(6 pages) **Reg. No. :** .....

Code No. : 6359 **Sub. Code : HMAM 23**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2016.

Second Semester

Mathematics

CLASSICAL MECHANICS

(For those who joined in July 2012 onwards)

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The linear momentum p =

(a) $\frac{m}{v}$ (b) $\frac{dr}{dt}$

(c) mv (d) $m\frac{dv}{dt}$

2. In a rigid body the internal potential must remain _____

(a) Constant (b) Zero

(c) Independent (d) Negative

3. The Lagrangian L =

(a) $T+V$ (b) $T-V$

(c) TV (d) $\frac{T}{V}$

4. The _____ machine is an example of a conservative system with holonomic scleronomous constraint

(a) Heawood's (b) Steawood's

(c) Atwood's (d) Redwood's

5. The generalised momentum conjugate to a cyclic coordinate is _____

(a) Conserved (b) Not conserved

(c) A variable (d) Undetermined

6. _____ is the rate of energy dissipation

(a) $2\mathcal{F}$ (b) $3\mathcal{F}$

(c) $\mathcal{F}$ (d) $4\mathcal{F}$

7. The reduced mass μ =

(a) $m_1 - m_2$ (b) $m_1 + m_2$

(c) $\frac{m_1 + m_2}{m_1 m_2}$ (d) $\frac{m_1 m_2}{m_1 + m_2}$

8. $\overline{T}$ = _____

(a) $-\overline{V}$ (b) $\frac{1}{2}\overline{V}$

(c) $-\frac{1}{2}\overline{V}$ (d) $-\frac{1}{3}\overline{V}$

9. _____ is called the mean anomaly

(a) w (b) wt

(c) $\frac{w}{t}$ (d) $w + t$

10. The _____ character of orbits in a gravitational field fixes the form of the force law

(a) Non degenerate (b) Degenerate

(c) Elliptic (d) Circular

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

11. (a) State and prove the conservation theorem for the linear momentum of a particle.

Or

(b) Define the holonomic constraints and the nonholonomic constraints. Give examples.

12. (a) Prove that $\sum_i \left(F_i^{(a)} - \dot{p}_i\right) . \delta r_i = 0$.

Or

(b) Discuss the motion of a bead sliding on a uniformly rotating wire in a force-free space.

13. (a) State and prove Hamilton's principle.

Or

(b) Find the shortest distance between two points in a plane.

14. (a) Prove that the central force motion of two bodies about their center of mass can be reduced to an equivalent one-body problem.

Or

(b) Prove that the total number of integral exponents in the differential equation of the orbit resulting in elliptic functions is $n = +5, +3, 0, -4, -5, -7$.

15. (a) Derive the Kepler's equation.

Or

(b) Using Laplace-Runge-Lenz vector, derive the orbit equation for the Kepler problem.

SECTION C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

16. (a) State and prove the conservation theorem for

(i) The angular momentum of a particle

(ii) The total angular momentum.

Or

(b) State and prove :

(i) Energy conservation theorem for a particle

(ii) Conservation theorem for the linear momentum of a system of particles.

17. (a) Derive the Lagrange's equation.

Or

(b) Explain the Rayleigh's dissipation function.

18. (a) Discuss on Hamilton's principle to nonholonomic systems.

Or

(b) Derive Euler-Lagrange differential equations.

19. (a) Derive the two equations of motions.

Or

(b) State and prove the Virial theorem.

20. (a) State and prove Bertrand's theorem.

Or

(b) Discuss about the inverse square law of force.

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