(PART-B : Descriptive)

Time : 2 hrs. 40 min. **Marks : 50**

[Answer question no.1 & any four (4) from the rest]

1. Deduce the expressions of velocity and acceleration in terms of spherical polar coordinate — 3+7=10

2. A uniform rod AB of mass 2m is freely joined at B to a second rod BC of mass m. The rods lie on a smooth horizontal plane at right angles to each other and an impulse I is applied to AB at A in a direction parallel to BC. Find the initial velocity of BC and prove that the kinetic energy generated is $\frac{5}{6}\frac{I^2}{m}$ — 4+6=10

3. State and prove Kelvin's Theorem. — 2+8=10

4. Deduce Euler's equation of motion of a body about a fixed point — 10

5. Obtain the equation of motion for the Lagrangian $L = a^2(1-\cos\theta)\dot{\theta}^2 - ag(1+\cos\theta)$. — 5+5=10
Twice the Kinetic energy of a system is $A\dot{\theta}^2 + 2Hw\dot{\theta} + Bw^2$, where A, H, B are all functions of θ and w is a constant, also the work function of the field of conservative force U, a function of θ alone, show that $\frac{1}{2}(A\dot{\theta}^2 - B\omega^2) = U + c$.

6. A particle of mass m moves in a force field of potential V . Write the Hamiltonian and the Hamilton's equation in spherical polar coordinate. — 10

7. Explain about classification of tensor — 10

8. Define Symmetric,Antisymmetric,Outer product of tensor,Contravariant and Covariant tensor — 2×5=10

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M. Sc. MATHEMATICS
SECOND SEMESTER
TENSOR AND MECHANICS
MSM – 204

(Use Separate Answer Scripts for Objective & Descriptive)

Duration : 3 hrs. **Full Marks : 70**

(PART-A : Objective)

Time : 20 min. **Marks : 20**

Choose the correct answer from the following: ***1×20=20***

1. Impulse of a body is equal to change in
   a. momentum b. velocity
   c. Both of these d. None of these

2 If impulse of a body is becomes zero , then momentum before and after impulse becomes
   a. unequal b. equal
   c. Doesnot exist d. exist

3. Rate of change of angular momentum is equal to
   a. torque b. force
   c. Both of these d. None of these

4. The Kinetic energy of a system after explosion is increased by the Kinetic energy of a relative motion.
   a. Carnot's second theorem b. Carnot's first theorem
   c. Both of these d. None of these

5. The Kinetic energy of a system after collision is less than the Kinetic energy of a relative motion before collision
   a. Carnot's second theorem b. Carnot's second theorem
   c. Both of these d. None of these

6. The equation of virtual work under impulsive forces is given by
   a. $\sum m_\alpha(q_\alpha - q'_\alpha)\delta r_\alpha = \sum I_\alpha \delta r_\alpha$ b. $\sum m_\alpha(q'_\alpha - q_\alpha)\delta r_\alpha = \sum I_\alpha \delta r_\alpha$
   c. None of these d. All of these

7. The K.E of a points of a system which are suddenly set in motion is less than any other kinematically possible motion is a statement of
   a. Bertrand's Theorem b. Carnot's Theorem
   c. Kelvin's Theorem d. None of these

8. In second Carnot's theorem , external impulse is
   a. present b. zero
   c. absent d. None of these

9. The angular momentum of a rigid body with one end fixed is given by

a. $L=\sum_i m_i\{r_i \times (\vec{w} \times r_i)\}$
b. $L=\sum_i m_i\{r_i \times v_i\}$
c. Both of these
d. None of these

10. A rectangular parallelepiped with edges a,b and c along x, y and z axis respectively has the Moment of Inertia about any side equal to

a. $\frac{2}{3} M(a^2 + b^2)$
b. $\frac{2}{3} M(a^2 b^2)$
c. $\frac{2}{3} M(b^2 + c^2)$
d. $\frac{1}{3} M(a^2 + b^2)$

11. According to Carnot's Theorem , The Kinetic energy of a system after explosion is increased by the kinetic energy of a relative motion ______ impulse.

a. Before
b. After
c. Both of these
d. None these.

12. The radial acceleration in case of motion of a particle in three dimension with cylindrical polar coordinate is given by

a. $\ddot{r} + r\dot{\theta}^2$
b. $\ddot{r}^2 - r\dot{\theta}^2$
c. $\ddot{r} - r\dot{\theta}^2$
d. None of these

13. If product of inertia are zero and the principal moments of inertia is nonzero, then by Kinetic energy of rotation we get the value of T as

a. $2[Aw_1{}^2 + Bw_2{}^2 + Cw_3{}^2]$
b. $\frac{1}{2}[Aw_1{}^2 + Bw_2{}^2 + Cw_3{}^2]$
c. $\frac{1}{4}[Aw_1{}^2 + Bw_2{}^2 + Cw_3{}^2]$
d. $\frac{1}{2}[Aw_1{}^2 + Bw_2{}^2 + Cw_3{}^2]$

14. The radial acceleration in case of motion of a particle in three dimension with cylindrical polar coordinate is given by

a. $\frac{1}{r}\frac{d(r^2\ddot{\theta})}{dt}$
b. $\frac{1}{r}\frac{d(r^2\theta)}{dt}$
c. $\frac{1}{r}\frac{d(r^2\dot{\theta})}{dt}$
d. None of these

15. The equation $\frac{d}{dt}\left(\frac{\partial T}{\partial \dot{q}_\alpha}\right) - \frac{\partial T}{\partial q_\alpha} = \varphi_\alpha$ is known as Lagrange's equation for a

a. Holonomic system
b. Holonomic conservative system
c. Non holonomic system
d. None of these

16. In $\sum a_i x^i$, i is called

a. Dummy suffix
b. Real suffix
c. Kronecker delta
d. Convention

17. Kronecker delta has

a. One value
b. Two value
c. Three value
d. No value

Contd....

18. Sum of two tensor is a

a. vector
b. Quotient law
c. tensor
d. product

19. What is value of $A^{\prime i}$

a. $\frac{\partial x}{\partial x^\alpha} A^\alpha$
b. $\frac{\partial x^{\prime i}}{\partial x} A^\alpha$
c. $\frac{\partial x^{\prime i}}{\partial x^\alpha} A^\alpha$
d. $\frac{\partial x^{\prime i}}{\partial x^\alpha} A$

20. $A^{\prime ij} = \frac{\partial x^{\prime i}}{\partial x^\alpha}\frac{\partial x^{\prime j}}{\partial x^\beta} A^{\alpha\beta}$ is a tensor of rank

a. One
b. Two
c. Three
d. zero

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P.T.O.