

Roll No.

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13663/NH**B/2111****MECHANICS**

Paper–III

Semester–III

Time Allowed : 3 Hours] [Maximum Marks : 40

Note : The candidates are required to attempt **two** questions each from Sections A and B carrying 6 marks each and the entire Section C consisting of 8 short answer type questions carrying 2 marks each.

SECTION—A

1. ABC is a triangle and O its circumcentre. AO meets

BC in D. Show that the components of force AD along AB and AC are : 6

$$\frac{AB \sin 2B}{\sin 2B + \sin 2C} \text{ and } \frac{AC \sin 2C}{\sin 2B + \sin 2C} \text{ respectively.}$$

2. A, B, C, are three points on the circumference of circle. Forces P, Q, R acting along AB, BC and the tangent at B are in equilibrium. Show that P and Q are inversely proportional to the sides AB and BC. 6

3. AB is a straight rod, of length $2a$ and weight λW , with the lower end A on the ground at the foot of a vertical wall AC, B and C being at the same vertical height $2b$ from A, a heavy ring of weight W , is free to move along a string of length $2l$, which joins B and C. If the system be in equilibrium with the ring at the middle point of the string, show that : 6

$$l^2 = a^2 - b^2 \left[\frac{\lambda^2 + 2\lambda}{(\lambda + 1)^2} \right].$$

4. State and prove Varignon's theorem. 6

SECTION—B

5. Find the latus rectum, the vertex, the focus and the height of the directrix of the parabola traced out by a projectile. 6

6. Find the escape velocity of a particle projected from the surface of Earth where $g = 9.8 \text{ m / sec}^2$ and $R = 6370 \text{ km}$, R being the radius of Earth. 6

7. A body sliding down a smooth inclined plane is observed to cover equal distances, each to l , in consecutive intervals of time t_1 and t_2 . Show that inclination of the plane is : 6

$$\sin^{-1} \left[\frac{2l(t_1 - t_2)}{gt_1 t_2 (t_1 + t_2)} \right].$$

8. A particle executing S.H.M. has amplitude 'a'. Show that the distance of the point from the centre at

which the velocity is half of the maximum velocity

is $\frac{\sqrt{3}}{2} a$. 6

SECTION—C

9. Answer the following questions briefly : $8 \times 2 = 16$

- (i) Write down the necessary and sufficient conditions of equilibrium of a number of coplanar-concurrent forces.
- (ii) State Newton's third law of motion and explain with two examples.
- (iii) Define the terms Force, Body, Equilibrium.
- (iv) State the Lami's theorem and converse of Lami's theorem.
- (v) Define the terms Speed, Velocity and Acceleration.

- (vi) What is meant by Projectiles, Trajectory and Angle of projection?
- (vii) Explain the term acceleration due to gravity with example.
- (viii) Explain the Periodic Motion with example.
Is Simple Harmonic motion periodic?