

Subject Code—18062
Dual Degree B.Sc. (Hons.)
EXAMINATION

(Batch 2017 Onwards)

(Sixth Semester)

MATHEMATICS

BML-605

Dynamics

Time : 3 Hours

Maximum Marks : 70

Note : Attempt *Five* questions in all, selecting *one* question from each Unit. Q. No. 1 is compulsory. All questions carry equal marks.

Compulsory Question

1. (i) Define Radial and Transverse velocity and write their formulas.

- (ii) Define S.H.M. and its amplitude.
- (iii) Define Hooke's law and modulus of elasticity.
- (iv) Define Horizontal Range in projectile motion and find its expression.
- (v) Define principle of work and energy.
- (vi) Give Kepler's laws of Planetary motion.
- (vii) Define Apse and Apsidal distance.

7×2=14

Unit I

2. (a) A particle moves along a circle $r = 2a \cos \theta$ in such a way that its acceleration towards the origin is always zero. Prove

$$\text{that : } \frac{d^2\theta}{dt^2} = -2 \cot \theta \left(\frac{d\theta}{dt} \right)^2. \quad 7$$

- (b) Find an expression for tangential and normal acceleration of particle moving along a plane curve. 7

3. (a) A ship steams due west with a velocity of 15 km/hr relative to the current which is flowing at rate 6 km/hr due west. What is the velocity of a train going north at 30 km/h relative to the ship ?

7

- (b) A particle in SHM has amplitude a show that distance of point from the centre at which velocity is half of maximum velocity is $\frac{\sqrt{3}}{2}a$.

7

Unit II

4. (a) A force of 150 N acts on a body of mass 15 kg for 5 minutes and then ceases. What is the force required to bring the body to rest in 2 minutes ?

7

- (b) A mass of 5 kg falls from height of 5 m at rest and again brought to rest by penetrating $\frac{1}{2}$ m into sand. Find the average thrust of sand on it.

7

5. (a) A man is drawing water from a well with a light bucket which leaks uniformly. The pail when full weights 50 lbs and when it arrives at top, half of the water remains. Find the workdone if the depth of well is 100 ft. 7
- (b) In any displacement of a particle, the change in K.E. is equal to workdone by the impressed forces acting on the particle. 7

Unit III

6. (a) If a particle starts from rest at a depth $\frac{r}{3}$ below the highest point of smooth vertical circle of radius ' r ', prove that it will leave the circle at distance $\frac{r}{3}$ above the centre. 7
- (b) A particle slides down a rough curve under gravity in a vertical plane. Discuss the motion. 7

7. (a) Prove that trajectory of a projectile motion is a parabola. 7

(b) A body is projected at an angle α to the Horizon so as to clear two walls of equal height at distance ' $2a$ ' from each other. Show that range is equal to $2a \cot \alpha/2$. 7

Unit IV

8. (a) Derive differential equation of central orbit in polar form. 7

(b) If a particle projected from an apse at ' a ' with velocity from infinity, under action of a central force μr^{-7} , prove orbit is $r^2 = a^2 \cos 2 \theta$. 7

9. (a) If v_1 and v_2 are linear velocities of a planet at nearest and farthest point from sun. Prove that $(1 - e) v_1 = (1 + e) v_2$. 7

(b) Find the expression for acceleration of a particle in terms of spherical polar co-ordinates. 7