

- (a) State and prove Lamy's theorem. (04)
- (b) Answer any **TWO** of the following: (10)
- (1) Explain: (i) The triangle of forces (ii) The polygon of forces.
 - (2) State and prove the principle of Virtual work.
 - (3) A light lever in the form a letter L with arms a and b is pivoted at the angle so that it can turn freely in a vertical plane. Weights w and W are suspended from the ends. Show that there are just two positions of equilibrium.

Que 3 :

- (a) Define: Field of force. Show that in a conservative system, the field of force is the gradient of a potential energy with sign reserved. (04)

OR

- (a) Define Mass centre. Prove that mass centre of the system always exists. (04)
- (b) Answer any **TWO** of the following: (10)
- (1) Define mass centre. If the position vectors of the vertices of ΔABC are $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{c} = 3\hat{i} + 4\hat{j} + \hat{k}$, and if the particles of masses 1, 2, 3 units are placed at the vertices A, B and C. Find the mass centre of the system.
 - (2) Show that the field of force (X, Y) is conservative if and only if $\frac{\partial X}{\partial y} = \frac{\partial Y}{\partial x}$.
 - (3) Find the mass centre of the cubical box with no lid; the sides and bottom being made of the same thin material.

Que 4 :

- (a) Derive the general formula for all flexible cables hanging freely. (04)

OR

- (a) In the usual notations prove that $\vec{F} = -grad V$. (04)
- (b) Answer any **TWO** of the following: (10)
- (1) A rod of length $2a$ rests on a rough floor against a smooth edge of a table of length 3 ft. If the rod is on the point of slipping when inclined at an angle of 60° to the horizontal, find the coefficient of friction.
 - (2) Explain the following terms:
 - (i) Angle of friction. (ii) Cone of friction.
 - (3) Find the distance of mass centre
 - (i) of the wire bent in to semicircular form of the radius a from its diameter joining the two ends.
 - (ii) of a flat semicircular plate from the terminating diameter.