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B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: V**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 20AE5DCMAM **Max Marks: 100**
Course: MACHINES AND MECHANISMS **Date: 27.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) Explain the following with respect to mechanism. **10**
   i. Mobility
   ii. Kinematic diagram
   iii. Degree of freedom
   iv. Inversions.

   b) Explain the whit worth quick-return mechanisms with neat sketch. **10**

UNIT - II

2. a) In a four link mechanism, the dimensions of the links are as under: AB=50mm, BC=66mm, CD=56mm and AD=100mm. At the instant when $\angle DAB=60^0$, the link AB has an angular velocity of 10.5 rad/s in the counter-clockwise direction. Determine the **12**
   i) Velocity of the point C
   ii) Velocity of the point E on the link BC when BE=40mm
   iii) Angular velocities of the links BC and CD
   iv) Velocity of an offset point F on the link BC if BF=45mm, CF=30mm and BCF is read clockwise
   v) Velocity of rubbing at pins A, B, C and D. When the radii of the pins are 30, 40, 25 and 35mm respectively.

   b) What is Instantaneous center of rotation? How do you know the number of instantaneous center in a mechanism? **8**

UNIT - III

3. a) The crank of a slider crank mechanism rotates clockwise at a constant speed of 300 rpm. The crank is 150 mm and the connecting rod is 600 mm long. Determine: a) Linear velocity and acceleration of the midpoint of the **12**

connecting rod, b) angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead center position.

b) What are velocity and acceleration images? State why they are known as a helpful devices in the analysis of complicated linkages. **8**

OR

4. a) What is the Coriolis acceleration component? In which cases does it occur? How it is determined? **8**

b) PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ= 62.5 mm; QR =175 mm; RS = 112.5 mm ; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS. **12**

UNIT - IV

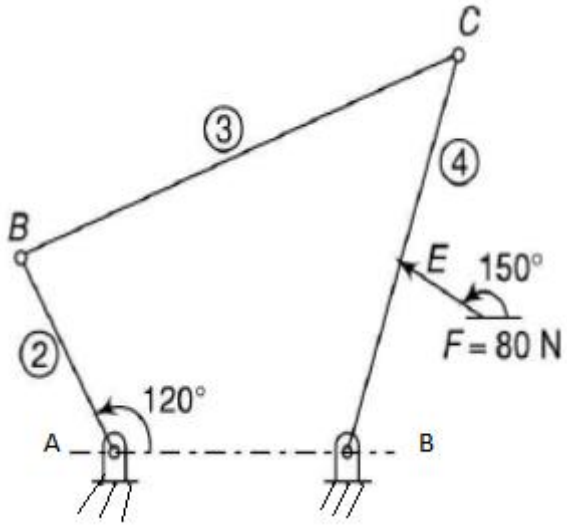
5. a) In an epicyclic gear train, the internal wheels A and B and compound wheels C and D rotate independently about axis O. The wheels E and F rotate on pins fixed to the arm G. E gears with A and C and F gears with B and D. All the wheels have the same module and the number of teeth are T_C= 28; T_D= 26; T_E= T_F= 18. (i). Sketch the arrangement; (ii). Find the number of teeth on A and B; (iii). If the arm G makes 100 r.p.m. clockwise and A is fixed, find the speed of B. **10**

b) Explain in what way the gyroscopic couple affects the motion of an aircraft while taking a turn with neat sketches. **10**

UNIT - V

6. a) What are the conditions for a body to be in equilibrium under the action of two forces, three forces and two forces and a torque. **8**

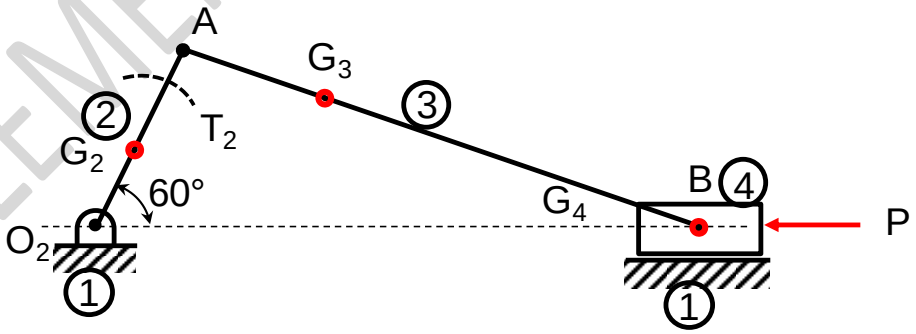
b) A four link mechanism with the following dimensions is acted upon by a force $80\angle 150^0$ N on link DC as shown in figure below. AD=500 mm, AB=400 mm, BC=1000 mm, DC=750 mm, DE=350 mm. Determine the input torque T on the link AB for the static equilibrium of the mechanism for the given configuration. **12**



OR

7. a) Write a note on sources forces in a machinery and different methods to analyze the forces in mechanisms. **6**

b) A horizontal reciprocating engine mechanism as shown below with crank length 7.5 cm is rotating clockwise at constant speed and connecting rod has length 28 cm. Determine magnitude and direction of all inertia forces for a configuration that has turned 60° from horizontal from line of stroke. CG of links 2 and 3 are located on the links at a distance i.e. and are 5 and 12 cm respectively. The mass of links 2, 3 and 4 are 2.5, 4 and 3 kg respectively and mass moment of inertia of link 2 and 3 are 60 and 500 kg-cm^2 respectively. Determine T_2 to keep the body in equilibrium under the combined effect of gas force P = 2kN along with inertia forces. **14**



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