This question paper contains **2** printed pages]

SB—94—2022

FACULTY OF SCIENCE

B.Sc. (Sixth Semester) EXAMINATION

MAY/JUNE, 2022

(CBCS/New Pattern)

MATHEMATICS

Paper-XVII

(Mechanics-II)

(Thursday, 16-06-2022) **Time : 10.00 a.m. to 12.30 p.m.**

Time— 2½ *Hours* *Maximum Marks*—40

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

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

1. (*a*) Find the expressions for velocity and acceleration in terms of vector derivatives. 15

Or

(*b*) Prove that 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 $\int_C \vec{F}.\vec{dr} = 0$. 8

(*c*) A shell of mass $m_1 + m_2$ is fired with a given velocity in a given direction. At the highest point of the path, the shell explodes into two portions of masses m_1 and m_2. The explosion produces an additional K.E. = E and the portions separate out in a horizontal direction. Show that the portions strike the ground at a distance $\frac{v}{g}\sqrt{2E\left(\frac{1}{m_1}+\frac{1}{m_2}\right)}$, where v is the vertical component of the velocity of projection. 7

2. (*a*) Prove that the kinetic energy of particle of mass m moving with velocity $\vec{V}$ is $\frac{1}{2}mV^2$. Also, show that change in K.E. of the particle is equal to the work done. 15

P.T.O.

Or

(*b*) Derive the range of a projectile on an inclined plane. 8

(*c*) A boy sitting on the top of a tower 96 ft. per sec. at an elevation of 30° to the horizon. 7

Calculate :

(*i*) The time the stone takes to reach the horizontal plane through the foot of the tower.

(*ii*) The horizontal distance of the stone from the foot of the tower when it strikes this plane.

3. Attempt (any *two*) : 5 each

(*i*) Find the tangential and normal components of acceleration.

(*ii*) Prove that the sum of the work done by any number of forces is equal to the work done by their resultant.

(*iii*) A particle of mass m moving with velocity $\vec{v}$ picks up a mass M at rest. Find the velocity of the combined mass, the kinetic energy of the combined mass and the loss in K.E.

(*iv*) A man can throw a cricket ball upto 160 metres and no more. With what speed, in meter per sec., must it be thrown ?

Take g = 980 cm/sec^2.