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

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S.E. (Mechanical) (Second Sem.) EXAMINATION, 2010

THEORY OF MACHINES—I

(2008 COURSE)

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

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*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*) Your answers will be valued as a whole.

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

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

(*viii*) The problems having graphical solutions preferred to solve completely on drawing sheets.

SECTION I

UNIT I

1. (*a*) Define :

(*i*) Kinematic link

(*ii*) Kinematic pair

P.T.O.

(*iii*) Kinematic chain

(*iv*) Mechanism. [4]

(*b*) Write a short note on Gnome engine. [4]

(*c*) What is the condition of correct steering ? Explain the construction and working of Davis Steering Gear Mechanism with the help of neat sketch. [8]

Or

2. (*a*) Define :

(*i*) Degree of freedom

(*ii*) Machine

(*iii*) Ternary joint

(*iv*) Grashoff's law. [4]

(*b*) Write a short note on 'Scotch yoke' mechanism. [4]

(*c*) Write short notes on :

(*i*) Pantograph

(*ii*) Equivalent linkage of mechanisms. [8]

UNIT II

3. The dimensions of the differential stroke engine mechanism are shown in Fig. 1 and other are OA = 75 mm, QB = 35 mm, AC = BC = 150 mm, CP = 100 mm, OA and QB are geared together so

that QB turns at twice the speed of OA and in opposite direction of OA. For the given configuration, find velocity, acceleration of piston and angular velocity, angular acceleration of CP if OA turns with a speed of 700 rpm in clockwise direction. [16]

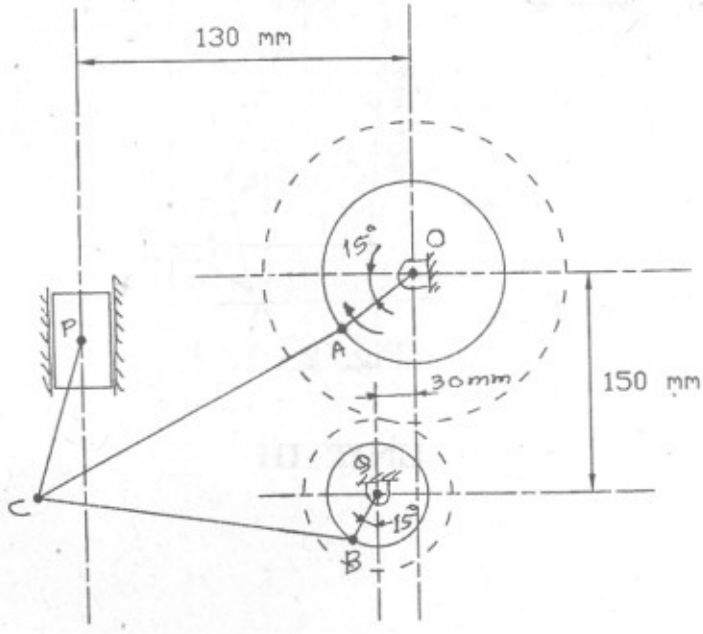

Fig. 1

Or

4. The Fig. 2 shows a crank OA 100 mm long, rotating clockwise about O at 130 rpm. AB is connecting rod 400 mm long. At a point C on AB, 150 mm from A, the rod CE, 350 mm long is attached. This rod CE slides in a slot in a turnnion at D. The end E is connected by link EF 300 mm long, to the horizontally moving slides F.

For the mechanism in the position shown, determine using theorem of three centers in line the velocity of F. [16]

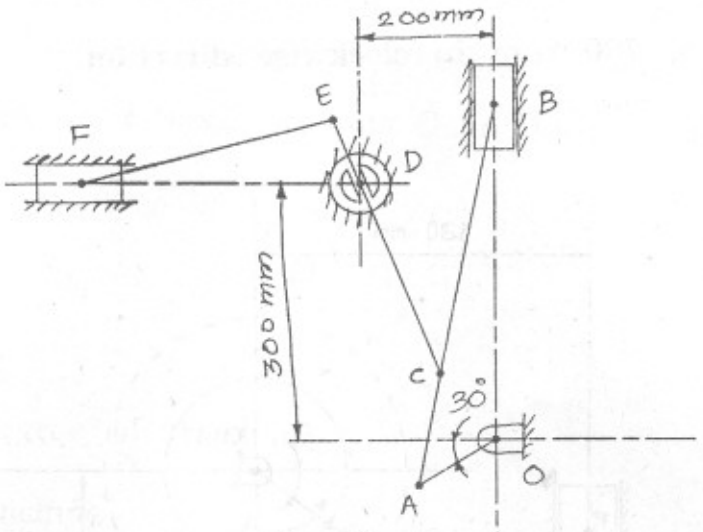

Fig. 2

UNIT III

5. The Fig. 3 shows a mechanism in which crank OA is rotating clockwise at 10 rad/s. At the instant shown, the coupler AC is horizontal and freely slides in a slotted trunnion B. The slotted trunnion is carried on the second link EF which is freely slides vertically in the guides. Hence determine :

(*i*) linear velocity and acceleration of link EF,

(*ii*) angular velocity and angular acceleration of the trunnion. [18]

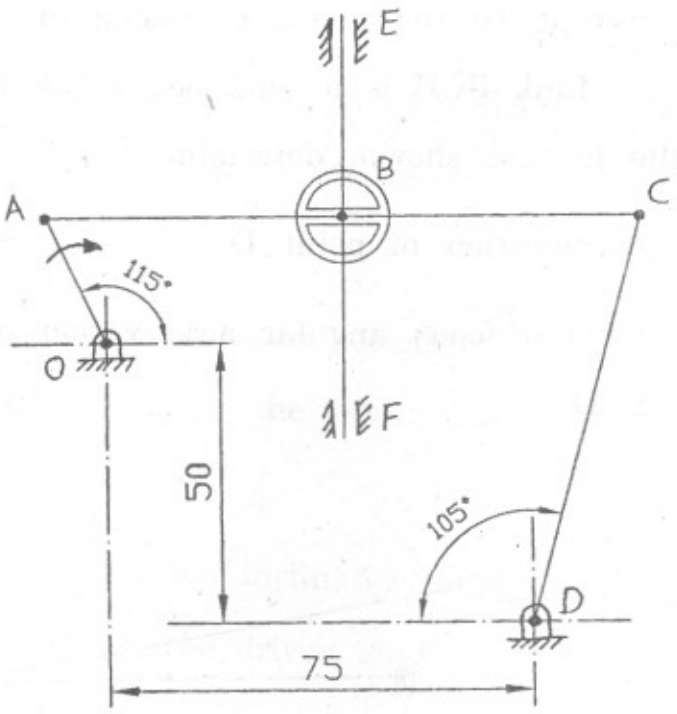

Fig. 3

Or

6. (*a*) In a slider crank mechanism having a crank length 20 cm and obliquity ratio of 4. The crank is rotating uniformly clockwise. The angular acceleration of connecting rod is 50 rad/s^2 when the crank is perpendicular to the line of stroke. Determine using Klein's construction :

(*i*) Linear velocity and acceleration of slider.

(*ii*) Angular velocity of the connecting rod. [6]

(*b*) The Fig. 4 shows a mechanism in which crank OA is rotating clockwise at 10 rad/s. Slider pivoted at A slides along the rod BC. Link BCD is a rigid bell crank lever pivoted at C. At the instant shown, determine :

(*i*) Acceleration of point D

(*ii*) Instantaneous angular acceleration of bell crank lever BCD. [12]

Fig. 4

SECTION II

UNIT IV

7. (*a*) In an IC engine mechanism, stroke is 120 mm and connecting rod is 3 times the crank length. The crank rotates at 1200 rpm in counterclockwise direction. Determine :

(*i*) Velocity and acceleration of piston

(*ii*) Angular velocity and angular acceleration of the connecting rod when the piston has moved one-fourth of its stroke from inner dead center. [8]

(*b*) Two horizontal shafts are connected by a Hooke's joint. The angle between the shafts is 160°. The driving shaft rotates uniformly at 150 rpm. The driven shaft with attached masses has a mass of 50 kg at a radius of gyration of 100 mm.

(*i*) If a driven shaft is subjected to a constant resisting torque of 100 N-m, find the torque required at the driving shaft, when $\theta = 30°$. [6]

(*ii*) At what value of inclination angle will the total fluctuation of speed of the driven shaft be limited to 25 rpm ? [2]

Or

8. (*a*) The crank of a reciprocating engine is 100 mm long and it rotates at an uniform speed of 20 rad/sec counterclockwise. The connecting rod length is 400 mm. Determine :

(*i*) velocity and acceleration of piston

(*ii*) angular velocity and angular acceleration of connecting rod

by using Complex Algebra method when the crank makes normal to the line of stroke. [12]

(*b*) State the applications of Hooke's joint. [4]

UNIT V

9. (*a*) The rocker of a crank-rocker mechanism is to have a length of 400 mm and swing through a total angle of 50° with a time ratio of 1.25. Determine the suitable lengths of remaining links. [8]

(*b*) A function varies from 0 to 8. Find the Chebychev spacing for four precision positions by using graphical method. [4]

(*c*) Explain the following terms related to synthesis problem :

(*i*) Function Generation

(*ii*) Body Guidance. [4]

Or

10. (*a*) Synthesis a four bar mechanism for three successive positions given in the table below :

Positions	**1**	**2**	**3**
θ	30	90	180
ϕ	40	115	175

Consider L_1 = Grounded Link, L_2 = Input Link, L_3 = Coupler Link, L_4 = Output Link, θ = input link angle, ϕ = output link angle.

If the grounded link of length 100 mm is horizontal and input link is of 20 mm length, synthesize the mechanism using precision

positions of the input link and precision positions of the output link. Ground the pivot of input link on left hand side and ground the pivot of output link on right hand side. Input and output links are rotating in opposite directions. Use the method of inversion. [7]

Draw the mechanism in its first precision position. [2]

Comment on the mechanism obtained. [1]

(*b*) Explain the following terms :

(*i*) Precision positions

(*ii*) Structural error

(*iii*) Chebychev spacing. [6]

UNIT VI

11. A high speed vertical engine has a connecting rod length five times the crank which is 60 mm. Its mass is 3 kg and has a C.G. 200 mm from the small end bearing. When suspended in a small end bearing, it makes 50 oscillations in 52 seconds. The reciprocating parts have a mass of 1.5 kg. Determine the torque exerted on the crankshaft due to inertia of the moving parts when the crank makes an angle of 135° with TDC, and speed of rotation is 1200 rpm. [18]

Or

12. (*a*) With the help of a neat diagram, derive the expression for the natural frequency of "Trifilar Suspension". [8]

(*b*) The connecting rod of an engine has a length equal to 220 mm between centers and has a mass equal to 2 kg. Its centre of gravity is at 150 mm from the small end centre and the moment of inertia of 0.02 kg-m^2 about its centre of gravity. Find :

(*i*) the two mass dynamically equivalent system when one mass is located at the small end centre,

(*ii*) the correction couple, if two masses are placed at the two ends and the angular acceleration of the connecting rod is 20,000 rad/s^2 anticlockwise. [10]