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Total Number of Pages : 03

B.Tech

PCME4204

4<sup>th</sup> Semester Back Examination 2018-19  
KINEMATICS AND DYNAMICS OF MACHINES  
BRANCH : AUTO, MECH  
Time : 3 Hours  
Max Marks : 70  
Q.CODE : F847

Answer Question No.1 which is compulsory and any FIVE from the rest.  
The figures in the right hand margin indicate marks.

- Q1** Answer the following questions : (2 x 10)
- a) What do you mean by degree of freedom of a mechanism? Explain Grubler equation for determining degree of freedom of a planar mechanism.
  - b) What do you mean by kinematic chain? Show with the help of suitable sketches the inversion of double slider crank mechanism.
  - c) What do you mean by Instantaneous Centre rotation? State and prove Aronhold-Kennedy Theorem of three centers.
  - d) What is the main limitation of a helical gear? How the limitation can be overcome in herringbone gear?
  - e) When and where the correction couple is applied?
  - f) What is a clutch? What is the functional difference between a brake and a clutch?
  - g) Explain briefly about the terms i) friction circle and ii) friction axis.
  - h) What do you understand by uniform wear theory and name the mechanical components where this theory is used for design.
  - i) Explain with reason the effect of power transmission capacity of a belt drive if flat belt is replaced with V-belt.
  - j) Explain with figure about belt transmission dynamometer.
- Q2**
- a) What do you mean by Coriolis acceleration? Prove that the Coriolis acceleration is  $2\omega v$ . Name any two machines, where you will find the presence of Coriolis component of acceleration. Sketch the kinematic diagram of a windshield wiper mechanism of a passenger car and find the total degrees of freedom. (5)
  - b) Define the following terms i) Coefficient of fluctuation of speed and ii) Coefficient of fluctuation of energy. Explain the procedure to construct turning moment diagram of a four stroke I.C. engine. (5)
- Q3**
- a) What do you understand by dynamical equivalent system? State the important role played by such system for determining the line of action of the inertia force. (5)
  - b) A vertical cylinder petrol engine has a cylinder diameter of 120 mm and stroke 150 mm. The length of the connecting rod between the centers is 250 mm. The mass of the piston is 1.2 kg. The speed of the engine is 1500 rpm. In the expansion stroke with a crank at  $30^\circ$  from top dead center, the gas pressure is  $700 \text{ kN/m}^2$ . Determine the force acting on the connecting rod and the crank effort. (5)

**Q4 a)** A conical pivot supports a load of 22.5 kN. The cone angle being  $120^\circ$ , and the intensity of normal pressure is not to exceed 0.25 MPa. The external diameter is twice the internal diameter. Find the inner radius and outer radius of the bearing surface. If the shaft rotates at 3 rps and the co-efficient of friction is 0.15, find the power lost in friction, assuming uniform wear. **(5)**

**b)** A band and block brake, having 12 blocks each of which subtends an angle of  $12^\circ$  at the centre, is applied to a drum of 1.2 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 1800 Kg and have a combined radius of gyration of 45 cm. The two ends of the band are attached to pins on opposite side of the brake lever at distances of 4 cm and 12 cm from the fulcrum. If a force of 200 N is applied at a distance of 100 cm from fulcrum, find **(5)**

- Maximum braking torque,
- Angular retardation of the block,

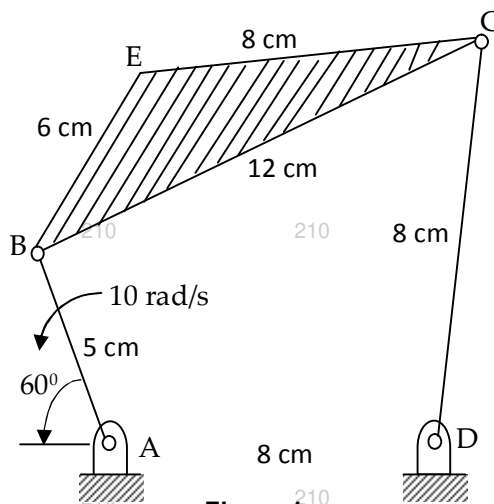
Time taken by the system to come to rest from the rated speed of 360 r.p.m.,  $\mu=0.25$

**Q5 a)** Describe with the help of neat sketch the principles of operation of an internal expanding shoe brake. Derive an expression for the braking torque in terms of applied effort exerted by cam. Neglect the pull on the spring used to keep the brake shoes in position. **(5)**

**b)** A pulley is driven by a flat belt of 120 mm wide and 10 mm thick. The allowable strength of belt material is 2.25 MPa. The density of the belt material is  $1250\text{kg/m}^3$ . The angle of lap is  $120^\circ$  and the coefficient of friction is 0.25. Considering the centrifugal tension, determine the maximum power that can be transmitted by the belt drive. **(5)**

**Q6**

Determine the angular velocities, and angular acceleration of all the members of the linkage shown in 'Figure 1' when link AB is at  $60^\circ$  to the horizontal. Also find the velocity, and acceleration of point E in the coupler member of the linkage. Link AB is driven at a constant angular velocity of 15 rad/sec CCW.



**Figure 1**

**(10)**

Q7

(10)

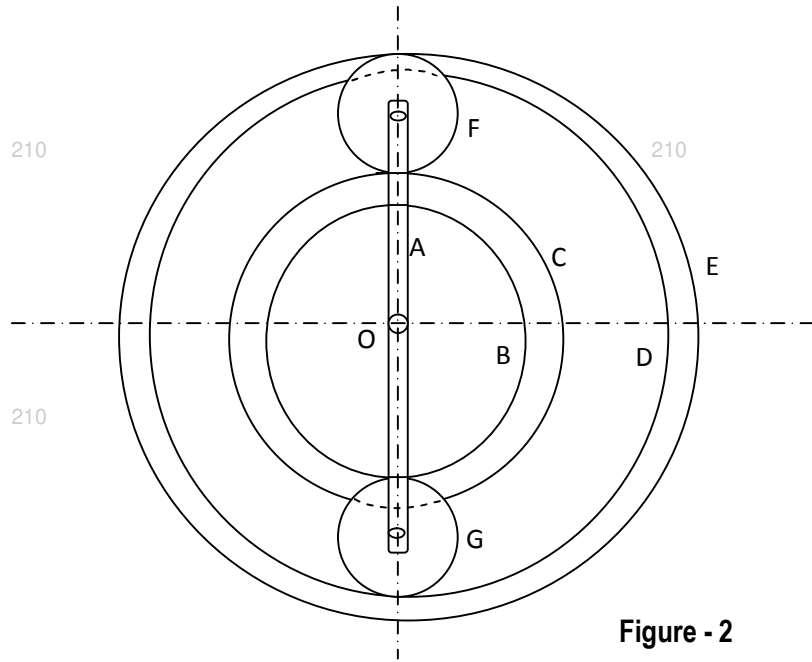


Figure - 2

In the epicyclic gear train as shown in figure 2, the arm A is fixed to the shaft at O. The compound gears B and C as well as internal gears D and E rotates independently about the axis O. The gears F and G rotate on the pins fixed to the arm A. Assume all the gears are of same module. The number of teeth on the gears are

$Z_B = 50$ ,  $Z_C = 54$ ,  $Z_F = 32$  and  $Z_G = 32$  where Z represent number of teeth.

Determine the speed of D if

- The gear E is fixed and arm A rotates at 250 rpm.
- The gear E rotates at 90 rpm in counter clockwise direction and the arm A rotates at 252 rpm in clockwise direction.

Q8 Write short answer on any TWO :

(5 x 2)

- What do you mean by crowning of pulleys in flat belt drive? What is its use? What is the effect of centrifugal tension on power transmission capacity of a belt drive? Differentiate between 'slip' and 'creep' in belt drive.
- What do you mean by crank effort? Derive an expression for crank effort for any given crank position. Why does a cone clutch transmit more power than a plate clutch?
- What is a gear train? Classify them. What do you mean by reverted gear train? In which manner, does epicyclic gear train differ from a compound gear train?