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

Seat No.	

[4657]-19

S.E. (Mechanical/Automobile) (II Sem.) EXAMINATION, 2014

THEORY OF MACHINES—I

(2008 PATTERN)

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*) Use of logarithmic tables, slide rules and electronic pocket calculator is allowed.

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

SECTION I

UNIT I

1. (*a*) Fill in the blanks with proper alternative and rewrite the sentences : [4]

(1) A kinematic chain having DOF equal to one is called ..... chain.

(*i*) Movable

(*ii*) Locked

(*iii*) Constrained

P.T.O.

(2) In a four bar 'Grashoffian Linkage', if shortest link is grounded, we get .....

(*i*) Double Crank Mechanism

(*ii*) Crank-Rocker Mechanism

(*iii*) Double Rocker Mechanism

(3) Piston and cylinder of a reciprocating steam engine forms a :

(*i*) Turning pair

(*ii*) Rolling pair

(*iii*) Sliding pair

(4) When three links are joined by a single pin, ... Joint(s) must be counted.

(*i*) One

(*ii*) Two

(*iii*) Three

(*b*) State and explain the 'Grashof's law'. [4]

(*c*) Distinguish between Ackerman and Davis steering gear mechanism. [3]

(*d*) Fig. 1 shows schematic of a mechanism. Redraw the free-hand sketch on the answer-book. Find out the total number of kinematic links and number of kinematic pairs. Hence find out the DOF for the mechanism. [5]

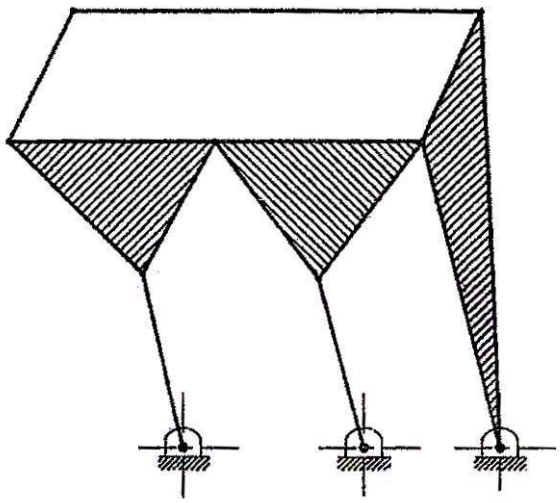

Fig. 1

Or

2. (*a*) Define the following : [4]

(*i*) Kinematic Link

(*ii*) Kinematic Pair

(*iii*) Kinematic Chain

(*iv*) Mechanism.

(*b*) Write short notes on (any *two*) : [6]

(*i*) Geneva Mechanism

(*ii*) Pantograph

(*iii*) Swinging Mechanism.

(*c*) In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 200 mm and the length of driving crank is 100 mm. Find the inclination of the slotted bar with vertical in the extreme position and the time ratio of cutting stroke to the return stroke. If the length of slotted bar is 400 mm, find the length of the stroke if the line of stroke passes through the extreme position of the free end of lever. [6]

UNIT II

3. In a mechanism as shown in Fig. 2, the crank OA is 100 mm long and rotates clockwise about O at 120 rpm. The connecting rod AB is 400 mm long. At a point C on AB, 150 mm from A, the rod CE 350 mm long is attached. The rod CE slides in a slot in a trunnion at D. The ene E is connected by a link EF, 300 mm

long to the horizontally moving slider F. For the mechanism in the position shown, find :

(*i*) Velocity of F

(*ii*) Velocity of sliding of CE in the trunnion and

(*iii*) Angular velocity of CE. [16]

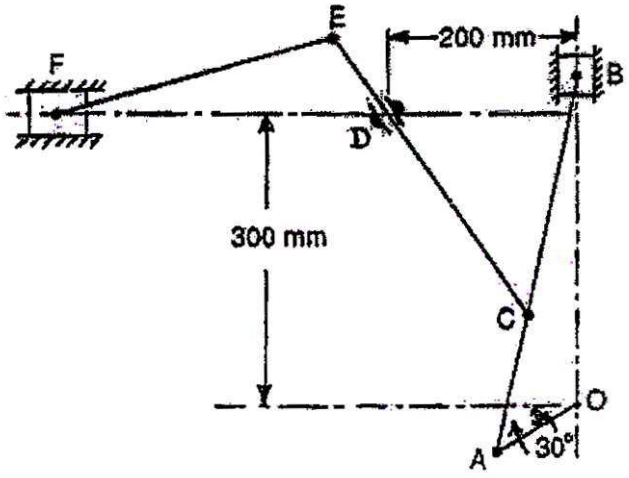

Fig. 2

Or

4. (*a*) The mechanism of a wrapping machine as shown in Fig. 3 has the following dimensions; O_1A = 100 mm, AC = 700 mm, BC = 200 mm, O_3C = 200 mm, O_2E = 400 mm, O_2D = 200 mm and BD = 150 mm. The crank O_1A rotates at a uniform speed

of 100 rad/s. Find the velocity of point E of the bell crank lever by instantaneous center method. [12]

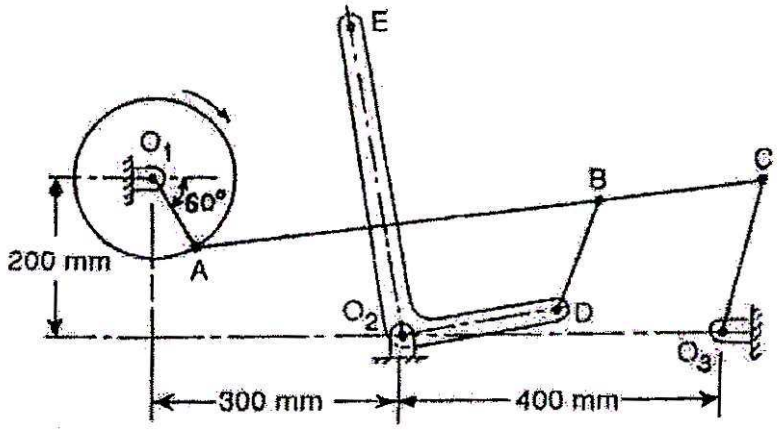

Fig. 3

(*b*) Define ICR. Explain different types of ICRs. [4]

UNIT III

5. In a Whitworth quick return motion as shown in Fig. 4, OA is a crank rotating at 30 rpm in a clockwise direction. The dimensions of various links are; OA = 150 mm, OC = 100 mm, CD = 125 mm and DR = 500 mm. Determine the acceleration of sliding block R and the angular acceleration of the slotted lever CB. [18]

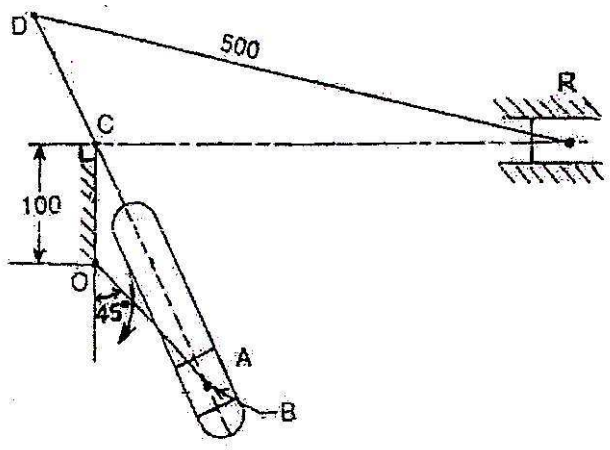

Fig. 4

Or

6. (*a*) In a reciprocating engine, crank length is 25 cm and obliquity ratio is 4. The crank rotates at uniform angular velocity of 300 rpm clockwise. Crank is at 30° from IDC. Using Klein's construction method, determine :

(*i*) Velocity of piston

(*ii*) Acceleration of piston

(*iii*) Angular velocity and angular acceleration of connecting rod. [12]

(*b*) Explain Klein's construction for determining the acceleration of piston of reciprocating engine. Also give the proof of the construction. [6]

SECTION II

UNIT IV

7. (*a*) Derive an analytical expression for displacement and velocity of the piston of an I.C. Engine Mechanism. [7]

(*b*) A universal coupling is used to connect two shaft whose axes intersect at 160°. The driving shaft rotates uniformly at 300 rpm. The driven shaft operates against steady torque of 200 N-m and carries a rotor whose mass is 2 kg and radius of gyration of 150 mm. What is the maximum value of torque which must be exerted by driving shaft. [9]

Or

8. (*a*) Derive loop closure equation for four bar mechanism. [4]

(*b*) In an I.C. Engine Mechanism, crank radius is 50 mm and connecting rod length is 200 mm. The crank is rotating at 100 rad/sec clockwise. Crank is at 40° from TDS position at particular instant, find out velocity of piston for this position by :

(*i*) Analytical Method

(*ii*) Complex Algebra Method. [12]

UNIT V

9. (*a*) Explain the following terms with suitable example :

(*i*) Function generation

(*ii*) Path generation

(*iii*) Motion generation. [9]

(*b*) Determine the Chebychev spacing for the function Y = $x^{1.5}$ for the range $0 \leq x \leq 3$ where three precision positions are required. Also determine θ_2, θ_3 and ϕ_2, ϕ_3 if $\Delta\theta = 40$ and $\Delta\phi = 90°$. Verify using graphical method $\theta_s = 0$ and $\phi_s = 0$ (θ-Theta, ϕ-Phi). [9]

Or

10. (*a*) Design a four bar mechanism to co-ordinate three positions of the input and output links as follows :

$\theta_1 = 20°$ $\theta_2 = 35°$ $\theta_3 = 50°$

$\phi_1 = 35°$ $\phi_2 = 45°$ $\phi_3 = 60°$

Assume length of fixed link = 15 cm. [10]

(*b*) What is the difference between analysis and synthesis of mechanism ? Explain with a suitable example. [4]

(*c*) What do you mean by relative pole ? Explain with neat sketch. [4]

UNIT VI

11. (*a*) Derive equation for periodic time of oscillations of rigid body using trifilar suspension method. [7]

(*b*) A connecting rod has mass of 3 kg. For 50 oscillations, it needs 40 seconds when suspended from small end and 35 seconds when suspended from big end. The distance between point of suspension is 200 mm. Find moment of inertia of the connecting rod and position of centre of gravity from the small end. [9]

Or

12. (*a*) Write short notes on :

(*i*) Turning moment diagram

(*ii*) Correction couple. [8]

(*b*) In slider crank mechanism, the crank is 300 mm long and connecting rod is 850 mm long. The piston is 90 mm in diameter and gas pressure acting on the piston is 5 MPa. When the crank has moved through 45° from IDC, find :

(*i*) Thrust in connecting rod

(*ii*) Radial load

(*iii*) Piston side thrust

(*iv*) Torque acting on the crank shaft. [8]