



Register number:

Date and session:

ST. JOSEPH'S UNIVERSITY, BENGALURU- 27
M.Sc MATHEMATICS- III SEMESTER
SEMESTER EXAMINATION: OCTOBER 2023
(Examination conducted in November/December 2023)
MT 9222: CLASSICAL AND CONTINUUM MECHANICS

(For current batch students only)

Time: 2 hr

Max. Marks: 50

The paper contains **TWO** printed pages.

Answer any FIVE full questions of the following:

1. Obtain the expression for the following:

(a) Acceleration in a plane polar co-ordinate system.

[4 marks]

(b) Coriolis force.

[6 marks]

2. Derive the following:

(a) Lagrangian form of D'Alembert's principle.

[3 marks]

(b) Generalized momentum of system of particles.

[2 marks]

(c) Hamiltonian principle for non-holonomic constraints.

[5 marks]

3. Derive the expression for principle of least action.

[10 marks]

(OR)

(a) State and prove $\epsilon - \delta$ identity.

[4 marks]

(b) Show that $\nabla^2(x_m x_n) = 2\delta_{mn}$.

[2 marks]

(c) Derive curl of a vector field.

[4 marks]

4. (a) State and prove divergence theorem of a tensor.

[5 marks]

(b) Find F and F^{-1} for the deformation defined as:

$$x_1 = x_1^0 - x_2^0 x_3^0, \quad x_2 = x_2^0 + x_1^0 x_3^0, \quad x_3 = x_3^0.$$

[5 marks]

5. (a) Prove the following:
- (i) $J = 1 + e_{kk}$ for a small deformation. [3 marks]
 - (ii) e_{kk} is a dilation. [2 marks]
- (b) Find the velocity and acceleration for a continuum rotates like rigid body with angular velocity $\vec{\omega}$ about x_3 axis. [5 marks]
6. (a) Find the stream lines and path lines for the motion determined by:
 $v_1 = 1 + at, v_2 = x_1, v_3 = 0$, where a is a constant. [5 marks]
- (b) State and prove Kelvin's circulation theorem. [5 marks]
7. (a) For a given velocity field $v_i = \frac{x_i}{1+t}$, show that $\rho = \rho_0(1+t)^{-3}$. [4 marks]
- (b) Derive the expression of balance of energy. [6 marks]

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