Total No. of Questions—12] [Total No. of Printed Pages—8+1

[3762]-215

S.E. (Prod/Prod Sand/Ind. Engg.) (II Sem.) EXAMINATION, 2010

THEORY OF MACHINES

(2008 COURSE)

Time : Four Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer any *three* questions from each Section.

(*ii*) Answers to the two Sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of electronic pocket calculator is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) Define and explain the following terms :

(*i*) Mechanism

(*ii*) Machine

(*iii*) Link

(*iv*) Kinematic Pair.

Give example of each. [5]

(*b*) What do you understand by Degrees of Freedom ? For a plane mechanism, derive an expression for Grubler's equation. [6]

(*c*) Describe Watt's straight line mechanism. What are the practical use of straight line mechanism ? [5]

P.T.O.

Or

2. (*a*) What is meant by Kinematic pair ? How are kinematic pairs classified ? Give example of each type. [5]

(*b*) How can cam-follower mechanism be converted into its equivalent mechanism by using the equivalent linkage concept ? [6]

(*c*) Write a short note on "Ackermann Steering Gear". [5]

3. (*a*) In a steam engine mechanism, shown in Fig. 1, the crank AB rotates at 200 rpm. Find the velocities of C, D, E, F and P. Also find the acceleration of the slider at C. The dimensions of the various links are AB = 12 cm, BC = 48 cm, CD = 18 cm, DE = 36 cm, EF = 12 cm and FP = 36 cm. [12]

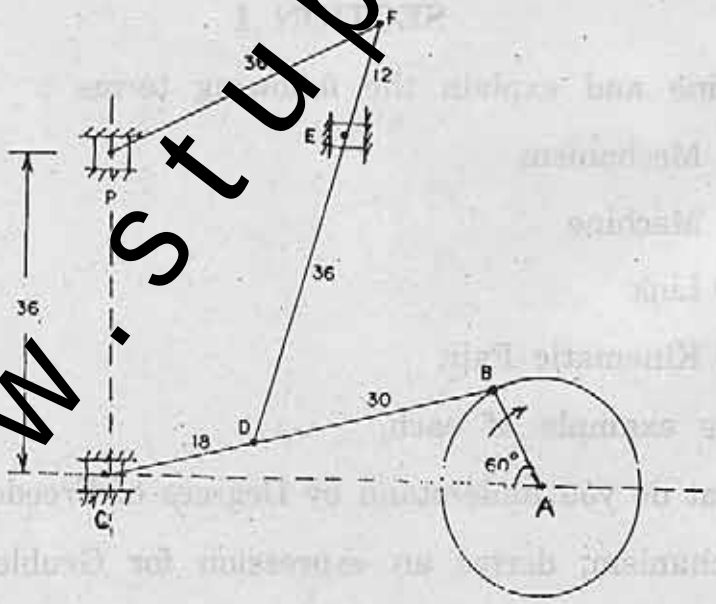


Fig. 1

(*b*) An I.C. engine runs at 2000 rpm. The length of the connecting rod is 270 mm and crank radius is 60 mm. Determine at 30% of outstroke :

(*i*) Angular position of the crank

(*ii*) Linear velocity of the piston

(*iii*) Linear acceleration of the piston

(*iv*) Angular velocity and angular acceleration of the connecting rod. [6]

Or

4. (*a*) The crank and connecting rod of a reciprocating engine are 200 mm and 700 mm respectively. The crank is rotating in clockwise direction at 120 rad/s.

Find :

(*i*) Velocity and acceleration of the piston

(*ii*) Velocity and acceleration of the midpoint of the connecting rod, and

(*iii*) Angular velocity and angular acceleration of the connecting rod, at the instant when the crank is at 30° to I.D.C.

Use Klein's construction. [6]

(*b*) Fig. 2 shows a mechanism in which crank OA is rotating anticlockwise at 10 rad/s. At this instant locate all its ICRs and hence using ICR method find out instantaneous linear velocity of slider D as well as angular velocity of link BC.

OA = BC = 40 mm, AB = 100 mm; BD = 120 mm. [8]

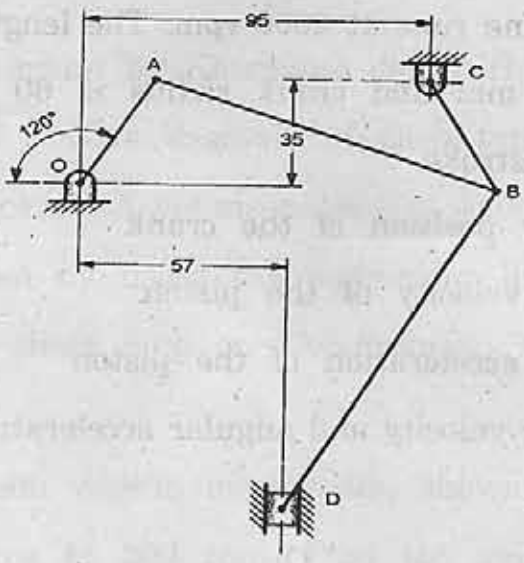


Fig. 2

(*c*) State and explain Kennedy's theorem. [4]

5. (*a*) Derivation

$$Q = \frac{2W\cot\theta}{\pi P_0}$$

Assuming "theory of ploughing" of soft surface by a hard conical shaped asperity. Show that the volume of wear is given by

$$Q = \frac{2W\cot\theta}{\pi P_0}$$

where,

W = load,

θ = semicone angle of asperity,

P_0 = Yield pressure of soft material. [8]

(*b*) Explain in detail various types of friction. [8]

Or

6. (*a*) Explain in detail the following :

(*i*) Coulomb's theory of interlocking

(*ii*) Stick-slip mechanism of friction. [8]

(*b*) Write short notes on (any *two*) :

(*i*) Two body and three body abrasive wear.

(*ii*) Corrosive wear

(*iii*) Surface fatigue wear. [8]

SECTION II

7. (*a*) Define and explain the following terms :

(*i*) Belt Drives

(*ii*) Slip of the belt

(*iii*) Open Belt Drives

(*iv*) Crossed Belt Drives [4]

(*b*) Distinguish between initial tension and centrifugal tension in a belt. [6]

(*c*) The maximum allowable tension, in a V-belt of groove angle of 45°, is 1500 N. The angle of lap is 170° and the coefficient of friction between the belt and material of the pulley is 0.27. If the belt is running at 2 m/s, determine :

(*i*) Net Driving Tension, and

(*ii*) Power transmitted by the pulley.

Neglect effect of centrifugal tension. [6]

Or

8. (*a*) Obtain an expression for the length of an open belt drive. [6]

(*b*) An open belt running over two pulleys 24 cm and 60 cm diameter connects two parallel shafts 3 m apart and transmits 3.75 kW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between the belt and the pulleys is 0.3 and the safe working tension is 100 N/cm width. Determine :

(*i*) Minimum width of the belt

(*ii*) Initial belt tensions, and

(*iii*) Length of the belt required. [10]

9. (*a*) What is the difference between a Simple band brake and Differential band brakes ? [6]

(*b*) Fig. 3 shows a differential Band Brake of drum diameter 400 mm. The two ends of the band are fixed to the point on the opposite side of fulcrum of the lever at a distance of 50 mm and 165 mm from the fulcrum as shown in Figure. The brake is to sustain a torque of 400 Nm. The coefficient of friction between the band and brake is 0.27. The angle of contact is 210° and the length of lever from the fulcrum is 700 mm.

Determine :

(*i*) The force required at the end of the lever for the clockwise rotation of the drum.

(*ii*) Value of OB for the brake to be self-locking for clockwise rotation. [10]

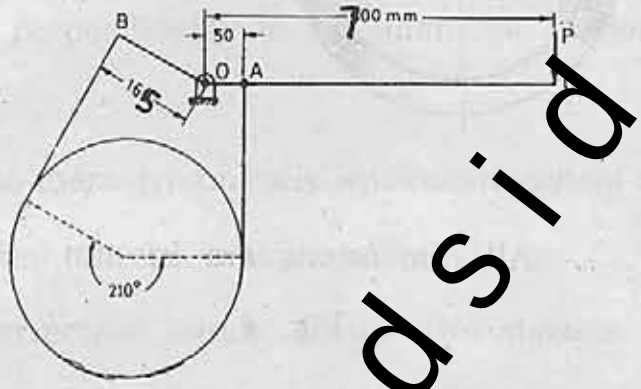
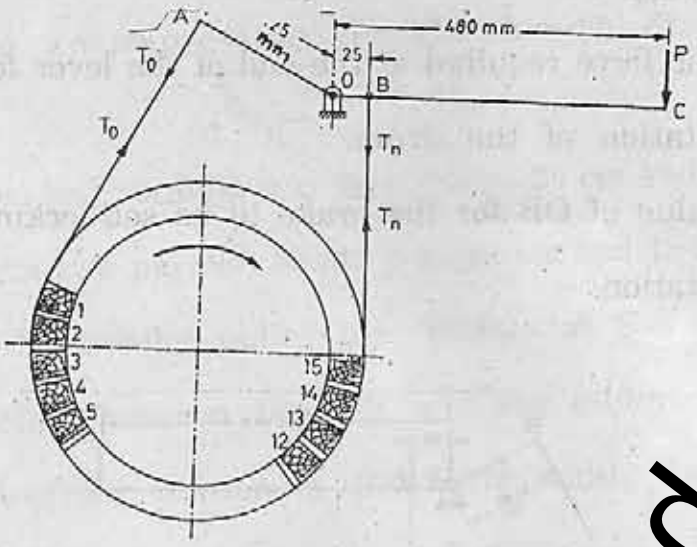


Fig. 3

Or

10. (*a*) Describe with the help of a neat sketch the construction and working of a Prony Brake absorption dynamometer. [6]

(*b*) The maximum braking torque acting on a band and block brake shown in Fig. 4 is 2000 Nm. The band is lined with 15 blocks each of which subtends an angle of 12° at the centre of rotating drum. The coefficient of friction between the band and block is 0.3. The diameter of the drum is 680 mm whereas the thickness of blocks is 60 mm. Find the least force required at the end of the lever which is 480 mm long. [10]



All dimensions are in mm.

Fig. 4

11. (*a*) Define and explain the following terms :

(*i*) Inertia force, and

(*ii*) Inertia torque. [4]

(*b*) Write a short note on D-Alembert's principle. [4]

(*c*) A connecting rod has mass 3 kg. For 50 oscillations it needs 45 seconds when suspended from small end and 40 seconds when suspended from big end. The distance between the points of suspension is 25 cm. Find the mass moment of inertia of the connecting rod and position of its CG from the small end. [10]

Or

12. (*a*) With the help of neat schematic diagram, derive frequency equation of Bifillar Suspension System. [6]

(*b*) The connecting rod of an engine has a length equal to 200 mm between centres and has a mass equal to 2.5 kg. Its centre of gravity is at 80 mm from the big end (crank pin) and the radius of gyration about an axis through the centre of gravity perpendicular to the plane of motion is 100 mm. Find :

(*i*) The two-mass dynamically equivalent system when one mass is placed at the small end.

(*ii*) The correction couple, if the two masses are placed at the two ends and the angular acceleration of the connecting rod is 100 rad/s^2 clockwise. [12]