Government College of Engineering, Amravati

(An Autonomous Institute of Government of Maharashtra)

Second Year B. Tech.

Summer – 2018

Course Code: MEU402

Course Name: Kinematics of M/c

Time: 3 hr. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1 (a) i) The angle of inclination of the plane, at which the body begins to move down the plane, is called 6

(a) angle of friction (b) angle of repose (c) angle of projection

ii) When the axes of first and last gear are co-axial, then gear train is known as

(a) simple gear train (b) compound gear train
(c) reverted gear train (d) epicyclic gear train

Contd..

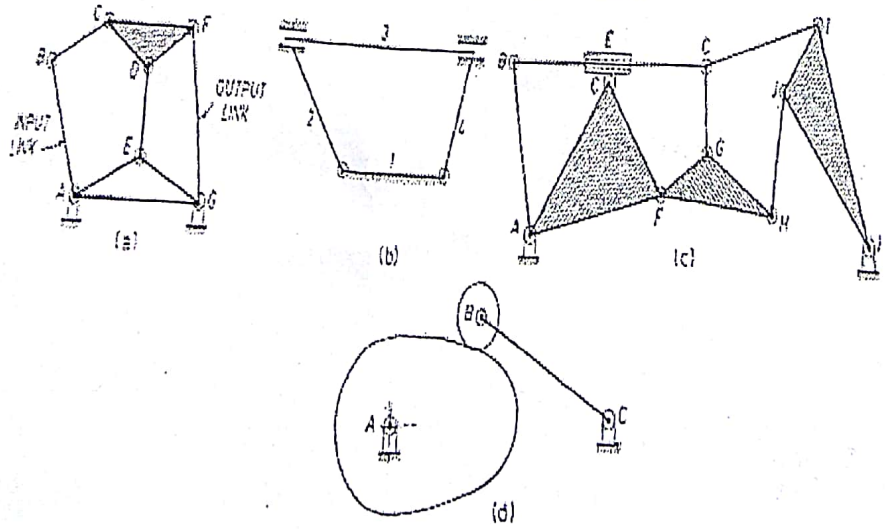
iii) The type of gears used to connect two non-parallel non-intersecting shafts are
(a) spur gears (b) helical gears (c) spiral gears (d) none of these

iv) The component of the acceleration, parallel to the velocity of the particle, at the given instant is called
(a) radial component (b) tangential component (c) coriolis component (d) none of these

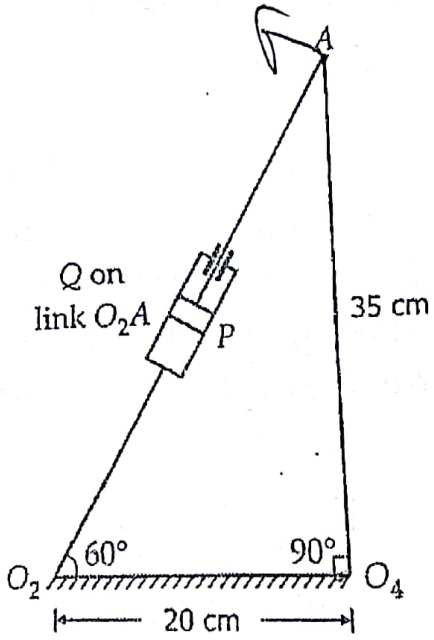
iv) In a structure the degree of freedom is
(a) 1 (b) 2 (c) infinite (d) 0

v) Hydraulic press is
(a) Rigid link (b) Flexible link (c) Fluid link
(d) None of the above

(b) Examine the mechanics as shown in figure and indicate the cases where unique relation between the motions of the input links and output links exists. Give reason for the answers. **6**



(a) Figure shows a mechanism in which the hydraulic actuator O_2A is expanding at a constant rate of 10 cm/sec. Determine the directions and magnitude of angular velocity and acceleration of link O_4A. 6



(b) The crank of an engine 20cm long and the connecting rod length to crank radius is 4. Determine the acceleration of the piston, the acceleration of a point X on the connecting rod located at its midpoint, and the angular acceleration of the rod, when crank has turned through 45^0 from the linner dead centre position. 6

(a) When crank rotates at a uniform speed of 240rpm.

(b) When the instantaneous speed of rotation of the crank is 240rpm clockwise and it is increasing at the rate of 100 rad/sec^2

3 Solve any **TWO** questions: 12

Contd..

(a) Design a four bar mechanism to co-ordinate the input and output angles as follows: Input angles = 15°, 30° and 45°; Output angles = 30°, 40° and 55°.

(b) What is meant by the expression 'friction circle'? Deduce an expression for the radius of friction circle in terms of the radius of the journal and the angle of friction.

(c) A body, resting on a rough horizontal plane required a pull of 180 N inclined at 30° to the plane just to move it. It was found that a push of 220 N inclined at 30° to the plane just moved the body. Determine the weight of the body and the coefficient of friction.

4 (a) It is required to set out the profile of a cam to give following motion to the oscillating roller follower. 6

(a) Follower to move outward by an angular displacement of 30^0 during 120^0 of cam rotation.

(b) Follower to dwell for 30^0 of cam rotation at end of outstroke

(c) Follower to return to the initial position during the 120^0 of cam rotation.

(d) Follower to dwell during the next 90^0 of cam rotation.

The distance between oscillating follower point centre and the cam axis = 115mm. The distance between pivot and oscillating roller follower centre or the length of follower =100 mm.,

minimum radius of cam = 50 mm; and follower roller radius = 10 mm

(e) Speed of cam = 500 rpm in clock wise direction.

The outstroke and the return stroke are executed with simple harmonic motion.

(b) It is required to set out the profile of a cam to give the following motion to the reciprocating follower with a flat mushroom contact face : 6

I. Follower to have a stroke of 20 mm during 120^0 of cam rotation.

II. Follower to dwell for 30^0 of cam rotation.

III. Follower to return to its initial position during 120^0 of cam rotation.

IV. Follower to dwell for remaining 90^0 of cam rotation.

The minimum radius of the cam = 25mm. Out stroke and return stroke of the follower are performed with simple harmonic motion.

5 Solve any **TWO** questions: 12

(a) A pair of spiral gears is required to connect two shafts 175 mm apart, the shaft angle being 70°. The velocity ratio is to be 1.5 to 1, the faster wheel having 80 teeth and a pitch circle diameter of 100 mm. Find the spiral angles for each wheel. If the torque on the faster wheel is 75 N-m; find the axial thrust on each shaft, neglecting friction.

(b) Derive an expression for the minimum number

Contd..

of teeth required on the pinion in order to avoid interference in involute gear teeth when it meshes with wheel.

(c) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the center of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B ?

Government College of Engineering, Amravati

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Fourth Semester B. Tech. (Mechanical Engineering)

Summer – 2017

Course Code: MEU402

Course Name: Kinematics of Machines

Time: 2 hr. 30Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1. (a) i)The frictional torque transmitted by a cone clutch is same as that of **06**

(a) flat pivot bearing (b) flat collar bearing

(c) conical pivot bearing (d) trapezoidal pivot bearing

ii)The train value of a gear train is

(a) equal to velocity ratio of a gear train (b) reciprocal of velocity ratio of a gear train (c) always greater than unity (d) always less than unity

iii) An imaginary circle which by pure rolling action, gives the same motion as the actual gear, is called

(a) addendum circle (b) dedendum circle (c) pitch circle (d) clearance circle

iv)The component of the acceleration, parallel to the velocity of the particle, at the given instant is called

(a) radial component (b) tangential component (c) coriolis component (d) none of these

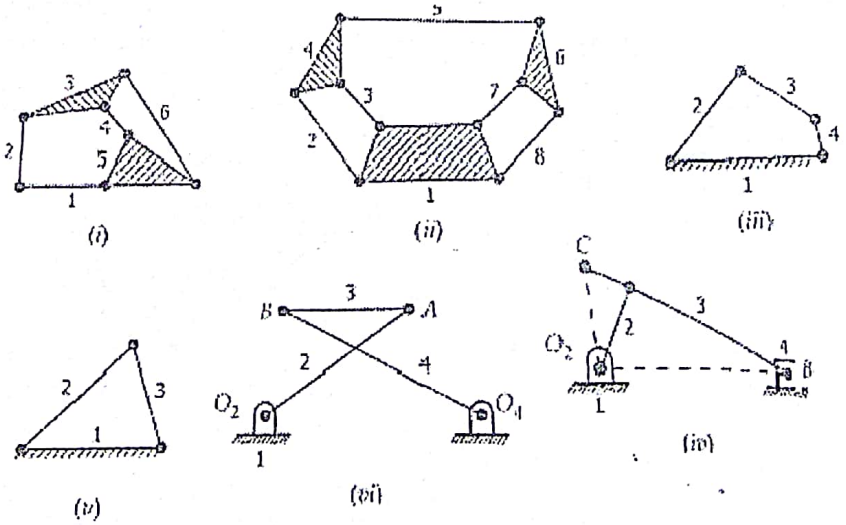
v)In a structure the degree of freedom is

(a) 1 (b) 2 (c) infinite (d) 0

vi)Hydraulic press is

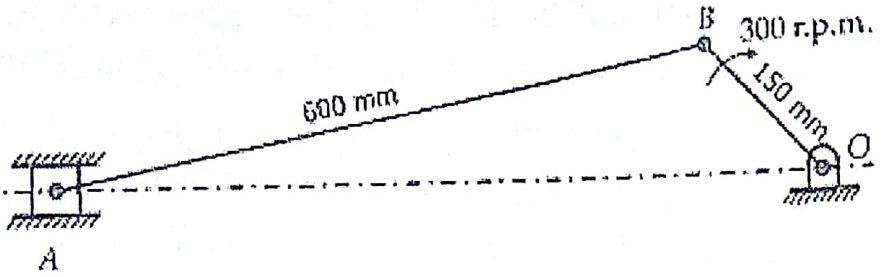
(a) Rigid link (b) Flexible link (c) Fluid link (d) None of the above

(b) Calculate the degree of freedom of the linkages as shown in figure. **06**



2 (a) The crank of slider mechanism rotates at a constant speed of 300 rpm The crank is 150 mm long and **06**

connecting rod is 600 mm long. Determine: - angular velocity, angular acceleration of the connecting rod, at a crank angle of 45^0 from inner dead centre position.



(b) The crank of an engine 20cm long and the connecting rod length to crank radius is 4. Determine the acceleration of the piston, the acceleration of a point X on the connecting rod located at its midpoint, and the angular acceleration of the rod, when crank has turned through 45^0 from the linner dead centre position. **06**

iv) When crank rotates at a uniform speed of 240rpm.

v) When the instantaneous speed of rotation of the crank is 240rpm clockwise and it is increasing at the rate of 100 rad/sec^2

3 Solve any **TWO** questions:

(a) Explain the following : **06**
(i) Limiting friction, (ii) Angle of friction, and
(iii) Coefficient of friction.

(b) Synthesize a four bar linkage, ~~as shown in Fig. 25.14~~, using Freudenstein's equation to satisfy in one of its positions. The specification of position θ, **06**

velocity ω and acceleration α are as follows :
$\theta = 60°$, $\omega 2 = 5$ rad/s; $\alpha 2 = 2$ rad/s2;
$\varphi = 90°$; $\omega 4 = 2$ rad/s; $\alpha 4 = 7$ rad/s2.

(c) A centrifugal clutch has four shoes which slide radially in a spider keyed to the driving shaft and make contact with the internal cylindrical surface of a rim keyed to the driven shaft. When the clutch is at rest, each shoe is pulled against a stop by a spring so as to leave a radial clearance of 5 mm between the shoe and the rim. The pull exerted by the spring is then 500 N. The mass centre of the shoe is 160 mm from the axis of the clutch. If the internal diameter of the rim is 400 mm, the mass of each shoe is 8 kg, the stiffness of each spring is 50 N/mm and the coefficient of friction between the shoe and the rim is 0.3 ; find the power transmitted by the clutch at 500 r.p.m. **06**

4 (a) A cam rotating at 150 rpm operate a reciprocating roller follower of radius 2.5 cm. The follower axis is offset by 2.5 cm to the right. The least radius of the cam is 5 cm and stroke of follower is 5 cm. Ascent and decent both takes place by uniform acceleration and retardation. Ascent takes place during 75^0 and decent during 90^0 of cam rotation. Dwell between ascent and decent is 60^0. Draw the cam profile. Also sketch velocity and acceleration diagram and mark salient values. **06**

(b) The following data relates to a cam operating the suction value of a four stroke petrol engine:- **06**

i) Lift 1 cm
ii) Least radius 2 cm
iii) Nose radius 0.25 cm
iv) Crank angle when suction value opens, after TDC 4^0
v) Crank angle when suction value close, after BDC 50^0
vi) Camshaft speed 1000 rpm

07

5 Solve any **TWO** questions: 12

(a) State and prove the law of gearing. Show that involute profile satisfies the conditions for correct gearing.

(b) In a spiral gear drive connecting two shafts, the approximate centre distance is 400 mm and the speed ratio = 3. The angle between the two shafts is 50° and the normal pitch is 18 mm. The spiral angle for the driving and driven wheels are equal. Find : 1. Number of teeth on each wheel, 2. Exact centre distance, and 3. Efficiency of the drive, if friction angle = 6°.

(c) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B ?

Government College of Engineering, Amravati

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Fourth Semester B. Tech. (Mechanical Engineering)

Summer – 2016

Course Code: MEU402

Course Name: Kinematics of Machines

Time: 2 Hrs. 30 Min. **Max. Marks: 60**

Instructions to Candidate

1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
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5) Figures to the right indicate full marks.

1 Choose **any four** the best score Qs among the following. **12**

a) Compare the Whitworth quick- return mechanism with crank-slotted-lever-quick-return mechanism

b) Sketch the mechanism obtained by fixing the slider of double slider crank kinematic chain and explain the working.

c) For the mechanism shown in Fig No.1 (b) calculate degree of freedom, hence conclude for whether mechanism or structure.

d) The following data refers to a symmetrical circular cam operating flat faced follower: least diameter of the cam is 40mm, lift 12mm, angle of action 160^0, speed of cam 500rpm. Determine the nose radius.

e) A pair of 20^0 gears has a module pitch of 4mm.The number of teeth on the gears I and II are 24 and 40 respectively and gear I rotates 600rpm. Take addendum is equal to one module. Find the maximum

Contd..

velocity of sliding.

f) Explain successfully constrained motion, with help of two examples.

2 **Solve any Two.** 12

a) Design four link mechanisms when the motion of input link and output links are governed by func $y=x^2$ and x varies from 0 to 2 with an interval of Assume θ to vary from 50^0 to 150^0 and φ from 80^0 160^0.

b) Discuss the design of slider crank mechanism inversion method.

c) A simple band brake is applied to a drum of 560m diameter which rotates at 240 rpm. Angle of cont of the band is 270^0. One of the ends of the band fastened to a fixed pin and the other end to the br lever 140mm from the fixed pin. The brake leve 800 mm long and is placed perpendicular to diameter that bisects the angle of contact. Take coefficient of friction as 0.3; determine the necess pull at the end of lever to stop the drum if 40kW power is being absorbed. Also find the width of band if its thickness is 3mm and the maximum ten stress is limited to $40N/mm^2$.

3 **Solve the followings.** 12

a) A cone clutch with cone angle of 30^0 transmits 10 at 600rpm. The normal pressure intensity between surfaces in contact is not to exceed $100kN/m^2$. T width of the friction surfaces is half of the m diameter. Take the coefficient of friction 0. Determine (i) outer and inner diameters of the pl (ii) width of the cone face (iii) the axial force engage the clutch.

b) The coefficient of friction between mating surfaces limit the power lost in friction is kept 0.06. The spe of shaft is 400rpm. For multi collar bearing inter

and external diameters of contacting surfaces are 200mm and 320mm respectively and has to support total axial load of 80KN. Determine power lost in friction and no. of collars to limit intensity of pressure to 350kN/m^2.

4 **Solve any two of the followings.** **12**

a) The following data relate to a cam operating an oscillating roller follower:
Minimum radius of cam =44mm, diameter of roller=14mm, length of the follower arm = 40mm, Distance fulcrum centre =50mm, Angle of ascent=75^0, angle of decent=105^0, angle of dwell for follower in the highest position60^0, angle of oscillation of follower=28^0. Draw the profile of cam if the ascent and decent both takes place with SHM.

b)

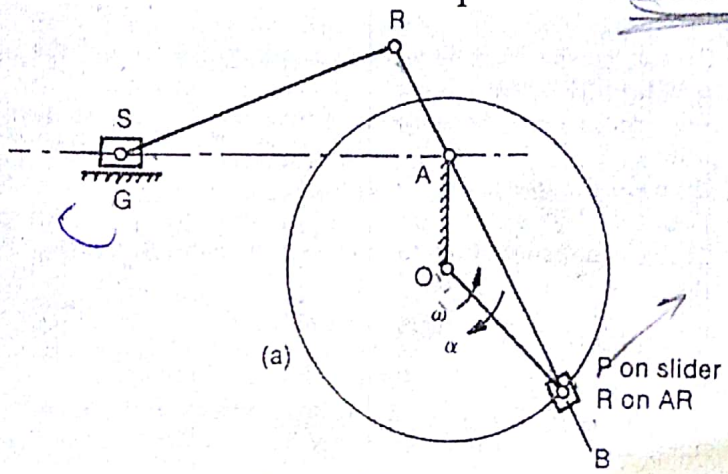


Figure No.(2)

For the mechanism shown in Figure No.(2), when the crank makes $45^0$with vertical ,estimate the velocity of the slider P and the ram S, for clockwise rotation of crank OP at the rate of 2.5rad/sec. by suitable method. Dimensions of Major Links are OP=240mm, OA=150mm, AR=165mm and RS=430mm.

c) For the same data of Q4(b),if the crank OP decelerates at the rate of 20rad/sec2,determine the acceleration of slider S and angular acceleration of link BR.

Contd..

5 a) The centre distance between two meshing spiral gears is260mm and the angle between the shafts 65^0. The normal circular pitch is 14mm and gear ratio 2.5. The driven gear has helix angle of 35^0
Find i) no. of teeth on each wheel,
ii) efficiency of the drive.
assuming the friction angle to be 5.5^0

b)

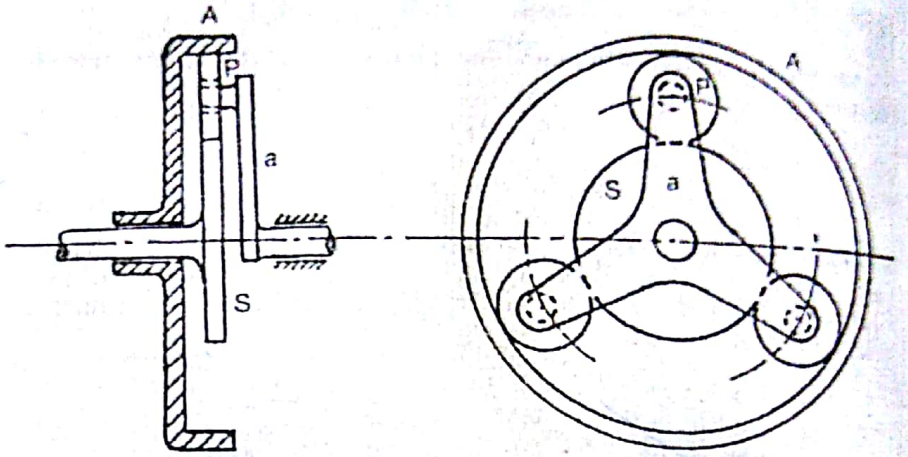
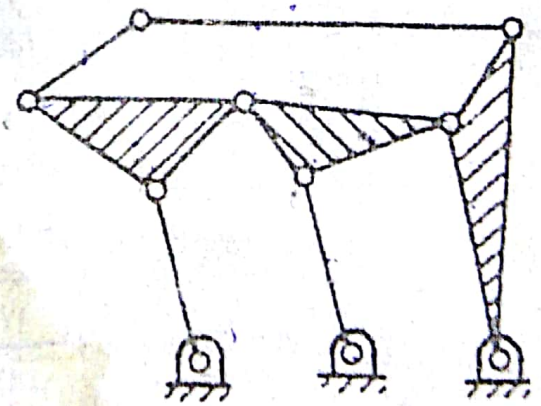


Fig.No.3

An epicyclic train of gears is arranged as shown in Fig.No.3 rotates at 300 rpm about the axis of fixed wheel S which has 80teeth. The three arm spider is driven at 180rpm. Determine the number of teeth required on wheel P.



(b)

Figure No.1

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Summer – 2014

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Course Name: Kinematics of Machines

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Instructions to Candidate

1) All questions are compulsory.
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5) Figures to the right indicate full marks.

1 a i) What is a resistant body? **6**

ii) State the significance of transmission angle in optimization

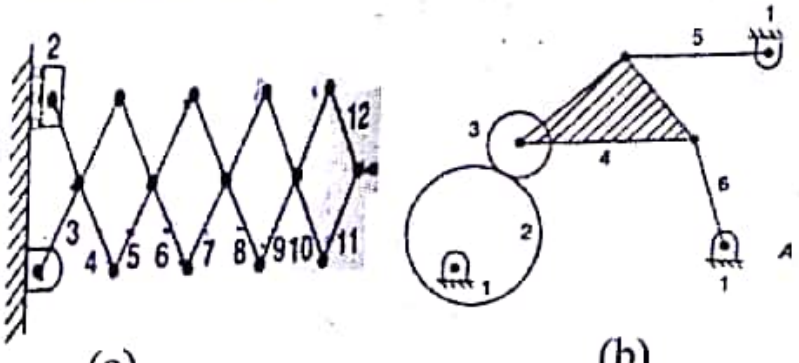
iii) Draw a neat sketch of worm and worm gear.

iv) Define degree of freedom of a Mechanism.

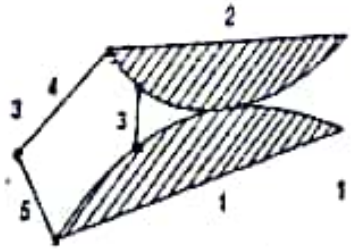
v) State Grasshof's law. How it is useful in linkage design.

vi) State the various types of brakes.

b Calculate the degree of freedom of the mechanism as shown in **fig no 1.** **6**



(a) (b)



(c) Fig no 1

OR

c For the mechanism shown in **fig no 2**,determine w_4 andw_6 6

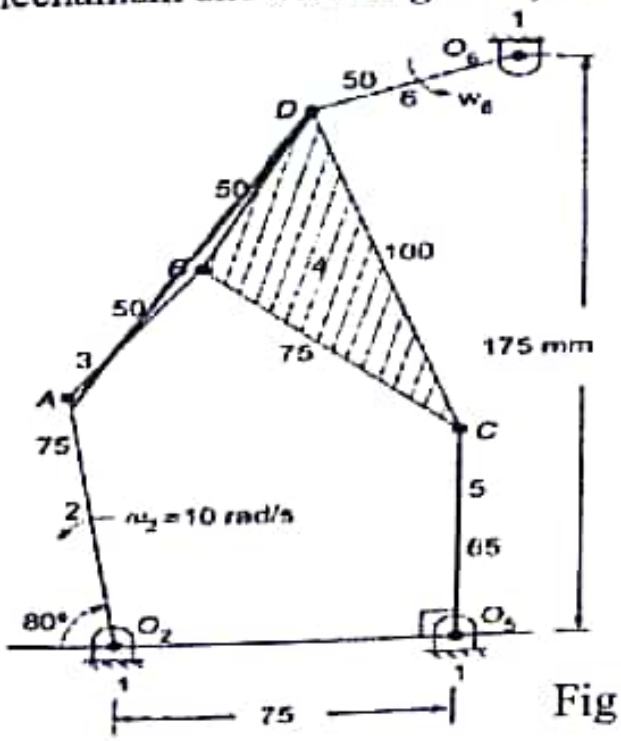


Fig no 2

2 a The crank of an engine 20 cm long and the connecting rod length to crank radius is 4. Determine the acceleration of the piston, the acceleration of a point X on the connecting rod located at its mid-point, and the angular acceleration of the rod, when the crank has turned through 45^0 from the inner dead center position. 6

(a) When the crank rotates at a uniform speed of 240 r.p.m.

(b) When the instantaneous speed of rotation of the crank is 240 r.p.m. clockwise and it is increasing at the rate of 100 rad / sec^2

b Mechanism is shown in fig no 2 roller 4 roll on plane fix surface. Crank 2 rotate in counter clockwise direction such that point B moves uniformly at 50 cm/sec about

fixed centre G. Determine the angular velocity of links 3,4,5,6, (all the dimension are given in meters). 6

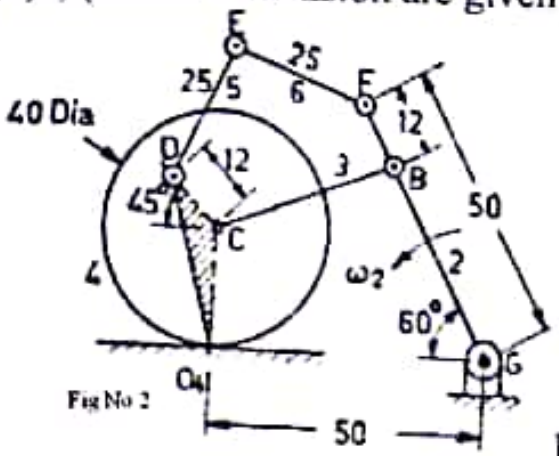


Fig No 2

Fig. No.3

3 Solve any **TWO** of the followings

a A bicycle and rider of mass 120kg are travelling at a speed of 15km/hr on level road. The rider applies brake to rare wheel that is 0.9m in diameter. How far will the bicycle travel before it come to rest? The pressure applied on the brake is 100N and coefficient of friction between the brake and cycle wheel is 0.05. Assume that no other resistance is acting on bicycle 6

b Name type of steering linkage is popularly used for Automobile, Explain its working. Apply the equation for correct steering to it, When it takes the turn. 6

c If an epicyclic gear train , as shown in fig 4 , number of teeth on wheel ~~A~~, B and ~~D~~ C are 50, 25 and 52 resp. If the arm rotate s at 420rpm cw, find (a) speed of wheel C when A is fixed (b) speed of wheel A when C is fixed 6

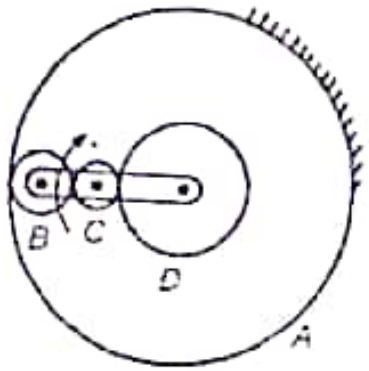


Fig no 4

Contd..

4 Solve any **TWO** of the followings

a Draw the cam profile for data given below: **6**

- Base circle radius of cam = 50mm
- Lift = 40mm
- Angle of ascent = 60^0
- Angle of dwell = 40^0
- Angle of descent = 90^0
- Speed of cam = 300 rpm
- Motion of follower = SHM
- Type of follower = knife-edge

Also calculate the maximum velocity and acceleration during ascent and descent.

b A cam of base circle 50mm is to operate a roller follower of 20mm diameter. The follower is to have SHM. The angular speed of the cam is 360rpm. Draw the cam profile for cam lift of 40mm. Angle of ascent =60^0, angle of dwell=40^0, and angle of descent=90^0, followed by dwell again. Also calculate the maximum velocity and acceleration during ascent and descent. **6**

c Explain with neat sketch working of a centrifugal clutch **6**

5 **a** For a pair of involute spur gears, m=10mm, $\acute{\alpha} = 20^0$, z_1=20, z_2=40, n_1=60rpm. The addendum on each gear is such that the path of approach and path of recess on each side is 50% of maximum possible length. Determine the addendum for the pinion and the gear and the length of arc of contact **6**

b Synthesize a slider crank mechanism for its three positions $\theta_{12} = 60^0$ and $\theta 13 = 100^0$ of the input crank and three positions x_{12} = 2cm and x13 = 5cm of the output slider block. The eccentricity is 2cm. The slider is moving outwards. **6**