12 Marks

19. (a) Obtain the Lagrangian for a charged particle moving in an electromagnetic field. What do you mean by the term, Rayleigh's dissipation function?

OR

 (b) What is Hamilton's principle? Obtain Lagrange's equations from Hamilton's principle using the calculus of variation.
20. (a) Obtain the equations of motion and first integrals of a particle moving in a central force field.

OR

 (b) Discuss force free motion of a symmetric top. What is a space cone?
21. (a) Explain normal coordinates and normal modes. Obtain the normal modes of vibration of carbon dioxide molecule.

OR

 (b) Discuss the Generating function in canonical transformations
22. (a) Obtain the Newtonian equation of Einstein's field equations in weak gravitational fields.

OR

 (b) What are the properties of a chaotic system? Explain Universality of Chaos

$$(4 \times 12 = 48)$$

****