Seat No. | | | | | | |

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मठ - 015

Theory of Machines - I
(1090, 1080)

P. Pages : 3

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

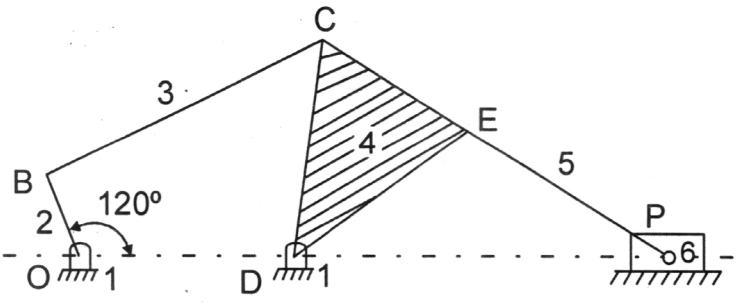
Instructions to Candidates :

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. All questions are compulsory, solve **any two** bits out of a, b, c in each question.
5. Solve graphical problems on drawing sheet only.
6. Assume suitable data if necessary.
7. Use of non programmable calculator is allowed.

1. a) i) Explain classification of pairs based on type of contact which was suggested by the great Kinematician Reuleaux.

ii) Draw crank rocker mechanism & double crank mechanism and also find its DOF. **10**

b) For the mechanism shown in fig.1 determine the velocities of points C, E and P and angular velocities of links 3, 4 and 5. Crank OB rotates at 120 RPM C.C.W. (Use Relative Velocity method) **10**



OB = 300 mm
BC = 1200 mm
CD = 1000 mm
CE = 800 mm
DE = 1200 mm
EP = 1500 mm
OD = 600 mm

Fig. 1

c) The dimensions of four bar mechanism are given below.

$P_1 P_2 = 600\,mm$ (fixed link)
$P_1 A = 300\ mm$ (crank) – clockwise rotation
$AB = 360\,mm$
$BG = 120\,mm$
$\angle P_2 P_1 A = 60^\circ$

The crank has an angular velocity of 10 r/s and determine the angular velocities of P_2B and AB and acceleration at point G. Which is on link AB. **10**

2. a) Show that the minimum periodic time of a compound pendulum is

$$t_{p(min)} = 2\,\Pi\sqrt{\frac{2\,K_G}{g}}$$

where K_G is the radius of gyration about C.G. **10**

b) The connecting rod of a diesel engine weight 556N, the distance between the bearing centres is 900 mm and the diameter of the crank pin bearing 130 mm and that of the wrist pin bearing is 70 mm. When suspended vertically on a knife edge through the crank pin bearing, it performs 61 oscillations in 100 sec and with knife edge through the wrist pin bearing, it makes 55 oscillations in the same time interval.

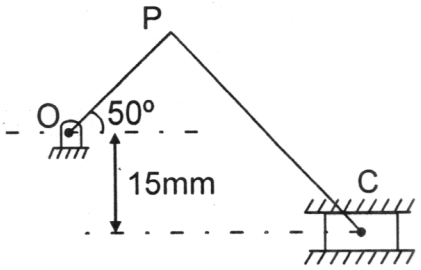
Determine the moment of inertia about the axis through the centre of gravity. (Note that the position of CG is unknown). **10**

c) Explain Biffilar & Trifilar suspension system. **10**

3. a) Write loop closure equation for four bar mechanism & explain it. **10**

b) In an I.C. engine mechanism the crank radius is 100 mm and the length of connecting rod is 450 mm. The crank rotating counter clockwise at a speed of 15 rad/sec. Find the piston velocity and an angular velocity of the CR when the crank is at 40° from the inner dead centre. (Use complex number method) **10**

c) Fig. (2) shows a single crank mechanism. The dimensions of various links are OP = 50 mm, PC = 200 mm, Crank OP is inclined at 50° with IDC. Write the loop closure equation showing all position vectors and relative position vectors.



(Fig.2 not to the scale) **10**

4. a) Explain overhauling and self locking of screw. **10**

b) Prove that the maximum efficiency of a square threaded screw moving in a nut is $\frac{1-\sin\phi}{1+\sin\phi}$, where ϕ is the friction angle. **10**

c) The cutter of a broaching machine is pulled by square threaded screw of 55mm external diameter and 10 mm pitch. The operating nut takes the axial load of 400 N on a flat surface of 60 mm internal diameter and 90 mm external diameter. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut, when the cutting speed is 6 m/min. **10**

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

ii) Two pulley of diameters d_1 and d_2, diameter d_1 is half of d_2 and 1m apart are connected by means of an open belt drive. What is the length of the belt when $d_1 = 200\text{mm}$. **5**

b) Show that $\frac{1}{3}$ rd of the maximum tension is absorbed as centrifugal tension when the power transmitted is maximum in belt drive. **10**

c) A belt transmitting power from a motor to a m/c weights 23.54 N/m and the maximum permissible tension for it is 5395 N. The angle of contact of belt with pulley is 200° and coeff. of friction is 0.28. If the belt runs under maximum power conditions, determine the maximum power transmitted and initial tension in the belt so that drive can fulfil the above conditions. **10**

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