Total No. of Questions : 8]

SEAT No. :

P3923

[Total No. of Pages : 7

[6001]-4007
F.E. (Common)
ENGINEERING MECHANICS
(2019 Pattern) (Semester - I/II) (Credit System) (101011)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Attempt Q.No.1 or Q.No.2, Q.No.3 or Q.No.4, Q.No.5 or Q.No.6, Q.No.7 or Q.No.8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data, if necessary and clearly state.*
5) *Use of cell phone is prohibited in the examination hall.*
6) *Use of electronic pocket calculator is allowed.*

Q1) a) Determine the force 'P' need to pull over the 50 kg smooth roller over the step of 50 mm as shown in Fig. 1 a. Calculate the contact reactions at B if radius of roller is 300 mm. Take $\theta = 30^{\circ}$. **[6]**

b) The square plate has mass of 1800kg with mass center at 'G'. Calculate the tension in each of the three cables with which the plate is lifted while remaining horizontal as shown in Fig. 1 b. **[8]**

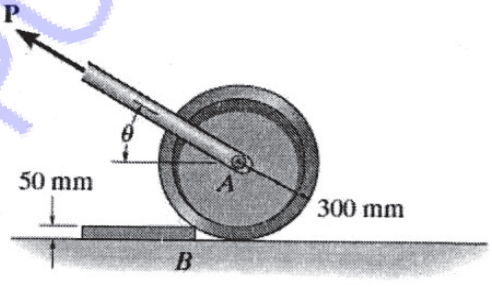

Fig. 1 a

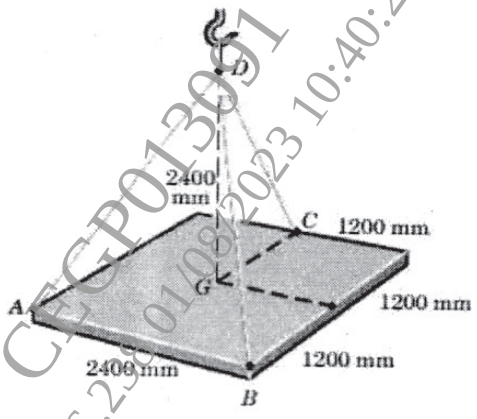

Fig. 1 b

P.T.O.

c) Explain Simple, Roller, Hinge and Fixed support with number of reactions developed at each support with sketch. **[4]**

OR

Q2) a) Determine the support reactions at fixed end A for a beam loaded with 6 kN/m UVL and 3 kN/m UDL as shown in Fig. 2 a. Neglect the weight of 3 m span beam. **[6]**

b) A uniform steel plate of 20 cm × 20 cm weighing 750 N is suspended in horizontal plane by three vertical wireas as shown in Fig. 2 b. Calculate the tension in each wire at A, B and C. **[6]**

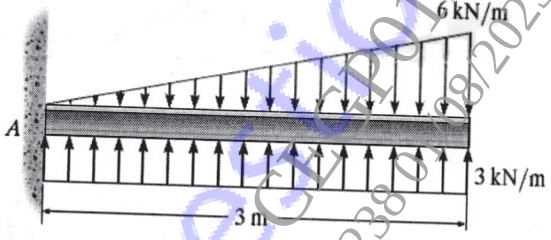

Fig. 2 a

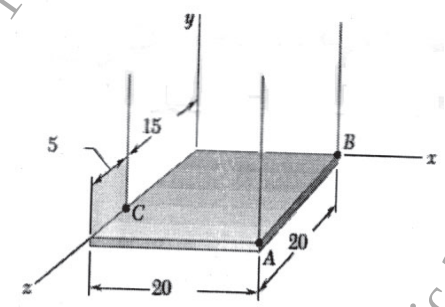

Fig. 2 b

c) Explain how uniformly distributed load (UDL) and uniformly varying load (UVL) is converted in to a point load with sketch. **[6]**

Q3) a) Determine the force in all members of the truss loaded with 3 kN and 4 kN forces at D and B respectively with supports hinge at A and Roller at B, as shown in Fig. 3 a. Take $\theta = 30^{\circ}$. **[6]**

b) Determine the *x* and *y* components of forces acting at joint B and D on the member BD for a frame loaded and supported as shown in Fig. 3 b. **[7]**

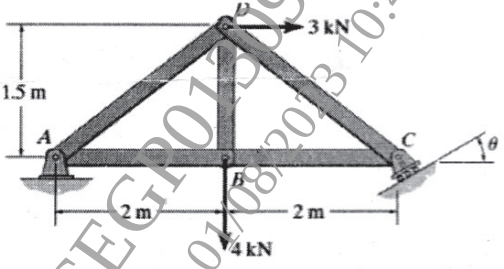

Fig. 3 a

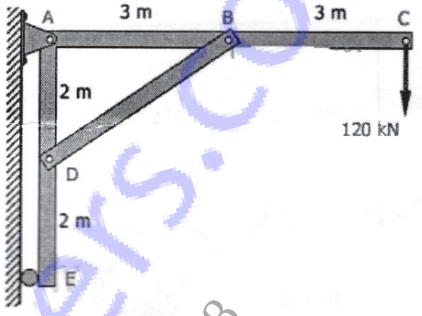

Fig. 3 b

c) Define zero force members in truss and what are the conditions to identify them, with a sketch? **[4]**

OR

Q4) a) Determine the forces in the members AD, BD and BC for the truss loaded and supported as shown in Fig. 3a. **[6]**

b) Knowing that lamp attached at D is, $m_F = 20$ kg, determine the tension in each segment of the cable loaded and supported as shown in Fig. 4b. **[5]**

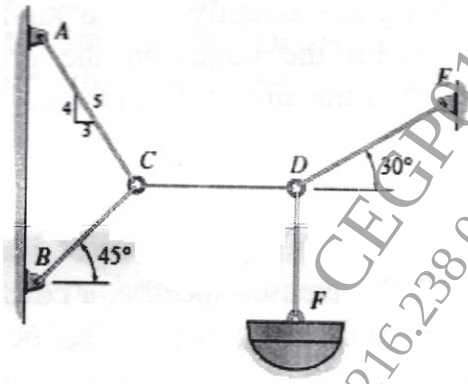

Fig. 4 b

c) Explain 2.j –3 <m; 2.j – 3 = m; 2.j –3 > m with sketch. **[6]**

Q5) a) The motion of a particle is given by : $a = t^3 - 3t^2 + 5$ where 'a' is the acceleration in m/s^2 and 't' is the time in seconds. The velocity of the particle, at t = 1 second is 6.25 m/sec and the displacement is 8.8 m. Calculate the displacement and velocity at t = 2 seconds. **[6]**

b) A ball thrown vertically upward with a velocity of 10 m/s from a window located 20 m above the ground. Knowing that the acceleration of the ball is cosntant and equal to 9.81 m/s^2 downward, determine **[6]**

i) the highest elevation reached by the ball and the corresponding value of t;

ii) velocity with which it hit the ground.

c) A golf player hits the ball from point A with a velocity 45 m/s as shown in Fig. 5c at an angle of 20° with horizontal. Determine the maximum height it reaches and the horizontal distance it falls w.r. to A. Consider ground to be horizontal. **[6]**

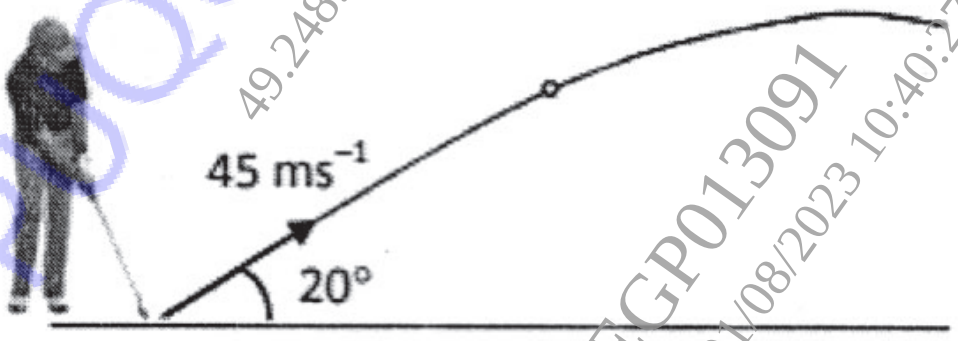

Fig. 5c

OR

Q6) a) The acceleration of a particle is given by an expression, $a = k.t^2$. At t=0, velocity of the particle is – 12 m/s. Knowing that v = 0 and x = 15 m when t = 4 s, write the equation of motion of a particle. **[6]**

b) An aircraft, moving horizontally at 108 km/hr at an altitude of 1000 m wants to hit the target on the ground. Estimate the horizontal distance of the aircraft from the target, when it released the bomb. Calculate also the direction and velocity with which the bomb hits the target. Neglect air friction. **[6]**

c) A motorist starts from rest at point A on a circular ramp of 150 m radius when t = 0 s, increases speed at a constant rate and enters the highway at point B as shown in **Fig. 6c**. Knowing that her speed increases with same rate till it reaches to 100 km/h at point C, determine the speed at point B. **[6]**

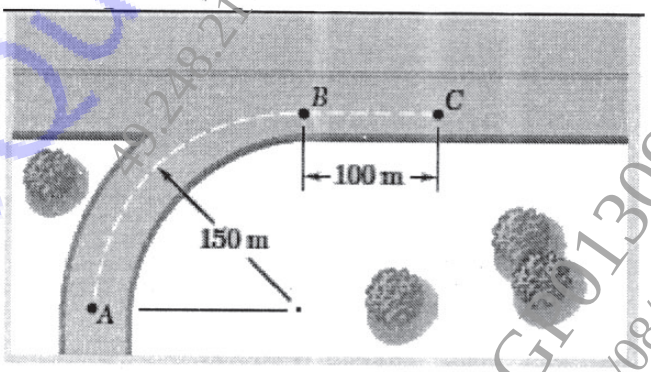

Fig. 6 c

Q7) a) If the coefficient of kinetic friction between the 50-kg crate and the ground is $\mu_k = 0.3$, determine the distance the crate travels when its velocity reaches to 8 m/s. Assume crate starts from rest, and P = 200 N, for crate shown in Fig. 7a. Use work-Energy principle. **[6]**

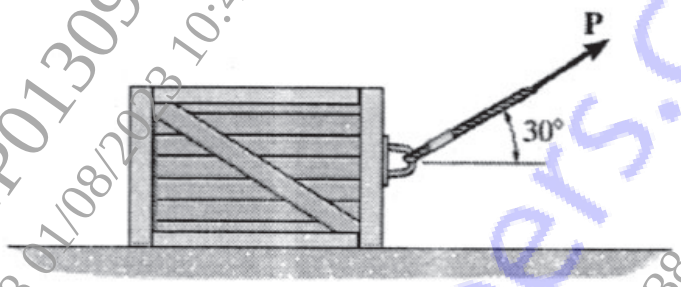

Fig. 7 a

b) A racing car travels around the horizontal circular track of radius 100m. If the car starts from rest and accelerates with tangential acceleration of 7 m/s^2 for some time. Determine the time and velocity when the total acceleration of the racing car reaches to 8 m/s^2. **[6]**

c) A ball of mass 1 kg dropped from 5m height on a horizontal floor rebounds back to 3m height. Determine the coefficient of restitution between the floor and ball. Also Determine its renounce height after falling from 3m again. **[5]**

OR

Q8) a) The conveyor belt is designed to transport packages of various weights. Each 10-kg package has a coefficient of kinetic friction $\mu_k = 0.15$. If the speed of the conveyor is 5 m/s, and then it suddenly stops, determine the distance the package will slide on the belt before coming to rest. **[6]**

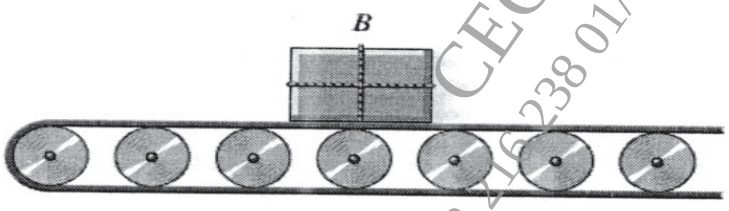

Fig. 8 a

b) Cylinder A of 0.5 kg is dropped from 2.4 m onto pan B of 2.5 kg, which is at a resting on a spring constant k = 3kN/m. Assuming the impact to be perfectly plastic, determine the compression of the spring after impact. **[6]**

c) Ball 'A' of 5 kg moving with 10m/s rightwards, strikes with ball 'B' of 1 kg which is at rest. If after the impact the velocity of the ball 'B' is 10 m/s rightwards. Determine, the velocity of the ball 'A' after impact. Also determine coefficient of restitution 'e'. **[5]**