

Instructions to candidates

Duration: Two (02) hours

Number of questions: Four (04)

Mark allocation: 100 Marks

Answer all questions

1.

A mechanism, as shown in Figure 1, has the following dimensions: $OA = 100$ mm, $AB = 250$ mm, $BC = 200$ mm, $CD = 125$ mm, $BE = 100$ mm and $\angle AOE = 45^\circ$. Locate all 'instantaneous centres'.

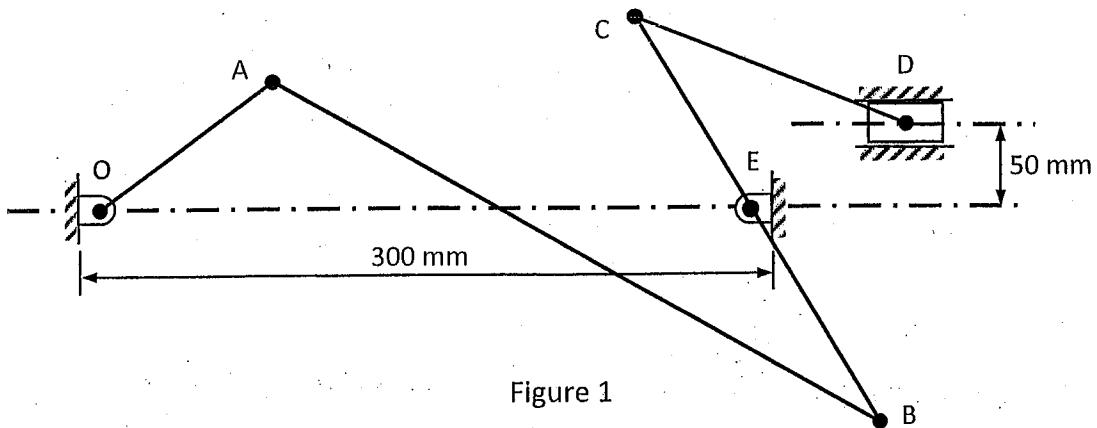


Figure 1

If crank OA rotates uniformly at 100 r.p.m. clockwise, find

a. the velocity of B, C and D,

(10 marks)

b. the angular velocity of the links AB, BC and CD.

(15 marks)

2.

Reconsider the mechanism shown in Figure 1 above.

a. Use the method of velocity diagrams to determine velocities of links OA, AB, BC and CD.

(10 marks)

b. Find the acceleration of each link in part (a) above.

(15 marks)

The crankshaft of a punching machine runs at a speed of 300 r.p.m. During punching of 10 mm diameter holes in mild steel sheets, the torque required by the machine increases uniformly from 1000 Nm to 4000 Nm while the shaft turns through 40° , remains constant for the next 100° , decreases uniformly to 1000 Nm for the next 40° and remains constant for the next 180° . This cycle is repeated during each revolution. The power is supplied by a constant torque motor and the fluctuation of speed is to be limited to $\pm 3\%$ of the mean speed. Find the power of the motor and the moment of inertia of the flywheel fitted to the machine.

(25 marks)

4.

A compressor, requiring 90 kW to run at about 250 r.p.m. The drive is by V-belts from an electric motor running at 750 r.p.m. The diameter of the pulley on the compressor shaft must not be greater than 1 meter while the center distance between the pulleys is limited to 1.75 meter. The belt speed should not exceed 1600 m/min.

Determine the number of V-belts required to transmit the power if each belt has a cross-sectional area of 375 mm^2 , density 1000 kg/m^3 and an allowable tensile stress of 2.5 MPa. The groove angle of the pulley is 35° . The coefficient of friction between the belt and the pulley is 0.25. Also calculate the length required of each belt.

(25 marks)

