UNIVERSITY OF PUNE
[4362]-116
S.E.(Mechanical / Automobile) Examination – 2013
(2008 pattern)
THEORY OF MACHINES -1

[Total No. of Questions: 12] **[Total No. of Printed pages: 7]**

[Time: 4 Hours] **[Max. Marks: 100]**

Instructions:

(1) Answer three questions from Section I and three questions from Section II
(2) Answers to the two sections should be written in separate answer-books
(3) Black figures to the right indicate full marks.
(4) Neat diagrams must be drawn wherever necessary.
(5) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.
(6) Assume suitable data, if necessary.

SECTION –I

UNIT- I

Q1. A) Define the Following Term [4]

i) Grubler's criterion

ii) Structure

iii) Degree of Freedom

iv) Mechanism

B) Explain with neat sketch whitworth Quick Return Mechanism. [4]

C) What is a condition of correct steering? With the help of neat sketch [8] explain the construction and working of Davis Steering Gear mechanism.

OR

Q2. A) Define the following [4]

i) Machine

ii) Kinematic Chain
iii) Kinematic Link

iv] Grashoff's law

B) Explain the following terms with suitable examples. [6]

i] Completely constrained motion

ii] Incompletely constrained motion

iii] Successfully constrained motion

C) Write short note on [6]

i) Pantograph along with its application.

ii) Scotch yoke mechanism

UNIT–II

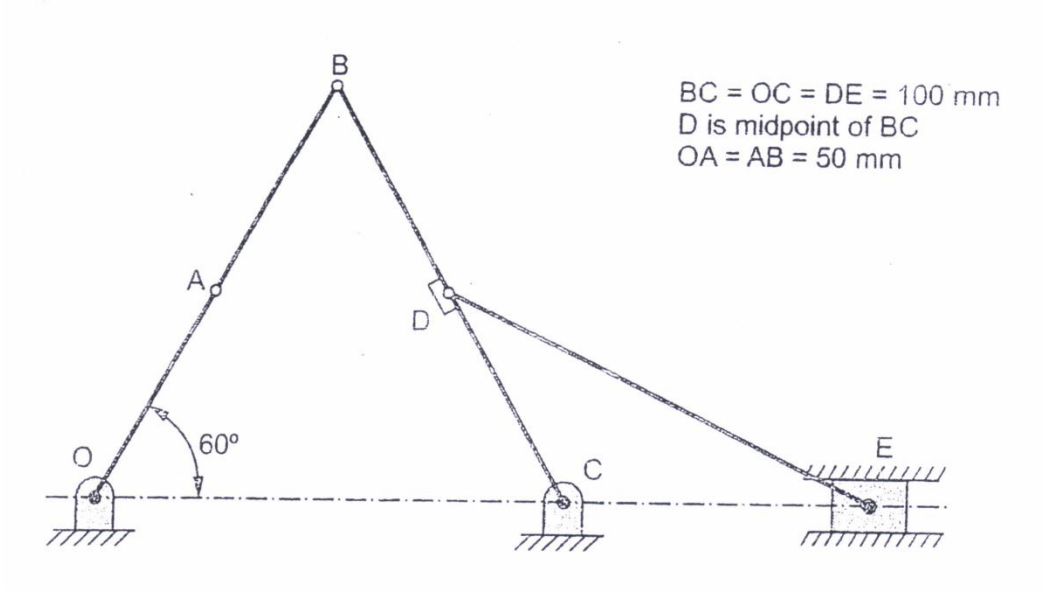
Q3. A) **Fig (1)** Shows mechanism in which crank OA is rotating clockwise at 240 rpm. At the instant Shown, locate all ICRs for the mechanism and find the velocity of slider E as well as the angular velocity of the link BC using ICR method. [12]

BC= OC=DE= 100mm

D is a midpoint of BC.

OA =AB=50mm.

Fig (1)



B] State and Explain Kennedy's Theorem 'of three centers in line. [4]

OR

Q4. A] In the Toggle mechanism shown in **Fig (2)**, the slider D is [16]

constrained to move on a Horizontal path. The crank OA is rotating in the counter clockwise direction at a speed of 180 r.p.m Increasing at the rate of 50 rad/ $s^{2.}$. The dimensions of the various links are as follows: OA=180 mm, CB=240 mm, AB=360 mm and BD=540mm.

For the given configuration,

Find i) Velocity of slider D

ii) Angular velocity of BD, AB, CB.

iii) Acceleration of slider D

iv) Angular acceleration of BD.

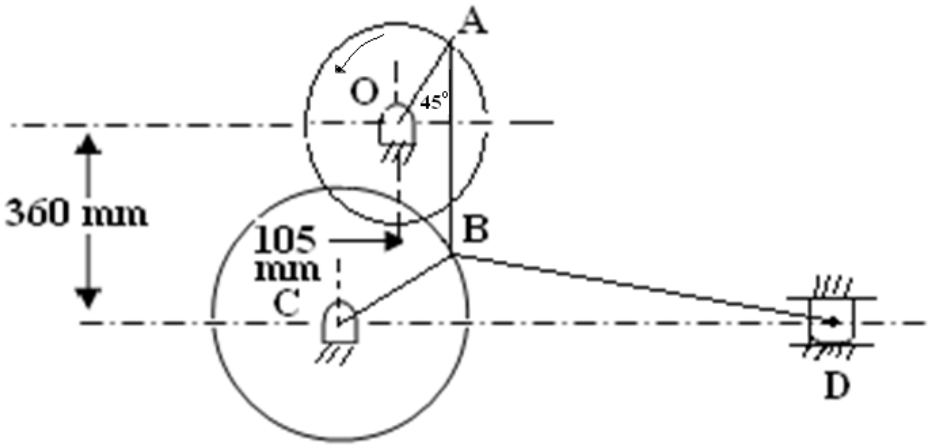


Fig (2)

UNIT–III

Q5. A] In a whitworth Quick return motion, as shown in **fig (3)**, [18]

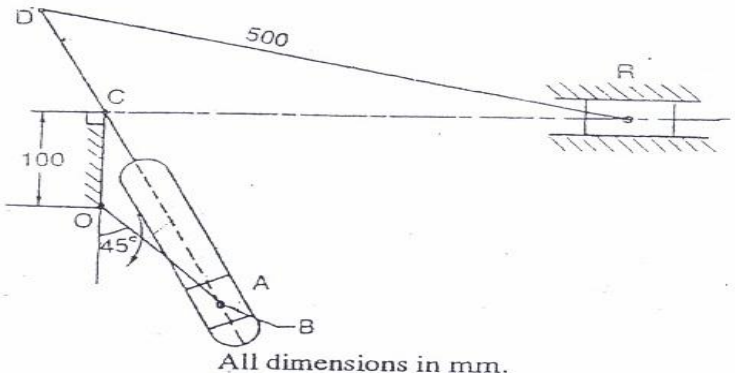
OA is a crank rotating at 30 r.p.m. in a clockwise direction. The dimensions of various links are OA=150 mm, OC=100 mm, CD=125 mm and DR=500 mm.

Determine-

i) The acceleration of the sliding block R

ii) The angular acceleration of the slotted lever CA

Fig (3)



OR

Q6. A) In a slider crank mechanism, the crank is 60 mm long and [12]

connection rod 240 mm long. When the crank has moved through 40^0 from the Inner dear centre position, the velocity of slider is 3 m/s.

Find i) Angular acceleration of connecting rod.

ii) Acceleration of centre of gravity of connecting rod, which is situated at a distance of 120 mm from big end.

Use Klein's construction.

B) Explains the procedure to construct Klein's construction to [6]

determine the acceleration of a slider crank mechanism. Also, find angular acceleration of connecting rod.

SECTION- II

UNIT- IV

Q7. A) An IC engine runs at 1600 rpm, has length of connecting rod 240 [10]

mm and obliquity ratio 4. Determine at 40% of outstroke

i] Angular position of the crank

ii] Linear velocity and acceleration of the piston

iii] Angular velocity and Angular acceleration of connecting rod

B) What is loop closure equation? Derive the same for offset slider [06]

crank mechanism.

OR

Q8. A) Two shafts, angle between whose axes is 20^0 are [10]

connected by Hook's joint. Find the angle turned through by the driving shaft rotates when:

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.

B) Explain complex number method of acceleration analysis. [6]

UNIT-V

Q9. A) A four bar mechanism is used to generate the function $y=x^2+4x$, [12]

for the range $1 \leq x \leq 3$. Find the three precision positions from chebychev spacing, if the initial values of the crank angle and follower angle are 30° and 150^0 respectively. Take $\Delta\theta = \Delta\Phi = 90^0$. Find the corresponding values of x, y, θ and Φ. Also find the dimensions of other link, if the grounded link is 100 mm and input link is 40 mm. Use inversion method.

B] Explain [6]

i] Number Synthesis

ii] Type Synthesis

iii] Dimensional Synthesis

OR

Q10. A) Explain following terms [8]

i) Function Generation

ii) Path Generation

iii) Precision Points

iv) Structural Error

B) Design a four bar mechanism with input link ‘a ‘and output link ‘c’ [10]

angles θ and Φ for three successive positions are as follows

$\theta_1 = 20^0$ $\Phi_1 = 35^0$

$\theta_2 = 35^0$ $\Phi_2 = 45^0$

$\theta_3 = 50^0$ $\Phi_3 = 60^0$

If the length of grounded link is 40 mm, using Freudenstein's equation find out other link lengths to satisfy the given positional conditions.

UNIT-VI

Q11 A) With the help of neat sketch explain Bifilar suspension method [06]

B) Explain dynamic equivalence of two mass systems, for a connecting rod of an IC 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 dynamical equivalence is achieved if it is required that the other mass located at the big end [10]

OR

Q12. A) An IC engine has a stroke of 100 mm and bore of 80 mm. [10]

The connecting rod is 160 mm between centers and has total mass of 1.3 kg. Its center of mass is 130 mm away from small end center and radius of gyration about the mass center is 75 mm. The reciprocating mass is 1.8 kg. Determine magnitude of resultant forces on the crank pin, neglecting friction and gravity, when the crank is 30^0 after the TDC position and rotating at 1600 rpm clockwise. The gas pressure on the piston is 2 N/mm^2

B) Derive frequency equation of compound pendulum [6]