Registration No : | | | | | | | | | | |

Total Number of Pages : 03 **B.Tech**
PME3I104

3rd Semester Back Examination 2019-20
KINEMATICS & DYNAMICS OF MACHINES
BRANCH : MECH
Max Marks : 100
Time : 3 Hours
Q.CODE : HB689

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(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 mechanism.
b) What do you mean by kinematic chain? State Grashof condition for four bar chain.
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 rope brake dynamometer.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) A mechanism is to be designed to generate the function using three precision positions find graphically the values of x and y to analyze the function generator y = log x over the range $1 \leq x \leq 10$.
b) 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.
c) 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.
d) 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.
e) What do you mean by crank effort? Derive an expression for crank effort for any given

crank position.

f) 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?

g) 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?

h) 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 30^0 from top dead center, the gas pressure is 700 kN/m^2. Determine the force acting on the connecting rod and the crank effort.

i) A conical pivot supports a load of 22.5 kN. The cone angle being 120^0, 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.

j) A band and block brake, having 12 blocks each of which subtends an angle of 12^0 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

i) Maximum braking torque,

ii) Angular retardation of the block,

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

k) 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.

l) 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 1250kg/m^3. The angle of lap is 120^0 and the coefficient of friction is 0.25. Considering the centrifugal tension, determine the maximum power that can be transmitted by the belt drive.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Determine graphically the angular positions, and angular velocities of all the members of the linkage shown in Figure 1 when link AB is at 60^0 to the horizontal. Link AB is driven at a constant angular velocity of 10 rad/sec CCW direction. Also find the velocity of the joint E on the link BC when BE = 4.5 cm.x **(16)**

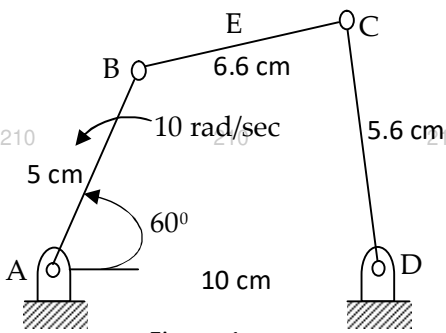


Figure 1

Q4 A four bar chain is to be designed to generate $y = e^x$ in the interval 0 ≤ x ≤ 10. Synthesise the four bar chain. The largest link of the chain is 100 cm. The range of the angles for input link (θ) and output link (φ) are $45^0 \le \theta \le 180^0$ and $145^0 \le \varphi \le 225^0$ respectively. **(16)**

Q5 In a slider crank mechanism, the crank radius: 75 mm and length of the connecting rod 275 mm. When the crank rotates at 2250 rpm in clockwise direction and has travelled 65^0 from dead center, Determine analytically; **(16)**

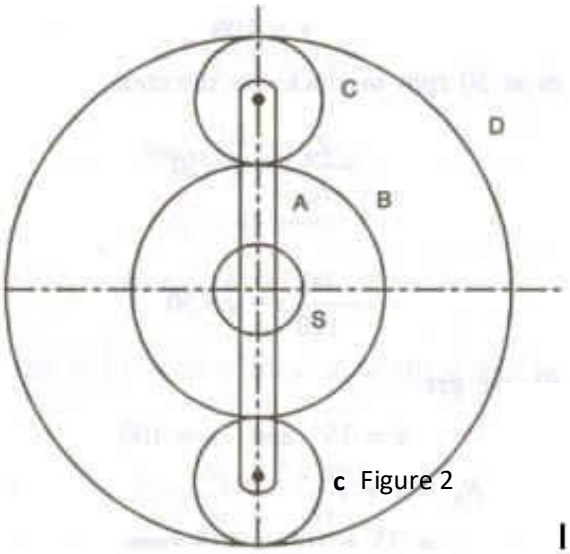
i) Velocity and acceleration of the piston and

ii) Angular Velocity and angualr acceleration of the connecting rod.

Q6 **(16)**

In an epicyclic gear train as shown in Figure 2, 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'.



c Figure 2