2063
B. Engg. (Mechanical Engg.)
3rd Semester
MEC-303: Kinematics of Machines

Time allowed: 3 Hours   Max. Marks: 50

NOTE: Attempt _five_ questions in all, including Q. No. I which is compulsory and selecting two questions from each Part.

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Q1. (a) Briefly discuss three types of Constrained Motions in mechanisms.

(b) Differentiate between absorption and transmission dynamometers. Give examples.

(c) Define pitch of chain. How pitch is related to pitch circle diameter of chain?

(d) Derive a relation between initial tension, tension on tight side & tension on slack side in belts.

(e) Define the terms Sensitiveness and isochronism in governors.   (2×5=10 Marks)

Part-A

Q2. (a) Determine the Degree of freedom of following mechanisms: (2 Marks)
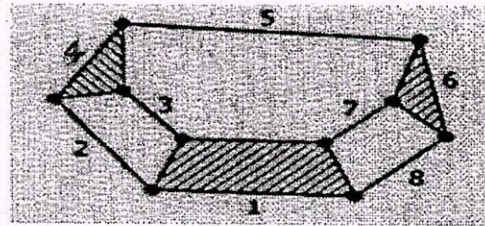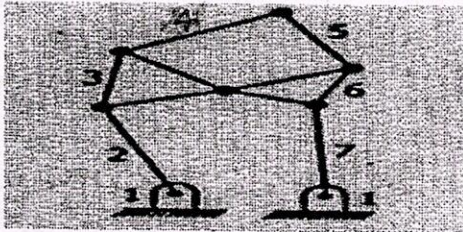
(b) The dimensions and configuration of 4-bar mechanism, shown in Figure below, are as follows: P1 A = 300 mm; P_2B = 360 mm; AB = 360 mm, and P_1P_2 = 600 mm. The angle AP_1P_2 = 60°. The crank P_1A has an angular velocity of 10 rad/s and an angular acceleration of 30 rad/s², both clockwise. Determine the angular velocities and angular accelerations of P_2B, and AB and the velocity and acceleration of the joint B.   (8 Marks)
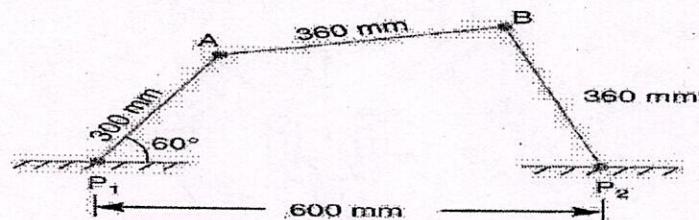
Q3 (a) State Grashof's law. What are class I and Class II mechanisms?   (2 Marks)

(b) Define synthesis in mechanism and briefly discuss various types of synthesis.   (3 Marks)

(c) Using two position synthesis, design a four-bar mechanism so that θ_{12} =45° and $\emptyset_{12}$ = 55°. Both input and output cranks should move in clockwise direction.   (5 Marks)

Q4. (a) Define the terms: coefficient of fluctuation of speed and coefficient of fluctuation of energy used in flywheel.   (2 Marks)

(b) An otto cycle engine develops 50 kW at 150 RPM with 75 explosions per minute. The change of speed from the commencement to the end of power stroke must not exceed 0.5% of mean on either side. Find the mean diameter of the flywheel and a suitable rim cross-section having width four times

the depth so that the hoop stress does not exceed 4 MPa. Assume that the flywheel stores 16/15 times the energy stored by the rim and the work done during power stroke is 1.40 times the work done during the cycle. Density of rim material is 7200 kg/m³.

(8 Marks)

Part-B

Q5. (a) Sketch a Hartnell governor. Deduce a relation to find stiffness of Spring. (5 Marks)

(b) A Proell type governor has each arm 250 mm long. The pivots of the upper and lower arms are 25 mm from the axis. The central load acting on the sleeve has a mass of 25 kg and each rotating ball has a mass of 3.2 kg. When the governor sleeve is in mid-position, the extension link of the lower arm is vertical and the radius of the path of rotation of the masses is 175 mm. The vertical height of the governor is 200 mm. If the governor speed is 160 r.p.m. when in mid-position, Determine: 1. length of the extension link; and 2. tension in the upper arm.

(5 Marks)

Q6. (a) Define centrifugal tension. Derive the condition for maximum power transmission from belt drive.

(5 Marks)

(b) Determine the maximum power transmitted by a V-belt drive having the included groove angle of 35⁰. The belt used is 18 mm deep with 18 mm maximum width and weighs 300 gram per meter length. The angle of lap is 145⁰ and maximum permissible stress is 1.5 N/mm². Take coefficient of friction as 0.2.

(5 Marks)

Q7. (a) For the brake shown in the figure below, the diameter of brake drum is 400 mm and the angle of contact is 96⁰. The applied force is 3 KN on each arm and coefficient of friction between the drum and the lining is 0.35. Determine the maximum torque transmitted by the brake. (5 Marks)
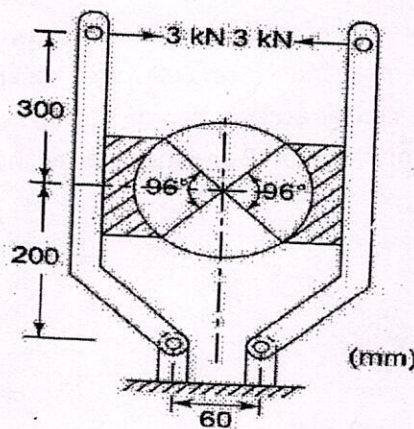
(b) A single plate clutch transmits 25 KW at 900 rpm. The maximum pressure intensity between the plates is 85 KN/m². The outer diameter of the plate is 360 mm. Both the sides of plate are effective and the coefficient of friction is 0.25. Determine (a) Inner Diameter of Plate (b) Axial Force to engage the given clutch.

(5 Marks)

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