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

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E.   Semester: V
Branch: Aerospace Engineering   Duration: 3 hrs.
Course Code: 20AE5DCMAM   Max Marks: 100
Course: Machines and Mechanisms   Date: 07.03.2023

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 Grashoff's condition for a Quadratic chain with neat diagram. **8**

   b) Imagine that you are designing a machine for crushing of stones in a quarry. With a neat sketch, explain the working of a basic mechanism required for the same. **6**

   c) Differentiate between Machine and a Mechanism. What do you mean by inversion of a mechanism? **6**

UNIT - II

2 a) State and prove Kennedy's theorem. **6**

   b) A pin jointed 4-bar linkage shown in Fig. 2b, is having dimensions AB = 0.5m, BC = 3m, DC = 1.5m, AD = 3.5m and BE = 2.25m. The link AB revolves at 20 rpm and angle BAD = 60˚. Find; (i) angular velocities of links CD&BC and (ii) Linear velocity of point E. **14**
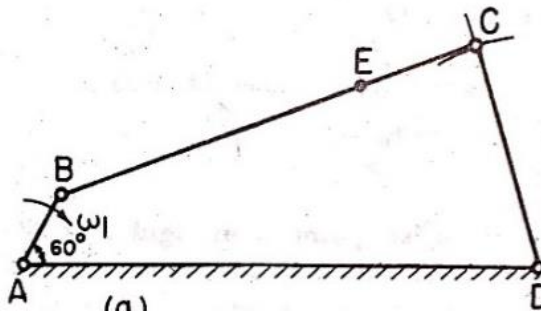

Fig. 2b

UNIT - III

3 a) Fig 3(a) shows the configuration OCPAQE of a mechanism. Find the angular acceleration of links CP, PA and AQ when the crank OC rotates uniformly at 120rpm in anticlockwise direction. The bell crank lever AQE is rocked about the fixed Centre Q by the link PA. Path of Point P is 25 mm vertically below **14**

point O. Also, OC = 125 mm, CP = 500 mm, PA = 125 mm, AQ = 250 mm, QE = 125 mm and Angle POC = 45°.
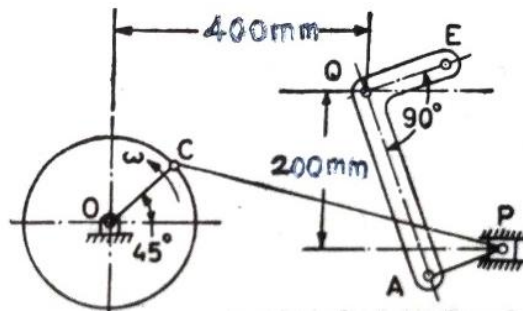

Fig. 3a

b) Derive an expression for Coriolis acceleration. **6**

OR

4   The following data refer to a quick return motion mechanism of crank and slotted lever type as shown in Fig. 4a. The dimensions are; Fixed link OA=250 mm, Crank AB=100 mm, Slotted lever OC=400 mm, CD=150 mm and Angle OAB=120°. Uniform speed of crank in clockwise direction is 1rps. The vertical distance of line of stroke of ram at D from O is 450 mm. Determine acceleration of ram at D and coriolis acceleration of slider at B. **20**
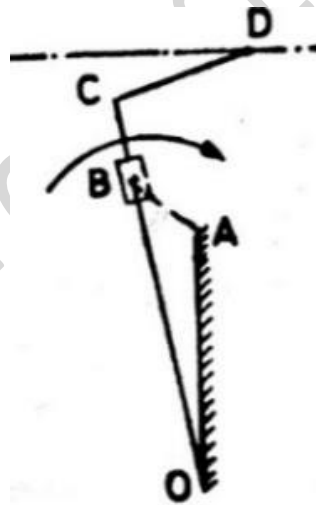

Fig. 4a

UNIT - IV

5   a) An aeroplane makes a complete half circle of 50 m radius towards left when flying at 200 kmph. The rotary engine and the propeller of the plane have a mass of 400 kg with a radius of gyration of 300 mm. The engine revolves at 2400 rpm clockwise viewing from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. What will be the effect if the aeroplane turns to right instead of to the left? **10**

  b) An epicyclic gear train consists of an arm and two gears A and B having 30 and 40 teeth respectively. The arm rotates about the centre of the gear A at a speed of 80 rpm counterclockwise. Determine the speed of gear B if (i) the gear A is fixed and (ii) the gear A revolves at 240 rpm clockwise instead of being fixed. **10**

6   a)   Explain how static force analysis is done on a slider crank mechanism.   **8**

b)   Determine T_2 for the static equilibrium of the mechanism shown in Fig. 6a, given; OA = 250 mm and AB = 650 mm.   **12**
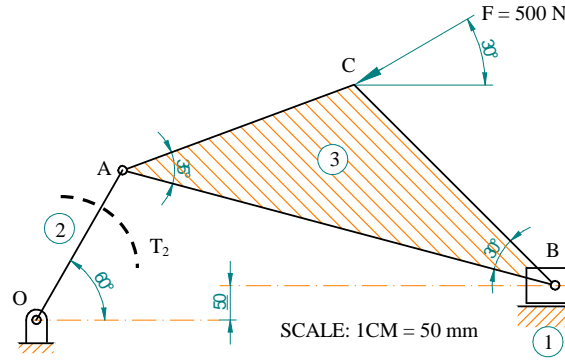

Fig. 6a

OR

7   a)   List the steps involved in performing dynamic analysis of four link mechanisms.   **6**

b)   A horizontal reciprocating engine mechanism as shown in Fig. 7b with crank O_2A length 7.5 cm is rotating clockwise at a constant speed of 2000 rpm and connecting rod AB has a length of 28 cm. Determine the magnitude and direction of all inertia forces for a configuration that has turned 60° from horizontal from the line of stroke. CG of links 2 and 3 are located on the links at a distance i.e. O_2G_2 and AG_3 are 5 and 12 cm respectively. The mass of links 2, 3, and 4 are 2.5, 4, and 3 kg respectively and the mass moment of inertia of links 2 and 3 are 60 and 500 kg-cm2 respectively.   **14**
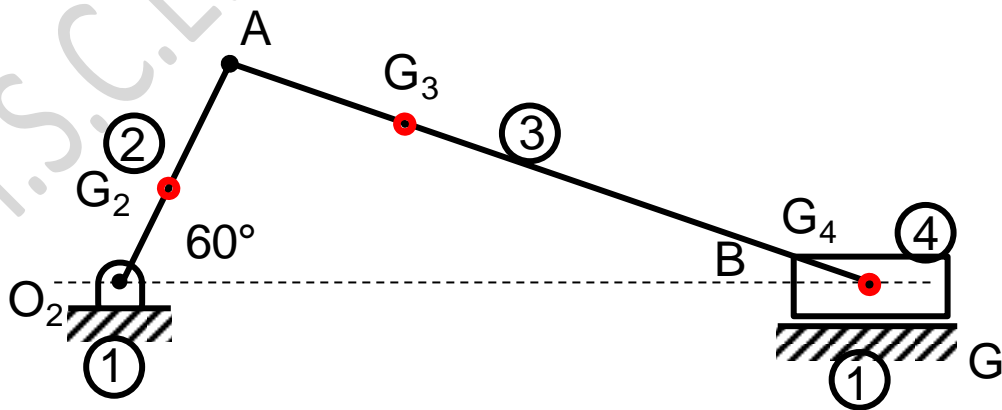

Fig.7b

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