

MA/MSCMT-05

December - Examination 2017

M.A. / MSc. (Previous) Mathematics Examination**Mechanics****Paper - MA/MSCMT-05****Time : 3 Hours]****[Max. Marks :- 80**

Note: The question paper is divided into three sections A, B and C.

Section - A**8 × 2 = 16**

(Very Short Answer Type Questions)

Note: Section 'A' contain 08 very short Answer Type Questions. Examinees have to attempt all questions. Each question is of 02 marks and maximum word limit is thirty words.

- 1) (i) Define the centroid of the system.
- (ii) Define moving axes and fixed axes.
- (iii) Write vector form of Euler's equation of motion.
- (iv) Define the Invariable line.
- (v) Write the Lagrange's equation of motion for conservative system in terms of Lagrange' function.
- (vi) Write the equation of continuity in Cartesian coordinates system.

(vii) Define a doublet.

(viii) Write the Bernoulli's equation for steady motion.

Section - B

$4 \times 8 = 32$

(Short Answer Type Questions)

Note: Section 'B' contain 08 short Answer Type Questions. Examinees will have to answer any four (04) questions. Each question is of 08 marks. Examinees have to delimit each answer in maximum 200 words.

- 2) State and prove D'Alembert's principle.
- 3) Show that the centre of suspension and centre of oscillation are convertible (or interchangeable.)
- 4) A cylinder rolls down a smooth plane whose inclination to the horizon is α , unwrapping as it goes a fine string fixed to the highest point of the plane find its acceleration and the tension of the string.
- 5) Prove that if rectangular parallelepiped (edges $2a$, $2a$, $2b$) rotates about its centre of gravity its angular velocity about one principal axis is constant and about the other principal axes is periodic, the period being to the period about the first mentioned principal axis as.

$$(b^2 + a^2) : (b^2 - a^2)$$
- 6) Deduce the Lagrange's equations from Hamilton's Principle.
- 7) Obtain an Image of a source with respect to a straight line.
- 8) Find the stream lines and paths of the particles when:

$$u = \frac{x}{(1+t)}, v = \frac{y}{(1+t)}, w = \frac{z}{(1+t)}$$

- 9) Steam is rushing from a boiler through a conical pipe the diameter of the ends of which are D and d . If V and v be the corresponding velocities of the steam and if the motion be supposed to be that of divergence from the vertex of the cone. Prove that.

$$\frac{v}{V} = \frac{D^2}{d^2} e^{(v^2 - V^2)/2k}$$

Section - C

$2 \times 16 = 32$

(Long Answer Type Questions)

Note: Section 'C' contain 04 Long Answer Type Questions. Examinees will have to answer any two (02) questions. Each question is of 16 marks. Examinees have to delimit each answer in maximum 500 words.

- 10) Explain Euler's geometrical equations of motion and Deduce Euler's equations from Lagrange's equations.
- 11) Derive the Lagrange's equations of motion in generalized coordinates for a Holonomic dynamical system under finite forces.
- 12) If the lines of motion are curves on the surface of spheres all touching the plane of xy at the origin O , then prove that equation of continuity is $r \sin \theta \frac{\partial p}{\partial t} + \frac{\partial(pv)}{\partial \phi} + \sin \theta \frac{\partial(pu)}{\partial \theta} + pu(1 + 2 \cos \theta) = 0$
- 13) Obtain the equations of motion under impulsive force.
