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KUMARAGURU college of technology
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B.E DEGREE EXAMINATIONS: MAY 2018

(Regulation 2015)

Fourth Semester

AERONAUTICAL ENGINEERING

U15AET402**:** Mechanics of Machines

COURSE OUTCOMES

CO1: To develop the ability to analyze and understand the dynamic (position, velocity, acceleration, force and torque) characteristics of mechanisms such as linkages and cams.

CO2: Students will be able to solve problems related to clutch and belt drives which works under the principle of friction.

CO3: Students will have very good understanding in topics like gear and gear trains.

CO4: Students will be able to draw cam profiles for different follower motions.

CO5: Appreciate concept of balancing of rotating and reciprocating masses.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Match the following CO1 [K_1]

List I	List II
A. Cam and follower	i. Grubler's rule
B. Screw pair	ii. Grashof's linkage
C. 4-bar mechanism	iii. Pressure angle
D. Degree of freedom of planar mechanism	iv. Single degree of freedom

	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	ii	iv

2. The minimum number of links in a single degree of freedom planar mechanism with both higher and lower kinematic pairs is CO1 [K_1]

a) 2 b) 3

c) 4 d) 5

3. The frictional torque transmitted by a disc or plate clutch is same as that of CO2 [K_1]

(i) Flat pivot bearing
(ii) Flat collar bearing
(iii)Conical pivot bearing
(iv)Trapezoidal pivot bearing

a) (ii) and (iii) only b) (i) and (iv) only

c) (ii) only d) (iii) only

4. The power transmitted by a belt is maximum when the maximum tension in the belt T is equal to — CO2 [K_1]

a) T_c b) $2T_c$

c) $3T_c$ d) $4T_c$

5. A spur gear with pitch circle diameter D has number of teeth T.The module m is defined as — CO3 [K_1]

a) m = T/D b) m = D/T

c) m = D.T d) m = πT/D

6. In a simple gear train ,if the number of idle gears is odd, then the motion of driven gear will — CO3 [K_2]

a) Be opposite as that of driving gear b) Depends upon the number of teeth on the driving gear

c) Depends upon the module d) Be same as that of driving gear

7. Consider the following statements: — CO4 [K_1]

Cam and followers are generally classified according to

1. The nature of its motion
2. The nature of its surface in contact with the cam
3. The speed of the cam

a) 1,2 & 3 b) Only 1 & 2

c) Only 2 & 3 d) Only 1 & 3

8. In a cam drive, it is essential to off-set the axis of a follower to — CO4 [K_2]

a) Decrease the side thrust between follower and guide b) Decrease the wear between follower and cam surface

c) Take care of space limitation d) Reduce the cost

9. Assertion (A): A dynamically balanced system of multiple rotors on a shaft can rotate smoothly at the critical speeds of the system. — CO5 [K_1]

Reason (R): Dynamic balancing eliminates all the unbalanced forces and couples from the system.

a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false d) A is false but R is true

10. Balancing of a rigid rotor can be achieved by appropriately placing balancing weights in — CO5 [K_1]

a) A single plane b) Two planes

c) Three planes d) Four planes

PART B (10 x 2 = 20 Marks)

(Answer not more than 40 words)

11. Differentiate between a machine and a structure. — CO1 [K_2]
12. Define rubbing velocity. What will be the rubbing velocity at a pin joint when the two links move in and opposite directions? — CO1 [K_2]
13. State the laws of dry friction. — CO2 [K_1]
14. What are the functions of clutches? — CO2 [K_1]

15.	List out the applications of epicyclic gear train.	CO3	[K_1]
16.	What is reverted gear train?	CO3	[K_1]
17.	Distinguish between radial and cylindrical cams.	CO4	[K_2]
18.	Define pressure angle of a cam mechanism and state the best value of the pressure angle.	CO4	[K_2]
19.	Write different types of balancing.	CO5	[K_1]
20.	Define hammer blow with respect to locomotives.	CO5	[K_2]

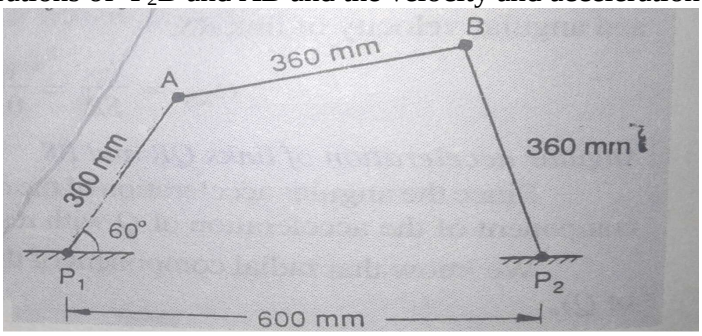
Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

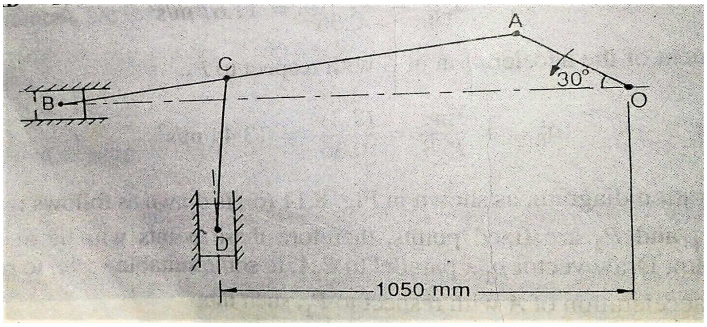
21. The dimensions and configuration of the four bar mechanism shown in figure are as follows CO1 [K_4]

P_1A = 300 mm; P_2B = 360 mm; AB = 360 mm, and P_1P_2 = 600 mm.

The angle AP_1P_2 = 60°.The crank P_1A has an angular velocity of 10 rad/s and an angular acceleration of 30 rad/s^2,both clockwise. Determine the angular velocities and angular accelerations of P_2B and AB and the velocity and acceleration of joint B.



22. In the mechanism ,as shown in figure the crank OA rotates at 20 r.p.m. anticlockwise and gives motion to the sliding blocks B and D.The dimensions of the various links are OA = 300 mm ; AB = 1200 mm ; BC = 450 mm and CD = 450 mm. CO1 [K_4]

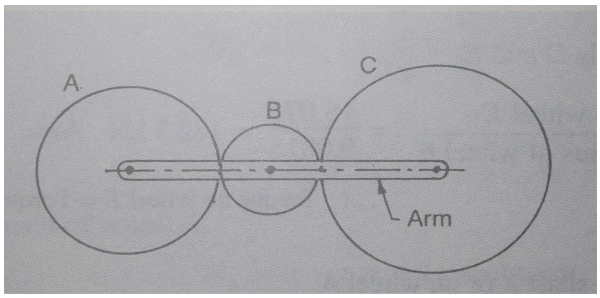


For the given configuration, determine (i) Velocities of sliding at B and D (ii) Angular velocity of CD (iii) linear acceleration of D and (iv) angular acceleration of CD.

23. A single dry plate clutch transmits 7.5 *k*W at 900 r.p.m. The axial pressure is limited to 0.07N/mm^2.If the coefficient of friction is 0.25,find (i) Mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4,and (ii) Outer and inner radii of the clutch plate. CO2 [K_3]

24. An open belt drive connects two parallel shafts 1.2 meters apart. The driving and the driven shafts rotate at 350 r.p.m. and 140 r.p.m respectively and the driven pulley is 400mm in diameter. The belt is 5 mm thick and 80mm wide. The coefficient of friction between the belt and pulley is 0.3 and the maximum permissible tension in the belting is 1.4MN/m². Determine a) diameter of the driving pulley b) maximum power that may be transmitted by the belting, and c) required initial belt tension. CO2 [K_4]

25. In an epicyclic gear train, as shown in figure the number of teeth on wheels A, B and C are 48, 24 and 50 respectively. If the arm rotates at 400 r.p.m. clockwise, find CO3 [K_4]
    (i) Speed of wheel C when A is fixed, and
    (ii) Speed of wheel A when C is fixed



26. A cam with a minimum radius of 50 mm ,rotating clockwise at a uniform speed of 900 r.p.m is required to give a knife edge follower the motion as described below CO4 [K_4]
    a) To move outwards through 40 mm during 100º rotation of the cam
    b) To dwell for next 80º
    c) To return to its starting position during next 90º and
    d) To dwell for the rest period of revolution 90º

    Draw the profile of the cam
    i) When the line of stroke of the follower passes through the centre of the camshaft

    The displacement of the follower is to take place with uniform acceleration and uniform retardation.

27. A rotating shaft carries four masses A, B, C and D which are radially attached to it. The mass centers are 30mm, 38mm, 40mm, and 35mm respectively from the axis of rotation. The masses A, C and D are 7.5kg, 5kg and 4kg respectively. The axial distances between the planes of rotation of A and B is 400mm and between B and C is 500mm.The masses A and C are at right angles to each other.Find for a complete balance, CO5 [K_4]
    (i) The angles between the masses B and D from mass A,
    (ii) The axial distance between the planes of rotation of C and D
    (iii) The magnitude of mass B.

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