Total No. of Questions—12] [Total No. of Printed Pages—8+2

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S.E. (Mech.) (II Sem.) EXAMINATION, 2010

THEORY OF MACHINE–I

(2008 COURSE)

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

N.B. :— (*i*) Solve graphical problems and its calculations on drawing sheets.

(*ii*) Answer *three* questions from Section I and *three* questions from Section II.

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

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

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

(*vi*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

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

SECTION I

1. (*a*) Explain the difference between the following : [6]

(*i*) Mechanism and Machine

(*ii*) Analysis and Synthesis of Mechanism

(*iii*) Ackermann and Davis Steering Gear Mechanism.

P.T.O.

(*b*) What do you understand by inversion of a kinematic chain ? Describe any *two* inversions of slider crank chain with neat diagrams. [8]

(*c*) Explain the equivalent linkage of mechanism with suitable example. [4]

Or

2. (*a*) What is the condition for correct steering ? Prove that the condition of correct steering is always satisfied in Davis steering gear mechanism. [8]

(*b*) Calculate the degree of freedom of the following mechanism, shown in Fig. 1. [6]

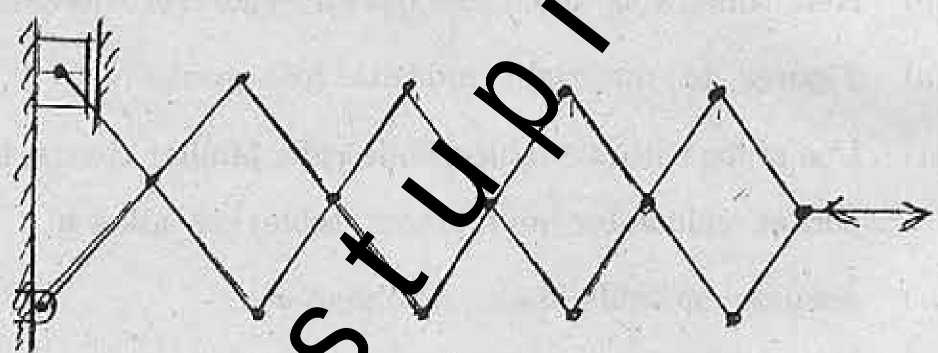

Fig. 1

(*c*) Explain "Pantograph" with the help of neat sketch. [4]

3. (*a*) State and explain "Kennedy's Theorem" of three centres in line. [4]

(*b*) Fig. 2 shows the mechanism of sewing machine needle box. For the given configuration, find the velocity of needle fixed to the slider 'D', when the crank OA rotates at 40 rad/sec. Use Instantaneous Centre of Rotation method. [12]

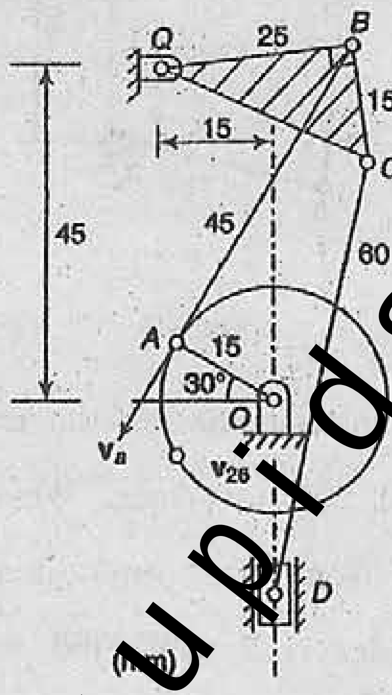

Fig. 2

Or

4. For a stone crusher mechanism as shown in Fig. 3, determine the angular velocity of link 5 and 6. Also determine the velocity and acceleration of point "P" in link 6. Assume crank 2 is

rotating at constant speed of 100 rpm anticlockwise. Use relative velocity and relative acceleration method. [16]

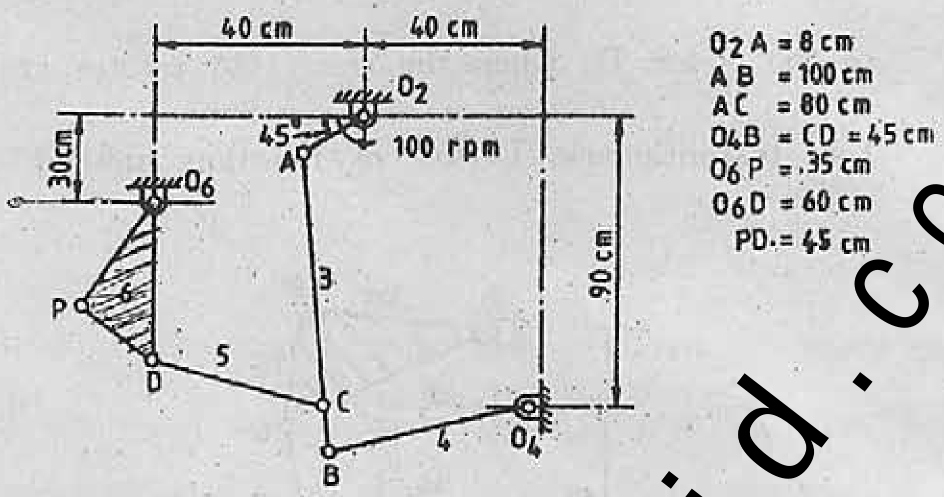

Fig. 3

5. (*a*) In a slider crank mechanism, the crank is 50 mm long and connecting rod 200 mm long. When the crank has moved through 30° from the inner dead center position, the velocity of slider is 2 m/s. Find using Klien's construction, angular acceleration of connecting rod and acceleration of center of gravity of connecting rod, which is situated at a distance of 80 mm from big end. [8]

(*b*) Fig. 4 shows a Scotch-Yoke mechanism. At the instant, shown in Fig., the crank OP has an angular velocity of 10 rad/sec. and angular acceleration of 30 rad/sec^2. Determine the acceleration of slider 'P' in the guide and the horizontal acceleration of the guide. Use relative velocity and relative acceleration method. [8]

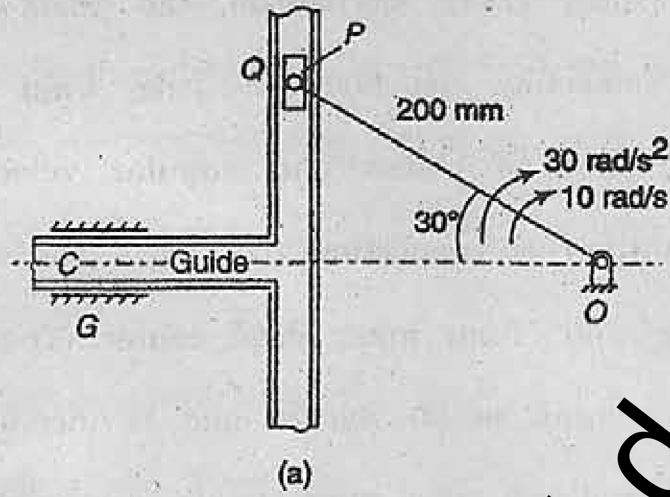

Fig. 4

Or

6. As shown in Fig. 5, crank OA, 100 mm long rotates clockwise at 100 rpm, Rod AC, 500 mm long slides in a swiveling pin at 'B'. The end 'C' slides on a swinging link DE. (Movable swivel joint at C) When the angle BOA is 120°, find the angular velocity and angular acceleration of 'DE'. Use relative velocity and relative acceleration method. [16]

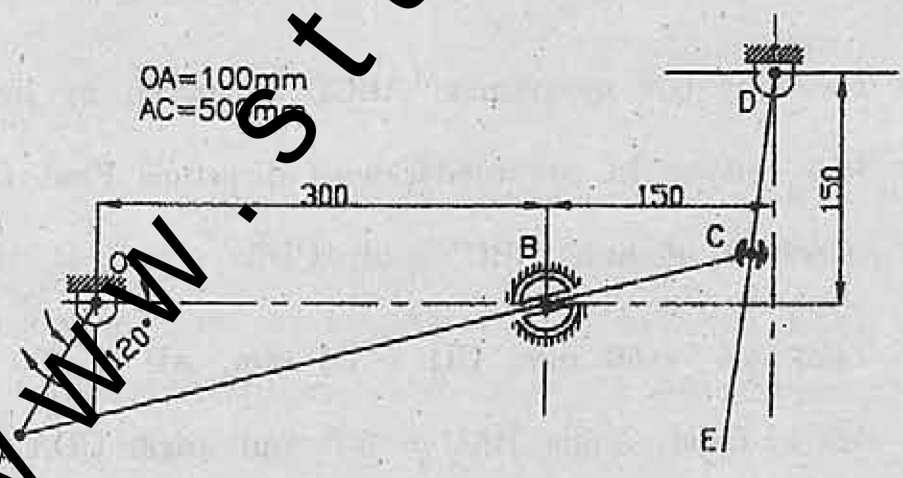

Fig. 5

SECTION II

7. (*a*) In a slider crank mechanism, the crank is 200 mm long and connecting rod 800 mm long. Find the velocity and acceleration of piston and angular velocity and angular acceleration of connecting rod, when the crank has turned through 60° from inner dead center. The angular velocity of the crank is 20 rad/sec and is increasing at the rate of 10 rad/sec^2. Use approximate Analytical method. [8]

(*b*) Draw a polar velocity diagram of Hooke's Joint and mark all silent features of the diagram for the driving shaft speed of 400 rpm having shaft angle of 18°. What is the average speed of driven shaft ? [8]

Or

8. (*a*) The four bar mechanism ABCD is driven by link "AB" at 10.5 rad/sec in counterclockwise direction Find the angular velocities of links "BC" and "CD".

Take AB = 50 mm, CD = 56 mm, AD = 100 mm. Link AD is fixed. Angle BAD = 60° and angle CDA = 80°. Use Complex Algebra method. [8]

(*b*) The two shafts of a Hooke's coupling have their axes inclined at 20°. The shaft A revolves at a uniform speed of 100 rpm. The shaft B carries a flywheel of mass 30 kg. If the radius of gyration of flywheel is 100 mm, find the maximum torque in shaft 'B'. [8]

9. (*a*) Explain the following terms related to synthesis of mechanism : [8]

(*i*) Function Generation

(*ii*) Dimensional Synthesis

(*iii*) Precision Points

(*iv*) Structural Error.

(*b*) Design a four bar mechanism with input link I_2, coupler link I_3 and output link I_4. Angles θ and Φ for 3 successive positions are given below :

Position	1	2	3
θ	40°	55°	70°
Φ	50°	60°	75°

If the grounded link I_1 = 30 mm, using Frudenstein's equation, find out lengths of other links to satisfy the given positional conditions. Also draw the synthesized mechanism in its first position and comment on the mechanism obtained. [8]

Or

10. (*a*) Derive the Frudenstein's equation of four bar mechanism. [10]

(*b*) Synthesize a four bar mechanism to guide a rod "AB" through 3 consecutive positions A_1B_1, A_2B_2 and A_3B_3 as shown in Fig. 6. [6]

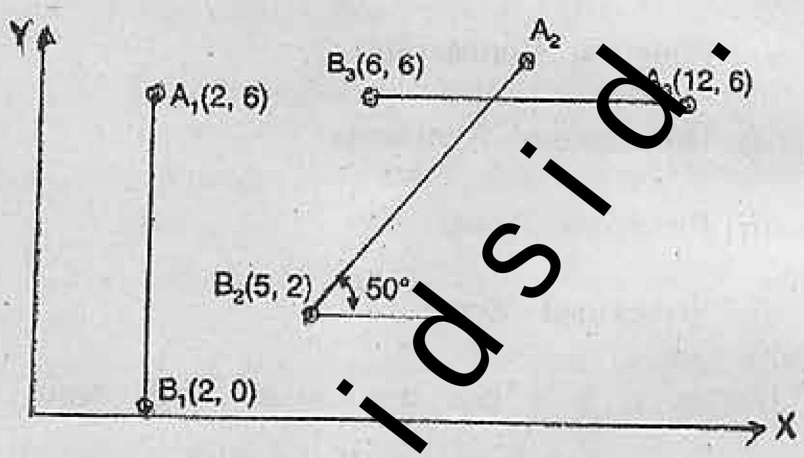

Fig. 6

11. (*a*) With the help of a neat diagram, derive the frequency equation for "Bifilar Suspension". [8]

(*b*) The following data relate to the connecting rod of a reciprocating engine :

Mass = 50 kg

Distance between bearing centres = 900 mm

Diameter of big end bearing = 100 mm

Diameter of small end bearing = 80 mm

Time of oscillations, when the connecting rod is suspended

from big end = 1.5 sec.

from small end = 1.85 sec.

Determine :

(*i*) The moment of inertia of rod about the axis through centre of mass perpendicular to the plane of oscillations.

(*ii*) The dynamically equivalent system of the connecting rod comprising two masses, one at the small end bearing centre. [10]

Or

12. (*a*) Draw and explain in brief Turning Moment Diagram of a 4 stroke single cylinder engine. State the utility of this diagram. [4]

(*b*) The following data relate to a horizontal reciprocating engine :

Mass of the reciprocating parts = 120 kg

Crank length = 90 mm

Engine speed = 600 rpm

Connecting rod data :

Mass = 90 kg

Length between centres = 450 mm

Distance of centres of mass from big end centre = 180 mm

Radius of gyration about an axis through centre of mass = 150 mm

Find the magnitude and direction of the inertia torque on the crankshaft, when the crank has turned through 30° from the inner dead centre. [14]