

**F.E. (Common)**  
**ENGINEERING MECHANICS**  
**(2019 Pattern)**

Time : 2½ Hours] [Max. Marks : 70**Instructions to the candidates :**

- 1) Attempt Q. 1 or Q. 2, Q. 3 or Q. 4, Q. 5 or Q. 6 and Q. 7 or Q. 8.
- 2) Neat diagram 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) The weight of the cycle is 500 N which act at center of gravity G as shown in Fig. 1 a. Determine the normal reaction at A and B when the cycle is in equilibrium. [7]

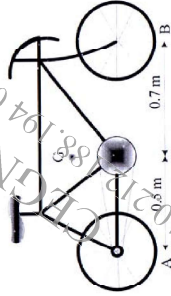


Fig. 1 a

- b) Pole OA is kept in vertical position using three guy-wires AB, AC and AD as shown in Fig. 1 b. Calculate the tension in each wire, if the weight of the pole is 5000 N. [8]

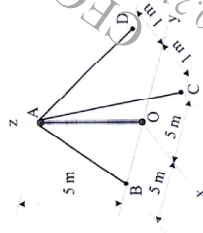


Fig. 1 b

- c) Explain hinge, roller and fixed support with maximum number of reaction exerted on it with suitable sketches. [3]

OR

- Q2) a) Find the reaction exerted at A and B on the sphere of 200 N kept in a trough as shown in Fig. 2 a. [8]

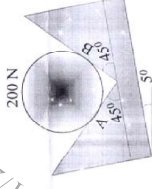


Fig. 2 a

- b) A square mat foundation supports four column as shown in Fig. 2 b. Determine the magnitude and point of application of the resultant with respect to origin. [7]



Fig. 2 b

- c) State the equation of equilibrium for concurrent, parallel and general force system. [3]

- Q3) a) Determine the forces in all members of the truss loaded and supported as shown in Fig. 3 a. [7]

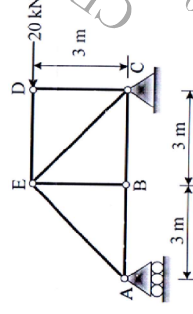


Fig. 3 a

- b) Determine the x and y components of forces acting at joint B on the horizontal member BD for a frame loaded and supported as shown in Fig. 3 b. [8]

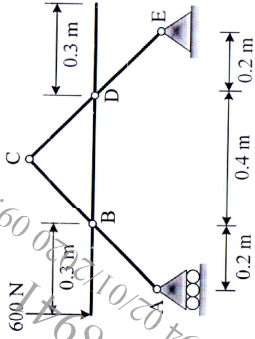


Fig. 3 b

- c) Define two force and multi force members. [2]

OR

- Q4) a) Determine the forces in the members DE, CE and BC for the truss loaded and supported as shown in Fig. 3 a. [7]  
b) Determine the reactions at support A and B for the cable loaded and supported as shown in Fig. 4 b. [7]

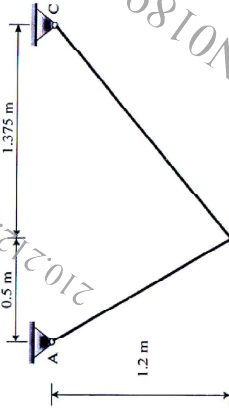


Fig. 4 b

- c) Explain imperfect, perfect and redundant truss with sketches. [3]

- Q5) a) Automobile A and B are traveling in adjacent lane at  $t = 0$  and have the position and speed as shown in the Fig. 5 a. Knowing that automobile A has a constant acceleration of  $0.6 \text{ m/s}^2$  and B has constant deceleration of  $0.4 \text{ m/s}^2$ , determine when and where A will overtake B. Also determine the speed at that time. [8]

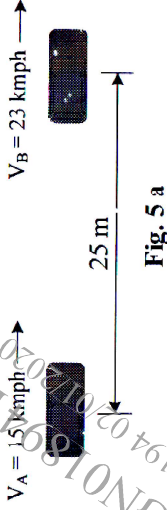


Fig. 5 a

- b) A stone thrown vertically upward comes back to ground in 8 s. Determine its velocity of projection and maximum height attained by the stone. [4]  
c) A ball is thrown by a player from 5 m above ground level, clears the 25 m high wall placed 100 m ahead of the player. If the angle of projection of the ball is  $60^\circ$ , determine the velocity of projection of the ball. [6]

OR

- Q6) a) A car comes to complete stop from an initial speed of  $50 \text{ m/s}$  in a distance of  $100 \text{ m}$ . With the same constant acceleration, what would be the stopping distance  $s$  from an initial speed of  $70 \text{ m/s}$ . [6]  
b) A golfer hits the golf ball from point A with an initial velocity of  $50 \text{ m/s}$  at an angle of  $25^\circ$  with the horizontal shown in Fig. 6 b. Determine the horizontal distance AB and maximum height it attain. [6]

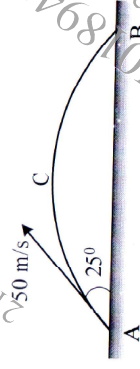


Fig. 6 b

- c) A train enters a curved horizontal section of track at a speed of  $100 \text{ km/h}$  and slows down with constant deceleration to  $50 \text{ km/h}$  in 12 seconds. An accelerometer mounted inside the train records a horizontal acceleration of  $2 \text{ m/s}^2$  when the train is 6 seconds into the curve. Calculate the radius of curvature  $\rho$  of the track for this instant. [6]

- Q7) 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. Refer Fig. 7 a. [6]

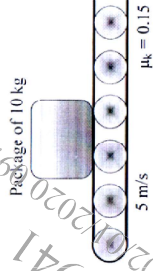


Fig. 7 a

- b) The pendulum bob has a mass  $m$ , length 1 m and is released from rest as shown in Fig. 7 b when  $\theta = 0^\circ$ . Determine the tension in the cord as function of the angle of descent  $\theta$ . Neglect the size of bob. [6]

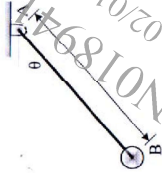


Fig. 7 b

- c) A 20 Mg railroad car moving with 0.5 m/s speed to the right collides with a 35 Mg car which is at rest, if the coefficient of restitution between the two cars is  $e = 0.65$  determine the speed of the cars after the collision. [5]

OR

- Q8) a) Block A has a weight of 40 N and block B has a weight of 30 N. They rest on a surface for which the coefficient of kinetic friction is  $\mu_k = 0.2$ . If the spring has a stiffness of  $k = 300$  N/m, and is compressed 0.05 m, determine the acceleration of each block just after they are released. [6]

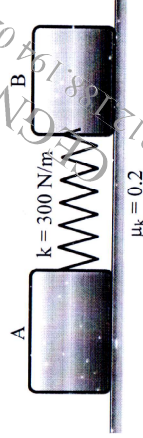


Fig. 8 a

- b) The man has a mass of 80 kg and sits 3 m from the center of the rotating platform. If the coefficient of static friction between the clothes and the platform is  $\mu_s = 0.3$  and tangential component of acceleration is  $0.4 \text{ m/s}^2$ , determine the time required to cause him to slip. [6]
- c) The velocities of two identical steel blocks of mass 0.6 kg before impact are  $v_A = 4 \text{ m/s}$  rightward and  $v_B = 2 \text{ m/s}$  leftward. After impact the velocity of block B is observed to be 2.5 m/s to the right, determine the coefficient of restitution between the blocks. [5]

