7.(a) 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.

(8+7=15)

(b) A bird is flying horizontally at a height of 100 m from the ground with a velocity of 30 m/sec. A hunter, standing on the ground, fires to shoot the bird when it is just above his head. After being hit by the bullet, the bird falls vertically down on the ground at a distance of 20 m from the hunter. Determine the angle of firing.

8.(a) Calculate the moment of inertia of a circular cylinder of radius R, length L and weight density ρ, about its axis.

(7+8=15)

(b) A tapered circular rod of end diameters D and d and length L is subjected to an axial load P as in **Fig. 9**. If modulus of elasticity of the rod material is E, show that the total change in length of the bar is $\frac{4PL}{\pi EDd}$.

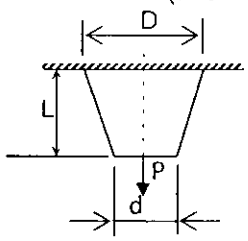


Fig. 9

9.(a) Determine the vertical acceleration of the 30 kg cylinder as shown in **Fig.10**.

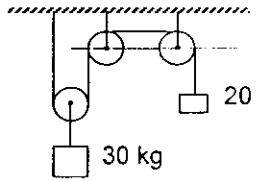


Fig.10

(7+8=15)

(b) A block of weight 50 N is placed on an inclined surface(μ = 0.3). The block is released at the position as shown in **Fig. 11** at a rest condition. What is the maximum compression of the spring? Take spring constant as 120 N/m.

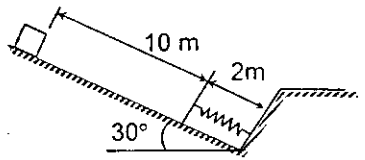


Fig. 11

Ex/IT/PE/T/115/2017(S)

JADAVPUR UNIVERSITY

Bachelor in Information Technology

Supplementary Examination–2017

(1st Year – 1st Semester)

Engineering Mechanics

Time : Three Hours | Full Marks : 100

Answer Part – A(compulsory)(20+20=40)
And any Four from Part – B (4x15=60).

Part – A (Compulsory)(20+20=40)

(4x5=20)

1. (a) Find out the components of the force F = 11388.647 kgf in X' and Y' direction as shown in **Fig.1**

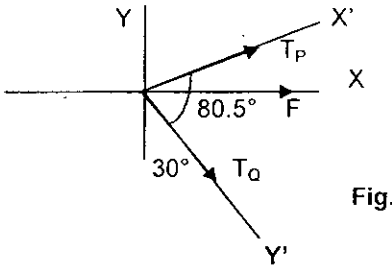


Fig. 1

(b) What is angle of friction? Prove that tangent of angle of friction will be equal to the coefficient of friction.

(c) Draw free body diagram(FBD) of the following system.

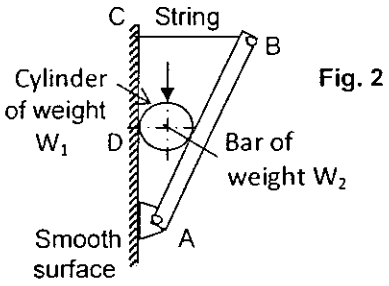


Fig. 2

(d) A weight W is kept at rest on a pulley with a rope as shown in **Fig. 3**. Find the minimum value of W that may be supported by the applied force. Given μ = 0.4.

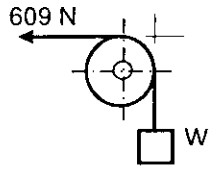


Fig. 3

(e) Define the equations of static equilibrium and dynamic equilibrium.

2. (a) A man can throw a ball upto a maximum distance of 30 m on a horizontal plane. Find out the maximum height he can throw the ball? (5x4=20)

(b) 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.

(c) Draw the graph of stress-strain for a mild steel specimen indicating all types of stresses.

(d) A cantilever beam of length 2 m is loaded at the free end by 2 N. Draw the shear force and bending moment diagram.

(e) Check whether the following force field is conservative or non-conservative.
$F = (5z \sin x + y)\,\bar{i} + (4yz + x)\,\bar{j} + (2y^2 - 5\cos x)\,\bar{k}$ N.

Part – B (Any Four)(4x15=60)

3.(a) A force $\bar{F} = 6\,\hat{i} - 3\,\hat{j} - 2\,\hat{k}$ 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. (8+7=15)

(b) A crane hook has to be designed for raising a load of 100 tonnes which is to be hung at A as shown in **Fig. 4**. Determine the equivalent system at 'O'.

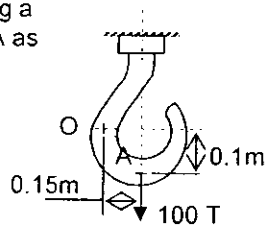


Fig.4

4.(a) The driver of car running at a speed of 30 km/hour sees a boy in front of him at a distance of 25 m. He thinks for a while and applies brakes. The boy is thus just saved. If the coefficient of friction between the tyre and the pavement is 0.5, find the reaction time taken by the driver. (8+7=15)

(b) Compute the magnitude v of the velocity required for the spacecraft to maintain a circular orbit of an altitude 320 km above the surface of the earth. Mean diameter of the earth is 12.742×10^3 km.

5.(a) A uniform ladder 40 m long and having a weight 20 kg_f is held from sliding by a force P applied at the lower end of the ladder as shown in **Fig. 5** . All surfaces of contact are smooth. Determine the force P. (8

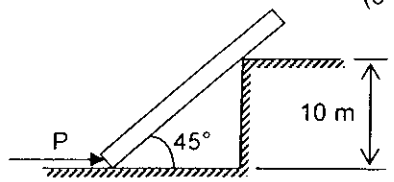


Fig. 5

(b) The two flywheels are mounted on a common shaft which is supported by a journal bearing between them as shown in **Fig.6**. 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.

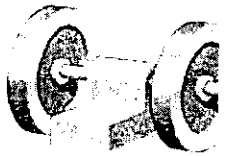
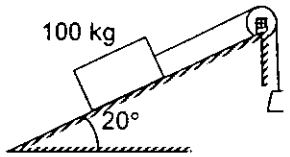


Fig. 6

6.(a) Determine the range of values which the mass m may have so that the 100 kg block shown in **Fig. 7** will neither start moving up the plane nor slip down the plane. The coefficient of static friction for the contact surfaces is 0.3.



(b) A rope passes over a pulley and carries a weight of 100 kg_f at one end as in **Fig. 8**. Determine the force which should be applied at the other end so that the weight will tend to move up. The rope completely winds around the pulley once and then leaves at D and the coefficient of friction is 0.3.

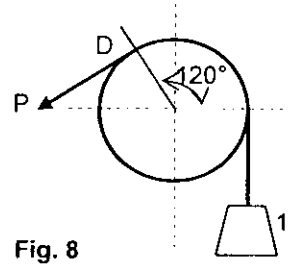


Fig. 8