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Theory of Machines - I
(1090, 1080)

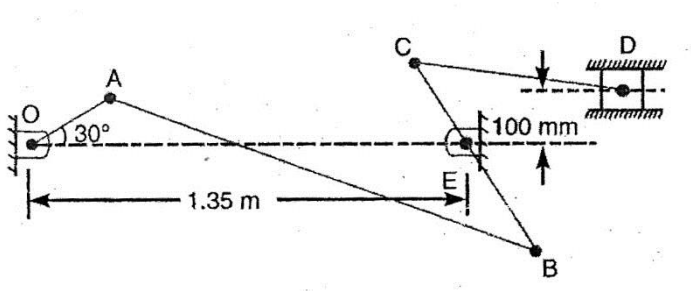
P. Pages : 4

Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. All questions are compulsory, solve **any two** bit out of a, b, c in each question.
5. Draw neat diagram wherever necessary.
6. Use of non-programmable calculator is allowed.
7. Answer all questions.

UNIT - I

1. a) A mechanism as shown in fig. has the following dimensions OA = 200 mm; AB = 1.5 m; BC = 600 mm, CD = 500 mm and BE = 400 mm. Locate all the instantaneous centres. **10**
If the crank OA rotates uniformly at 120 r.p.m clockwise, find
i) The velocity of B, C and D.
ii) The angular velocity of the links AB, BC and CD.

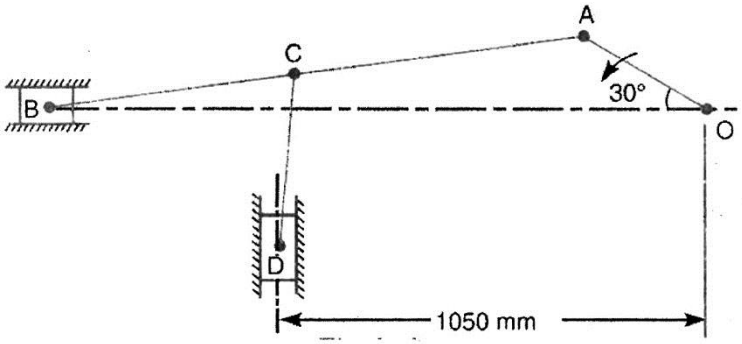


b) In the mechanism as shown in fig. the crank OA rotates at 20 r.p.m anticlockwise and gives motion to the sliding blocks B and D. The Dimensions of the various links are OA = 300 mm, AB = 1200 mm BC = 450 mm and CD = 450 mm for the given configuration, determine. **10**
i) Velocities of sliding at B and D.

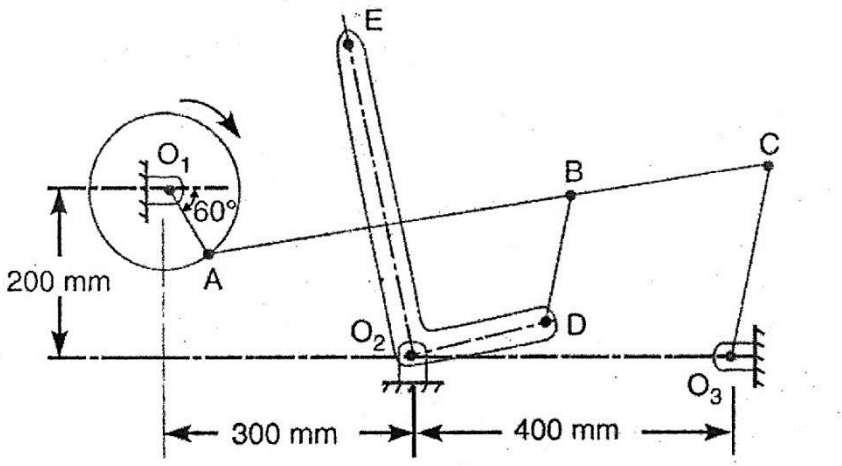
ii) Angular velocity of CD

iii) Linear acceleration of D.

iv) Angular acceleration of CD.



c) The mechanism of a wrapping machine as shown in fig. has the following dimensions. The crank O_1A rotates at uniform speed of 100 rad/sec. Find the velocity of the point E of the bell crank lever by instantaneous centre method. **10**



O_1A=100mm, BC = 200mm, O_2E = 400mm, BD = 150mm
AC = 700mm, O_3C = 200mm, O_2D = 200mm

UNIT - II

2. a) In a slider crank mechanism, the crank is 50mm long and connecting rod 200mm long. When crank has moved through 30º from inner dead centre position the velocity of slider is 2 m/s. Find using Klein's construction angular acceleration of connecting rod and acceleration of centre of gravity of connecting rod which is situated at a distance of 80mm from big end. **10**

b) Find the dynamically equivalent system for a connecting rod for a gas engine which is 900mm long between the centres and has mass 32 kg. The centre of gravity is 240mm from the crank pin **10**

centre. The rod makes 32 oscillations per minute when suspended from centre of small end.

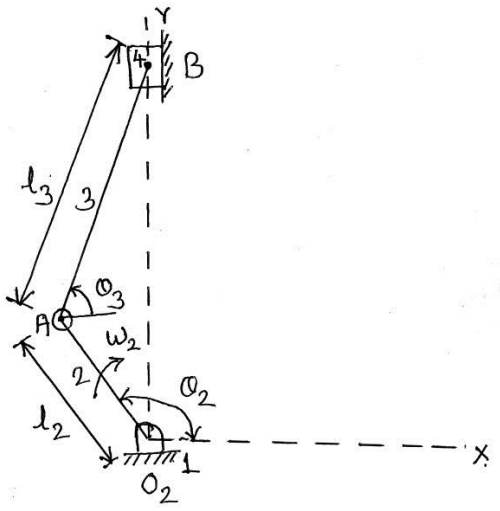
c) Crank radius and connecting rod length for an I.C engine mechanism are 1 cm and 4cm respectively. The crank is rotating uniformly at 1000 r.p.m. find : **10**
   i) Velocity and acceleration of piston.
   ii) Angular velocity and acceleration of the connecting rod, when the crank is 20º past the outer dead centre.

UNIT – III

3. a) Explain loop closure equation, for any mechanism. **10**

b) In single slider crank mechanism crank radius is 70mm and connecting rod length 300mm. Write loop closure equation using vector algebra when the crank is at 45º from IDC. **10**

c) The configuration of the slider mechanism is given in fig. The data given are $\theta_2 = 120º$, $\theta_3 = 67º$, length of link $2 = \ell_2 = 5$cm, length of link $3 = \ell_3 = 7$cm, angular velocity of link 2 = 600 r/min. The link 4 slides vertically with line of action passing through the ground pivot O_2. Determine velocity of sliding of link 4 and the linear velocity of point B relative to point A, and also the angular velocity of link 3 (Solve the problem analytically by complex number) **10**



UNIT - IV

4. a) Define and explain : **10**
   i) Limiting friction.
   ii) Angle of friction.
   iii) Angle of repose.
   iv) Coefficient of friction.

b) The mean diameter of a screw jack having pitch of 10mm is 50mm. A load of 20kN is lifted through a distance of 170mm. Find the work done in lifting the load and efficiency of the screw jack when, **10**
   i) the load rotates with the screw.
   ii) the load rests on the loose head which does not rotate with the screw.
   The external and internal diameter of the bearing surface of the loose head are 60mm and 10mm respectively. The coefficient of friction for the screw as well the bearing surface may be taken as 0.08.

c) A centrifugal clutch is to transmit 15 kw at 900 r.p.m. The shoes are four in number. The speed at which the engagement begins is 3/4^{rth} of running speed. The inside radius of the pulley rim is 150mm and the centre of gravity of the shoe lies at 120mm from the centre of the spider. The shoes are lined with Ferrodo for which the coefficient of friction may be taken as 0.25. Determine **10**
   i) Mass of the shoes, ii) Size of shoes.
   If angle subtended by the shoes at the centre of spider is 60º and the pressure exerted on the shoes is 0.1 N/mm^2.

UNIT - V

5. a) i) Explain the phenomena of slip in belt drive. **10**

   ii) What is centrifugal tension in belt.

b) A leather belt is required to transmit 7.5 kw from a pulley 1.2m in diameter, running at 250 rpm. The angle embraced is 165º and the coefficient of friction between the belt and the pulley is 0.3. If the safe working stress for the leather belt is 1.5 MPa, density of leather 1 Mg/m^3 and thickness of belt 10mm, determine the width of belt taking centrifugal tension into account. **10**

c) Two parallel shaft 6m apart are provided with 300mm and 400mm diameter pulleys and are connected by means of a cross belt. The direction of rotation of follower pulley is to be reversed by changing over to an open drive. How much length of the belt has to be reduced. **10**

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