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Total Number of Pages: 03

B.TECH
PME31104

3rd Semester Regular Examination 2016-17
KINEMATICS AND DYNAMICS OF MACHINES

BRANCH: Mechanical

Time: 3 Hours

Max Marks: 100

Q.CODE: Y699

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 Answer the following questions: *multiple type or dash fill up type* (2 x 10)

- a) The number of instantaneous centres for a 8 link kinematic chain is ____
- b) Coriolis acceleration is twice the product of _____
- c) Degree of freedom of a constrained mechanism is _____
- d) In case of pivot bearing, the wear is
 - (i) maximum at the centre (ii) zero at the centre (iii) uniform throughout the contact area (iv) minimum at maximum radius
- e) The surface of the gear tooth below the pitch surface is called _____
- f) The speed ratio of third to first gear in a simple gear train having three gears with 20, 40 and 60 teeth respectively is _____
- g) If P is the piston effort and α is the obliquity angle of the connecting rod in a slider crank mechanism, the expression for thrust in connecting rod is (i) $P/\cos\alpha$ (ii) $P \times \cos\alpha$ (iii) $P \tan\alpha$ (iv) $P/\sin\alpha$.
- h) In a simple band brake, when direction of rotation of drum is changed from counterclockwise direction to clockwise direction, the braking torque
 - (i) remains unchanged (ii) is increased (iii) is decreased (iv) is unpredictable.
- i) For constant velocity ratio with large centre distance, which of the following drives is recommended (i) flat belt (ii) V-belt (iii) Rope (iv) Chain.
- j) The efficiency of screw jack depends on (i) pitch (ii) coefficient of friction (iii) load (iv) all of the above.

Q2 Answer the following questions: *Short answer type* (2 x 10)

- a) What do you mean by kinematic chain? What conditions are required to be satisfied by a kinematic chain to give constrained motion?
- b) Using Chebychev spacing (three precision positions) find graphically the values of x and y to synthesize the function generator $y = x^{1.8}$ over the range $1 \leq x \leq 3$.
- c) Derive Grübler's equation for determining degree of freedom of a planner mechanism.
- d) What do you mean by Instantaneous Centre rotation? State and prove Aronhold-Kennedy Theorem of three centers.

- e) Write Freudenstin's equation and explain its signification with respect to analysis of four bar mechanism.
- f) What do you mean by kinematic chain? State Grashof condition for four bar chain.
- g) How epicyclic gear train differ from a compound gear train?
- h) What is a clutch? Describe the working principle of single plate clutch?
- i) What is the difference between simple band brake and differential band brake?
- j) What do you mean by dynamical equivalent system?

Part – B (Answer any four questions)

Q3 a) Determine the angular velocities, and angular acceleration of all the members of the linkage shown in Figure 3.1 when link AB is at 60° 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 10 rad/sec CCW. **(10)**

Figure 3.1

- b) What do you mean by Coriolis acceleration? Show that the Coriolis acceleration is $2\omega v$. Name any one machine, where you will find the presence of Coriolis acceleration. **(5)**
- Q4 a)** Derive an expression for the frictional torque for flat collar bearing assuming uniform pressure theory. **(5)**
- b) A conical pivot supports a load of 12.5 kN. The cone angle being 120° , 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. **(10)**
- Q5** A four bar chain is to be designed to generate the function $y = e^x$ in the interval $1 \leq x \leq 10$. Synthesise the four bar chain using three accuracy points. The largest link of the chain is 125 cm. The range of the angles for input link (θ) and output link (ϕ) are $45^\circ \leq \theta \leq 180^\circ$ and $45^\circ \leq \phi \leq 125^\circ$ respectively. **(15)**
- Q6 a)** What is the functional difference between a brake and a dynamometer? **(2)**
- b) Describe with the help of neat sketch the principles of operation of an internal expanding shoe brake. **(8)**
- c) Explain with figure about rope brake dynamometer. **(5)**

- Q7 a)** A multi-plate friction clutch has to be designed to transmit 80 kW from an engine rotating at 1500 rev/min. The inner and outer diameters are respectively 125 mm and 168 mm, the pressure is to be assumed uniform at 125 kN/m^2 and $\mu = 0.2$. Determine the necessary end thrust and the number of clutch plates required. **(10)**

If this clutch is then used to transmit power from a larger engine to a rotor which has a mass of 1150 kg and a radius of gyration of 200 mm, determine the time required for this rotor to reach 1200 rev/min from standstill, assuming that the clutch is transmitting the maximum possible torque.

- b)** Explain the terms i) friction circle and ii) friction axis. Derive an expression for its friction circle radius. **(5)**

- Q8 a)** **(10)**

In an epicyclic gear train as shown in Figure 8.1, the arm A is fixed to the shaft S. The gear B having 80 teeth rotates freely on the shaft S and gear D with 120 teeth is separately driven. If the arm A runs at 100 rpm and gear D at 50 rpm in same direction, find

- i) Number of teeth on wheel 'C' ii) Speed of gear 'B'.

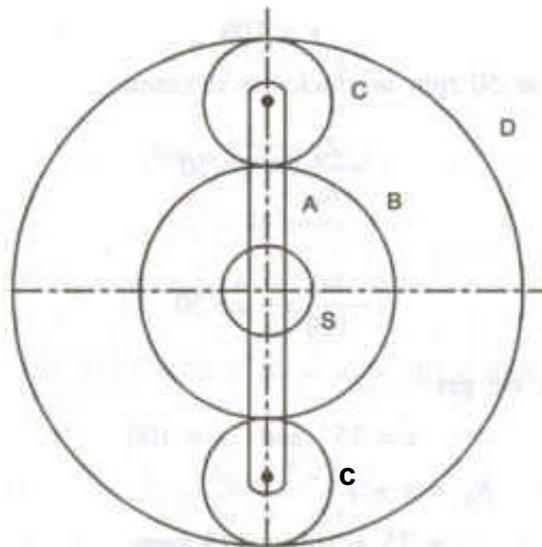


Figure 8.1

- b)** What is by crank effort? Derive an expression for crank effort for any given crank position. **(5)**

- Q9 a)** A flat belt having 125 mm wide and 12 mm thick runs between two pulleys. The allowable strength of belt material is 2.5 MPa. The density of the belt material is 1000 kg/m^3 . The angle of lap is 120° and the coefficient of friction is 0.25. Determine the maximum power that can be transmitted and the corresponding speed of the belt drive. **(10)**

- b)** Distinguish between 'slip' and 'creep' in belt drive. What is the effect of centrifugal tension on power transmission capacity of a belt drive? **(5)**