

M.Sc. MATHEMATICS
SECOND SEMESTER
MECHANICS AND TENSOR
MSM – 204
[USE OMR FOR OBJECTIVE PART]

2025/05

**SET
A**

Duration: 1:30 hrs.

Full Marks: 35

Time: 15 mins.

(Objective)

Marks: 10

$1 \times 10 = 10$

Choose the correct answer from the following:

- In the expression $a_{ij}x^j$, j is called
 - Real suffix
 - Dummy suffix
 - Kronecker Delta
 - None of the above
- $\delta_q^a B_i^{qr} = ?$
 - B_i^{qr}
 - B_i^{ar}
 - δ_i^{pr}
 - $\delta_a^q B_i^{ar}$
- If coordinate of a moving particle is (r, θ, ϕ) in a spherical coordinate system, then what is the velocity of particle
 - $\vec{v} = \dot{r}\hat{r} - r\dot{\theta}\hat{\theta} + r\dot{\phi}\sin\theta\hat{\phi}$
 - $\vec{v} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta} + r\dot{\phi}\sin\theta\hat{\phi}$
 - $\vec{v} = \dot{\rho}\hat{\rho} + \rho\dot{\phi}\hat{\phi} + \dot{z}\hat{k}$
 - None of the above
- If a body projected with speed 6m/s making angle 20° with the horizontal line, then vertical component of velocity is
 - $20\cos 6^\circ$
 - $20\sin 6^\circ$
 - $6\sin 20^\circ$
 - $6\cos 20^\circ$
- Degree of freedom(dof) is mathematically expressed as
 - $f = 3N - k$, where $N \rightarrow$ Number of particles, $k \rightarrow$ constraint
 - $f = 3N - k$, where $N \rightarrow$ Number of particles, $k \rightarrow$ No of axis
 - $f = 3N - k$, where $N \rightarrow$ Number of dimension, $k \rightarrow$ constraint
 - None of the above
- Bertrand's Theorem represent two types of potential. These are
 - Gravitational Potential and Electromagnetic potential
 - Gravitational Force and Electrostatic Force
 - Gravitational Potential and Electrostatic potential
 - None of the above

7. $\partial' = ?$
- N
 - 1
 - 0
 - None of the above
8. Impulse $I = ?$
- $mv_1 - mv_2$, v_2 & v_1 are the initial velocity and final velocity
 - $mv_2 - mv_1$, v_2 & v_1 are the final velocity and initial velocity
 - $mv_2 + mv_1$, v_2 & v_1 are the final velocity and initial velocity
 - None of the above
9. Kelvin's Circulation Theorem states that
- The circulation along any open path moving with the fluid is constant for all
- times if the external forces are conservative and density ρ is a function of pressure p only.
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10. The D'Alembert's principle is
- $\sum (F_i^a + p_i) \delta r_i = 0$, $F_i^a \rightarrow$ applied force, $p_i \rightarrow$ momentum, $\delta r_i \rightarrow$ virtual displacement
 - $\sum (F_i^a - p_i) \delta r_i = 0$, $F_i^a \rightarrow$ constraint force, $p_i \rightarrow$ momentum, $\delta r_i \rightarrow$ virtual displacement
 - $\sum (F_i^a - p_i) \delta r_i = 0$, $F_i^a \rightarrow$ applied force, $p_i \rightarrow$ momentum, $\delta r_i \rightarrow$ virtual work
 - $\sum (F_i^a - p_i) \delta r_i = 0$, $F_i^a \rightarrow$ applied force, $p_i \rightarrow$ momentum, $\delta r_i \rightarrow$ virtual displacement

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(Descriptive)

Time : 1 hr. 15 mins.

Marks: 25

[Answer question no.1 & any two (2) from the rest]

1. What is the condition for adding and subtracting two tensors. If a mixed tensor, contravariant of rank p and covariant of rank q , we equate a contravariant and covariant index and sum with regard to that index, then the resulting set of N^{p+q-2} sums is a mixed tensor, contravariant of rank $p-1$ and covariant of rank $q-1$ 1+4=5
2. Find the differential equation of motion in Spherical coordinate System. 10
3. State and Prove Carnot's Theorem. 3+7=10
4. What do you mean by Riemannian Metric. Prove that g_{ij} is a covariant tensor of rank 2. 2+8=10
5. What do you mean by Rigid body? How many types of motion of a Rigid Body. Prove that $C'^i_j = A^i_k B^k_j$ is a mixed tensor of order two. 1+3+6=10

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