Total No of Questions: [12] *SEAT NO. :*

[Total No. of Pages : 04]

S.E. 2008 Course (Mechanical/Automobile Engg.)
Theory of Machines-I
(Semester -II)

Time: 4 Hours *Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Answer any three questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of Calculator is allowed.***
6) ***Assume Suitable data if necessary***

SECTION I

Q1) a) Explain 'Completely constrained motion' and 'Successfully constrained motion' by giving examples of each [6]

b) Explain Pantograph mechanism with a neat sketch. State its applications. [4]

c) What is the condition of correct steering? Explain the construction and working of Ackermann steering Gear Mechanism with the help of neat sketch. [6]

OR

Q2) a) Explain Kutzbach criteria for motion in a plane and hence derive Grubler's Equation. [6]

b) Define kinematic pair. Explain Lower pair & Higher pair with suitable examples. [4]

c) With neat sketch, explain construction & working of Whitworth Quick Return Mechanism [6]

Q3) a) State & Explain 'Three Centres in Line' Theorem. [4]

b) A mechanism as shown in **fig.1,** has the following dimensions: OA = 200 mm, AB = 1.5 m, BC = 600 mm, CD = 500 mm, & BE = 400 mm. Locate all the possible instantaneous centres by inspection, if crank OA rotates uniformly at 400 rpm anticlockwise, find i) velocity of B,C & D & ii) angular velocities of AB, BC & CD. [12]

OR

Q4) For the mechanism as shown in **fig.2,** the crank AB rotates at 180 rpm uniformly in clockwise direction. The dimensions of various links are as follows; AB = 150 mm, BC = 450 mm, CE = 240 mm, CD = 210 mm, DF = 660 mm. Find acceleration of slider F & angular acceleration of link DF. [16]

Q5) **Fig.3** shows a mechanism in which crank OA is rotating clockwise at 20 rad/sec. Determine the angular velocity and angular acceleration of link BC & DE at the instant shown. [18]

OR

Q6) a) Explain Klein's construction for slider crank mechanism when the crank rotates with non-uniform angular velocity. [6]

b) In a slider crank mechanism, the crank is 200 mm long & connecting rod 750 mm long. Find by Klein's construction the velocity and acceleration of piston and angular velocity & angular acceleration of connecting rod when the slider has moved through 350 mm from top dead centre position. Assume crank rotates at uniform speed of 720 rpm. [12]

SECTION II

Q7) a) Derive an expression for finding velocity of slider and angular velocity of connecting rod in case of slider crank mechanism. [8]

b) In an I.C.Engine mechanism, the stroke of the slider is 180 mm and the obliquity ratio is 4.25. The crank rotates uniformly at 900 r.p.m. clockwise. Find analytically [8]

(i) Velocity and acceleration of piston and

(ii) Angular velocity and angular acceleration of connecting rod, when the crank is 30^0 past the outer dead centre.

OR

Q8) a) Distinguish between Single Hooke's Joint and Double Hook's Joint [2]

b) Derive loop closure equation for four bar chain mechanism. [4]

c) Two shafts, angle between whose axes is 15^0 are connected by a Hooke's joint. Find the angle turned through by the driving shaft rotates when: [10]

(i) The velocity ratio is maximum, minimum and unity.

(ii) The retardation of driven shaft is maximum.

(iii) Draw the polar diagram representing angular velocities of driving and driven shaft indicating the various angular positions calculated above.

Q9) a) Explain in short (a) Type Synthesis, (b) Number Synthesis,(c) Dimensional Synthesis. [6]

b) Determine the Chebyshev spacing for the function $y = 2x^3 - x$ for the range $0 \leq x \leq 4$, where four precession points are required. For these precision points, determine θ_2, θ_3 and Φ_2, Φ_3 if $\Delta\theta = 45^0$ and $\Delta\Phi = 90^0$. [12]

OR

Q10) a) Explain the terms: (i) Precision positions, (ii) Structural error [6]

b) Synthesize a four bar mechanism with input link 'a', coupler link ' b', output link 'c' and grounded link 'd'. Angles θ and Φ for three successive positions are given in the table below: [12]

If the length of grounded link is 40 mm, using Freudenstein's equation, find out other link lengths to satisfy the given positional conditions. Draw the synthesized mechanism in its second position.

	1	2	3
θ	20^0	35^0	50^0
Φ	35^0	45^0	60^0

Q11) a) Explain with a neat sketch D' Alembert's principle [4]

b) Compare 'Compound Pendulum method' and 'Bifilar Suspension method' of finding moment of inertia of a rod like body. [4]

c) A machine component of 5 kg mass is placed on a horizontal circular platform which is suspended by three equal wires, each 1.25 meter long from rigid support. The wires are equally spaced round the reference of circle with 125 mm radius. When the mass center of the component coincides with the axis of circle, it takes 30 sec for 10 angular oscillations. The platform alone has a mass of 1.5 kg and takes 35 sec for 10 oscillations. Find M.I. of the component about an axis through its mass center. [8]

OR

Q12) a) Explain what is meant by the "Dynamical Equivalence' of two systems of masses. For a connecting rod of an I.C. engine having mass 'm' and radius of gyration 'k', obtain a two mass dynamically equivalent system, having one of the two masses at the small end. How is the dynamically equivalence achieved if it is required that the outer mass located at the big end? [10]

b) A rigid link, 500mm long, has mass 2 kg and radius of gyration 200 mm. Replace this link by dynamically equivalent system of two concentrated masses located at the ends of the link [6]

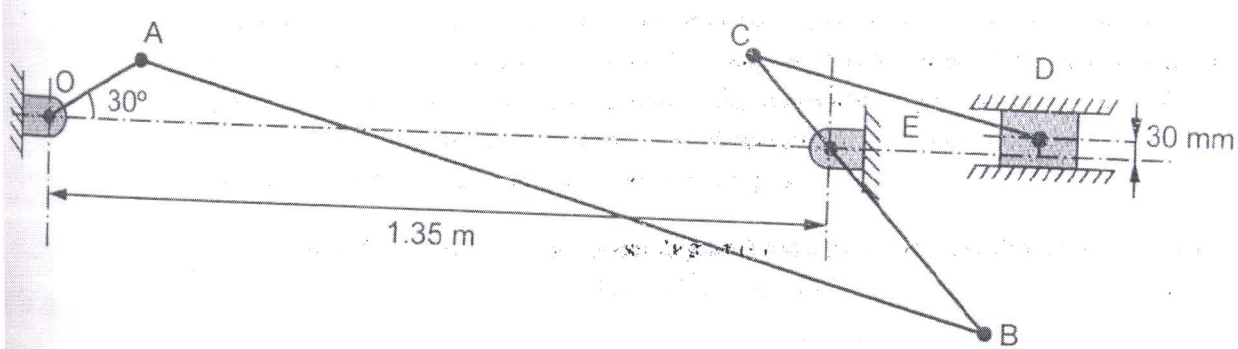

Fig.1 (Q 3 b)

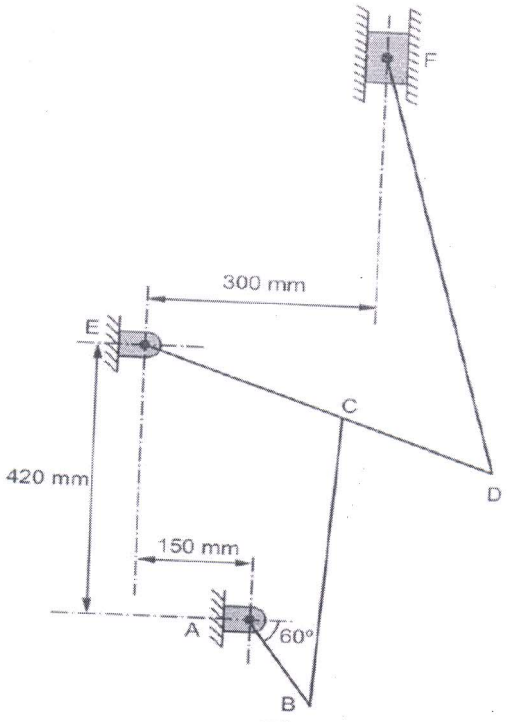

Fig.2 (Q 4)

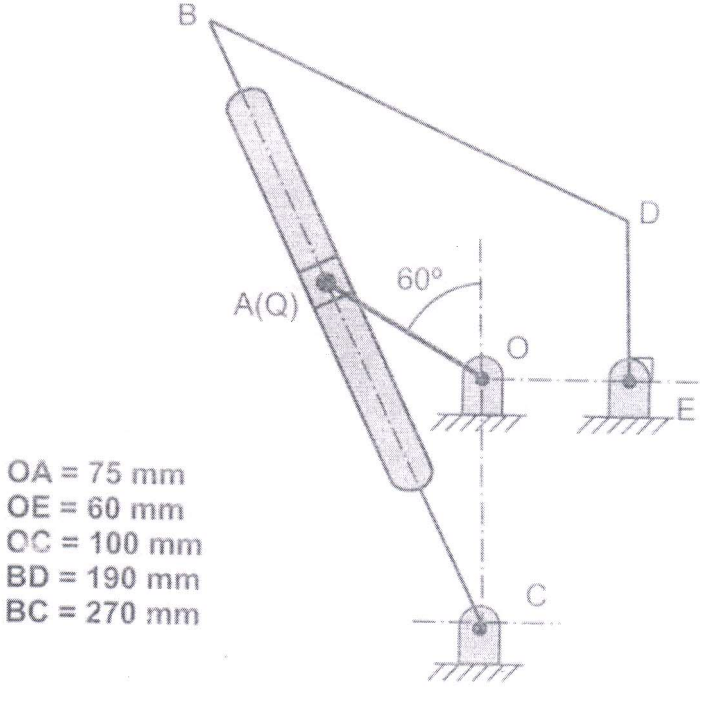

Fig.3 (Q 5)