9. A block of weight 50 N is placed on an inclined surface($\mu = 0.3$). The block is released at the position as shown in **Fig. 6** at a rest condition. What is the maximum compression of the spring? Take spring constant as 120 N/m.

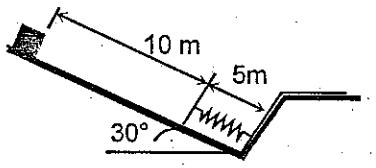

Fig. 6

10. The two flywheels are mounted on a common shaft which is supported by a journal bearing between them as shown in **Fig. 7**. Each flywheel has a mass of 40 kg, and the diameter of the shaft is 40 mm. If a 3-N.m couple M on the shaft is required to maintain rotation of the fly wheels and shaft at a constant low speed, compute:
(i) the coefficient of friction in the bearing and
(ii) the radius of the friction circle.

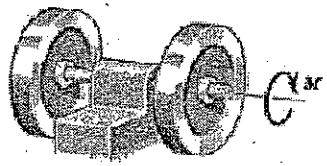

Fig. 7

Ex/IT/PE/T/115/2018(S)

JADAVPUR UNIVERSITY

Bachelor in Information Technology

Supplementary Examination – 2018

(1st Year – 1st Semester)

Engineering Mechanics

Time : Three Hours | Full Marks : 100

Answer Part – A(compulsory) (10+30=40), **any Two** from **Part – B** (2x10=20), and **any four** from **Part – C** (4x10=40). **[40+20+40=100]**

Part – A (Compulsory) (10+30=40)

Answer as per instruction/choose the most appropriate option as the case may be:

1. (a) The unit of work or energy in S.I units is : (10x1=10)
(i) Newton, (ii) Pascal, (iii) Watt, (iv) Joule.

(b) Given $\Phi_1 = 5\hat{j} + 4\hat{k}$ and $\Phi_2 = 3\hat{i} + 6\hat{k}$. Find the magnitude of the scalar product of these two vectors.

(c) What is angle of friction?

(d) If a momentum of a body is doubled, its K.E will:
(i) Increase by two times, (ii) Increase by four times, (iii) Remains same, (iv) Get halved, (v) Reduce to four times.

(e) Two non-collinear parallel equal forces in opposite direction
(i) balance each other, (ii) constitute a moment, (iii) constitute a couple, (iv) constitute a moment of couple, (v) constitute a resultant couple.

(f) State the condition of equilibrium for co-planar non-concurrent forces.

(g) A projectile is fired at an angle θ to the vertical. Its horizontal range will be minimum when θ is :
(i) 0 , (ii) 30 , (iii) 45 , (iv) 60 , (v) 90 .

(h) Two equal forces of magnitude P are acting at an angle θ. Find out the resultant force.

(i) Work done by all the forces is equal to change in:
(i) Potential Energy, (ii) Kinetic Energy, (iii) Power, (iv) Total mechanical energy, (v) None of these.

(j) M.I. of a circular cylinder of radius R and mass M about its axis is:
(i) $(\pi/5)MR^2$, (ii) $(2/5)MR^2$, (iii) $(\pi/5)MR^3$, (iv) $(1/2)MR^2$

2. (a) The moment of a force about the origin is $x\hat{i} + y\hat{j} + z\hat{k}$ N.m. Find the moment about x-axis. (10x3=30)

(b) Two springs of stiffness k_1 and k_2 are joined in series. Find stiffness of the system.

(c) In a flat belt drive, tension in the slack side and initial tension are 80 N and 100 N respectively. Find the tension in the tight side.

(d) A ladder AB of length L is supported by a horizontal floor at A and by a vertical wall at B and makes an angle with the horizontal as shown in **Fig. 1.** Draw free body diagram of the ladder.

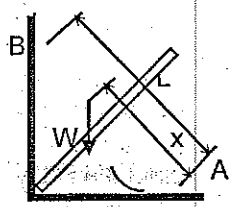

Fig.1

(e) State and prove Lami's theorem.

(f) What is the momentum of a body of 2 kg at its highest point, when thrown with a velocity of 15 m/s at an angle of 70° with the horizontal?

(g) Draw the graph of stress-strain for cast iron specimen indicating all types of stresses.

(h) A man can throw a ball upto a maximum distance of 20 m on a horizontal plane. Find out the maximum height he can throw the ball?

(i) A particle moves from t =0 to t = 3.5 sec along a straight line such that its velocity is given by $v = (3t^2 - 6t)$ m/sec. Find the average velocity of the particle.

(j) The position vector of a point at time 't' is $\vec{r} = a\cos\omega t\,\hat{i} + b\sin\omega t\,\hat{j}$ Find out the equation of its path.

Part – B (Any Two) (2x10=20)

3. A force $\vec{F} = 6\hat{i} - 3\hat{j} - 2\hat{k}$ N acts at a point P(2, 3, 4). The coordinates being given in meters. Determine moment of this force about the point of origin.

4. Determine the range of values which the mass m may have so that the 100 kg block shown in **Fig. 2** will neither start moving up the plane nor slip down the plane. The coefficient of static friction for the contact surfaces is 0.3..

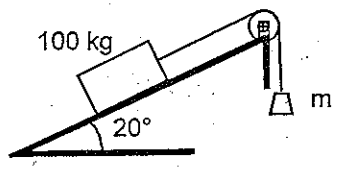

Fig. 2

5. A beam is subjected to forces as shown in **Fig. 3**. Find the magnitude, direction and the position of the resultant force.
Given: $\tan\theta = 1/\ ,\ \tan\alpha = 3/4$

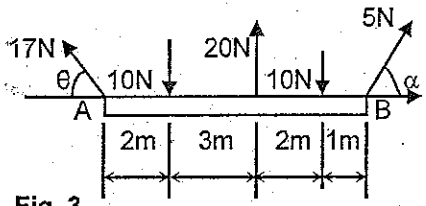

Fig. 3

Part – C (Any Four) (4x10=40)

6. A train enters bend of radius 500 m with a speed of 30 kmph and leaves the bend with a speed of 40 kmph during which it covers a distance of 200 m. Determine the total acceleration when it leaves the bend.

7. A boy standing on the ground throws a stone which crosses a building as shown in **Fig. 4.** It is found that the time taken to pass the floor AB in both directions is 2 sec, whereas that taken to cross the floor CD in both directions is 1 sec. Determine the height of the building.

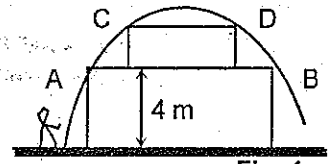

Fig. 4

8. A bar consists of three parts as shown in the **Fig. 5.** Find the stresses in those parts and the total extension of the bar for an axial load of 50 kN. Take E = 2 x 10^5 N/mm².

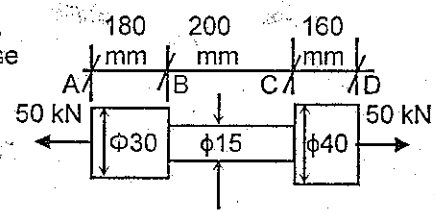

Fig.5

[Turn Over]