

This question paper contains 3 printed pages]

**SA—57—2025**

**FACULTY OF SCIENCE & TECHNOLOGY**

**B.Sc. (Third Year) (Sixth Semester) EXAMINATION**

**APRIL/MAY, 2025**

**(CBCS/New Pattern)**

**MATHEMATICS**

**Paper XVII**

**(Mechanics-II)**

**(Monday-, 21-4-2025)**

**Time : 10.00 a.m. to 12.00 noon**

*Time—2 Hours*

*Maximum Marks—40*

*N.B. :—* (i) *All questions are compulsory.*

(ii) *Figures to the right indicate full marks.*

1. To find the radial and transverse components of velocity. 15

*Or*

(a) Prove the necessary and sufficient condition for a force  $F$  to be conservative is that the line integral over a closed path  $C$  in a conservative field is zero, that is : 8

$$\int_C \vec{F} \cdot d\vec{r} = 0.$$

P.T.O.

(b) Show that the velocity of a particle increases from  $\vec{V}_1$  to  $\vec{V}_2$ , then the gain in the K.E is half the scalar product of impulse and the sum of  $V_1$  and  $V_2$ . 7

2. Define kinetic energy and prove that the kinetic energy of particle of mass  $m$  moving with velocity  $\vec{V}$  is  $\frac{1}{2} mV^2$ . 15

Or

(a) To find the velocity of a particle in terms of its height at that instant. 8

(b) A projectile aimed at mark, which is in a horizontal plane through the point of projection, falls 'a, feet short of it when the elevation is  $\alpha$  and goes' b, feet too far when the elevation is  $\beta$ . Show that if the velocity of projection be the same in both cases, the proper elevation is :

$$\frac{1}{2} \sin^{-1} \left[ \frac{a \sin 2\beta + b \sin 2\alpha}{a + b} \right]. \quad 7$$

3. Attempt any *two* of the following : 5 each

(i) Prove that if the tangential and normal acceleration a particle describing a plane curve be constant throughout the motion, the angle  $\psi$  through which the direction of motion turns in time  $t$  is given by  $\psi = A \log (1 + Bt)$ .

(ii) State Newton's laws of motion.

- (iii) A particle of mass  $m$ , moving with velocity  $\vec{v}$  picks up a mass  $M$  at rest. Find velocity of the combined mass, the kinetic energy of the combined mass and loss in K.E.
- (iv) The angular elevation of an enemy's position on hill 25 metres high is  $45^\circ$ . Show that in order to shell it the initial velocity of projection must not be less than  $5\sqrt{g(1+\sqrt{2})}$  metres/sec.