Seat No. | | | | | | |

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BBI1310

Theory of Machines - I
(New) (1090, 1080)

P. Pages : 4

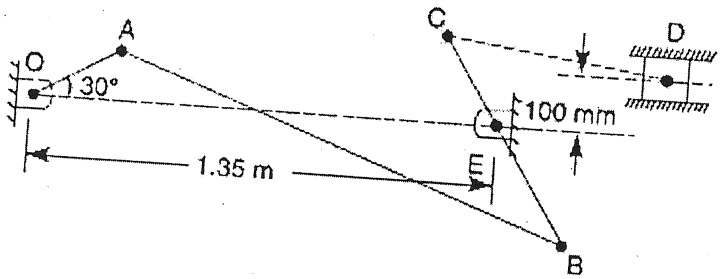
Time : Three Hours **Max. Marks : 100**

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet 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. Answer **any two** bits from a, b & c in each question.
5. Draw neat diagram whenever necessary.
6. Assume suitable data if necessary.
7. Use non-programmable calculator.
8. Solve Graphical problems on Drawing sheet only.

1. a) A mechanism, as shown in fig. has the following dimensions OA=200mm; AB=1.5m; BC=600mm; CD=500mm and BE=400m. Locate all the instantaneous centres.

If crank OA rotates uniformly at 120 r.p.m. clockwise. Find (1) the velocity of B, C and D. (2) the angular velocity of the links AB, BC and CD. **10**



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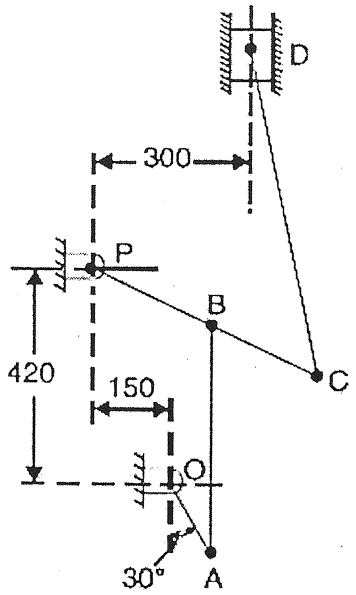
b) Find out the acceleration of the slider D and the angular acceleration of link CD for the engine mechanism shown in fig.

The crank OA rotates uniformly at 180 r.p.m. in clockwise direction. The various lengths are : OA=150mm; AB=450mm; PB=240mm; BC=210mm; CD=660mm. **10**



All dimensions in mm.

c) In a crank and slotted lever quick return motion mechanism, the distance between the fixed centres is 240mm and the length of the driving crank is 120mm. Find the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to the return stroke.

If the length of the slotted bar is 450mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever. **10**

2. a) The crank & connecting rod of a reciprocating engine are 200mm and 700mm respectively. The crank is rotating in clockwise direction at 120 rad/s. Find with the help of Klein's construction. (1) velocity & acceleration of the piston (2) velocity and acceleration of the mid point of the connecting rod, and (3) Angular velocity & angular acceleration of the connecting rod, at the instant when the crank is at 30° to I.D.C. (inner dead centre). **10**

b) A connecting rod with mass 2.5 kg oscillations 40 times in one minute when suspended at small end. Find its moment of inertia about the axis through its centre of gravity which is located at 250mm for small end. **10**

c) In a slider crank mechanism, the length of the crank and connecting rod are 150mm and 600mm respectively. The crank position is 60° from inner dead centre. The crank shaft speed is 450 r.p.m. (clockwise) using analytical method. Determine : (1) velocity & acceleration of the slider, and (2) Angular velocity and acceleration of the connecting rod. **10**

3. a) Explain the method of chace solution, when magnitude and direction of the same vector are unknown. **10**

b) In an internal combustion engine mechanism, the crank radius is 100mm and the length of the connecting rod is 450mm. The crank is rotating counter-clockwise at an angular velocity of 10 rad/sec. Using complex number method, determine the velocity of the position and the angular velocity of the connecting rod when the crank is 45° from the inner dead centre. **10**

c) In a slider crank mechanism, the crank is 50mm long and connecting rod 200 mm long. The crank makes an angle of 40° with top dead centre position. The crank is rotating with speed of 1000 rpm in clockwise direction. Write loop closure equation and find out the velocity of position by using chace solution. **10**

4. a) A load of 10 kN is raised by means of a screw jack, having a square threaded screw of 12mm pitch and of mean dia. 50mm. If a force of 100 N is applied at the end of a lever to raise the load, what should be the length of the lever used ? Take coefficient of friction = 0.15, what is the mechanical advantage obtained ? State whether the screw is self locking. **10**

b) A plate clutch has three discs on the driving shaft and two discs on the driven shaft, providing four pairs of contact surfaces. The outside diameter of the contact surfaces is 240mm and inside diameter 120mm. Assuming uniform pressure and $\mu = 0.3$; find the total spring load pressing the plates together to transmit 25 KW at 1575 rpm.

If there are 6 springs each of stiffness 13 kN/m and each of the contact surfaces has worn away by 1.25mm, find the maximum power that can be transmitted, assuming uniform wear. **10**

c) A centrifugal clutch has four shoes which slide radially in a spider keyed to the driving shaft and make contact with the internal cylindrical surface of a rim keyed to the driven shaft. When the clutch is at rest, each shoe is pulled against a stop by 0 spring so as to leave a radial clearance of 5mm between the shoe and the rim. The pull exerted by the spring is then 500N. The mass centre of the shoe is 160mm from the axis of the clutch.

If the internal dia. of the rim is 400mm, the mass of each shoe is 8 kg, the stiffness of each spring is 50 N/mm and the coefficient of friction between the shoe and the rim is 0.3; find the power transmitted by the clutch at 500 r.p.m. **10**

5. a) A shaft which rotates at a constant speed of 160 rpm, is connected by bending to a parallel shaft 720mm apart which has to run at 60, 80 and 100 rpm. The smallest pulley on the driving shaft is 40mm in radius. Determine the remaining radii of the two stepped pulleys for (1) a crossed belt, and (2) an open belt. Neglect belt thickness and slip. **10**

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 165° 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 & thickness of belt 10mm, determine the width of the belt taking centrifugal tension into account. **10**

c) The following data refer to an open drive :
Diameter of larger pulley = 400mm;
Diameter of smaller pulley = 250mm;
Distance between two pulleys = 2m;
Coefficient of friction between smaller pulley surface and belt = 0.4;
Maximum tension when the belt is on the point of slipping = 1200 N.
Find the power transmitted at speed of 10m/s. It is desired to increase the power, which of the following two methods you will select ?
1) Increasing the initial tension in the belt by 10 percent.
2) Increasing the coefficient of friction between the smaller pulley surface and belt by 10 percent by the application of suitable dressing on the belt.
Find, also, the percentage increase in power possible in each case. **10**

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