THE UNIVERSITY OF ADELAIDE
DEPARTMENT OF MECHANICAL ENGINEERING

EXAMINATION FOR THE DEGREE OF B.E.

4103: MACHINE DYNAMICS

NOVEMBER, 2000

TIME: 3 HOURS

[In addition, candidates are allowed ten minutes before the exam begins to read the paper.]

[The use of notes, textbooks and calculating devices is permitted in the examination room.]

Attempt **ALL FOUR** questions.

1.

a) Determine the relation between cam angles β_1, β_2 and lifts L_1, L_2 to match a harmonic curve H-2 to an eighth-power polynomial curve P-2.

[10 marks]

b) If the total rise of 20 mm during the H-2 motion occurs over 60 degrees of cam rotation, determine the cam rotation required for the fall during the P-2 motion to be 10 mm.

[5 marks]

c) Figure 1 shows a configuration of four equal masses on a shaft. Find the magnitude and angle, relative to mass 1, of the masses required in planes X and Y to achieve balance. Assume all masses are at the same radius.

[10 marks]

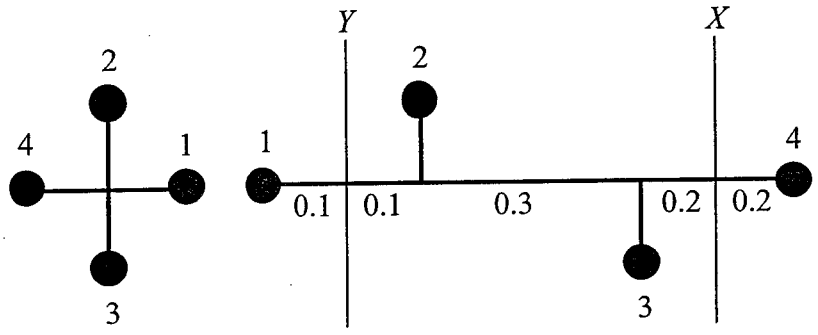

Figure 1

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2.

a) In the planetary gear train shown in Figure 2, determine the angular velocity ratio ω_2/ω_7.

[20 marks]

b) Determine the input to output angular velocity ratio if the arm 4 is connected directly to the output shaft and gears 5, 6, and 7 are omitted.

[5 marks]

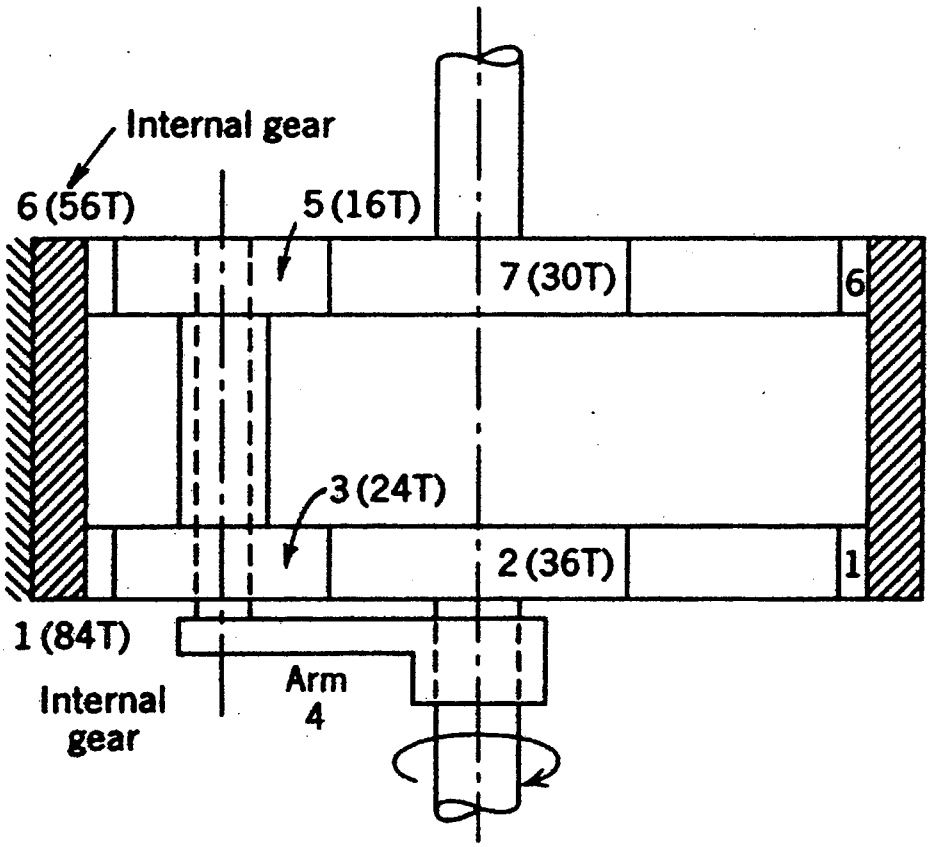

Figure 2

3. For the mechanism shown in Figure 3, assume that link 4 rolls on the frame (link 1) without sliding. You may also assume that Figure 3 is a scale drawing of the mechanism. If link 2 is rotating clockwise with a constant angular velocity of 10 rad/s, determine:

   a) The angular velocity of links 3 and 4.

   [5 marks]

   b) The velocity of point E.

   [3 marks]

   c) The angular acceleration of links 3 and 4.

   [12 marks]

   d) The acceleration of point E.

   [5 marks]

   Compute the quantities graphically, and properly label all terms.

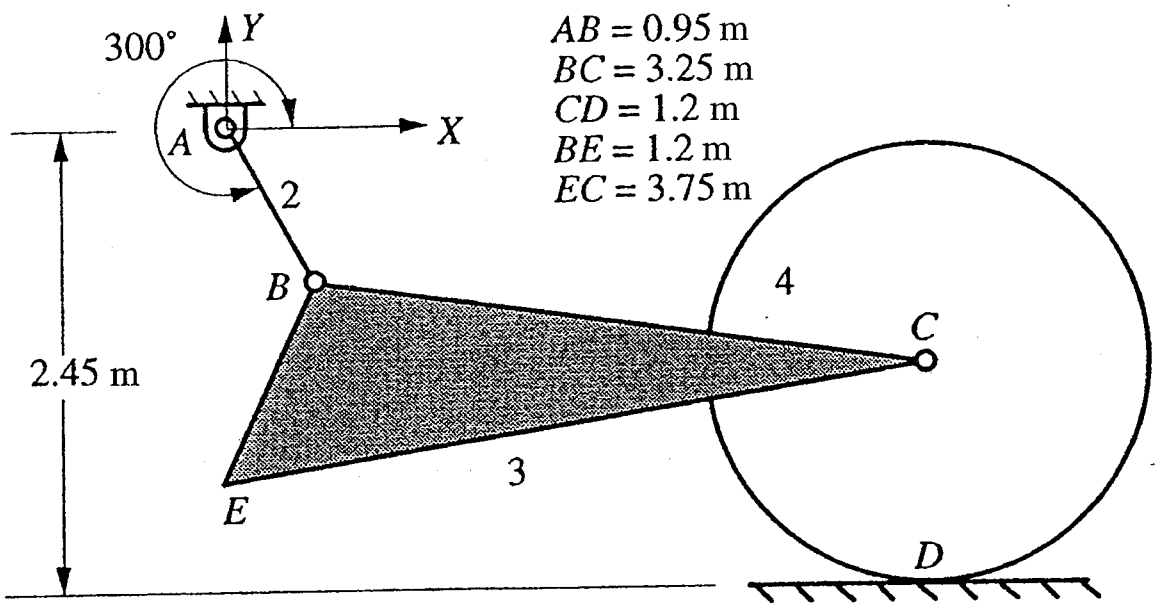

Figure 3

4. Find the external torque T_{12} that must be applied to link 2 of the mechanism shown in Figure 4 to drive it at ω_2 =1,800 rad/s anticlockwise and $\alpha_2 = 0$ rad/s^2. Link 2 is in a horizontal position, and it is balanced so that its centre of mass G_2 is at the pivot O_2. The mechanism moves in the horizontal plane, and friction may be neglected. You may assume that Figure 4 is a scale diagram of the mechanism. Compute the quantities graphically, and properly label all terms.

[25 marks]

$m_3 = 0.32$ kg, $m_4 = 0.35$ kg, $I_3 = 1.75\times10^{-3}$ kg.m^2, $I_4 = 1.25\times10^{-3}$ kg.m^2

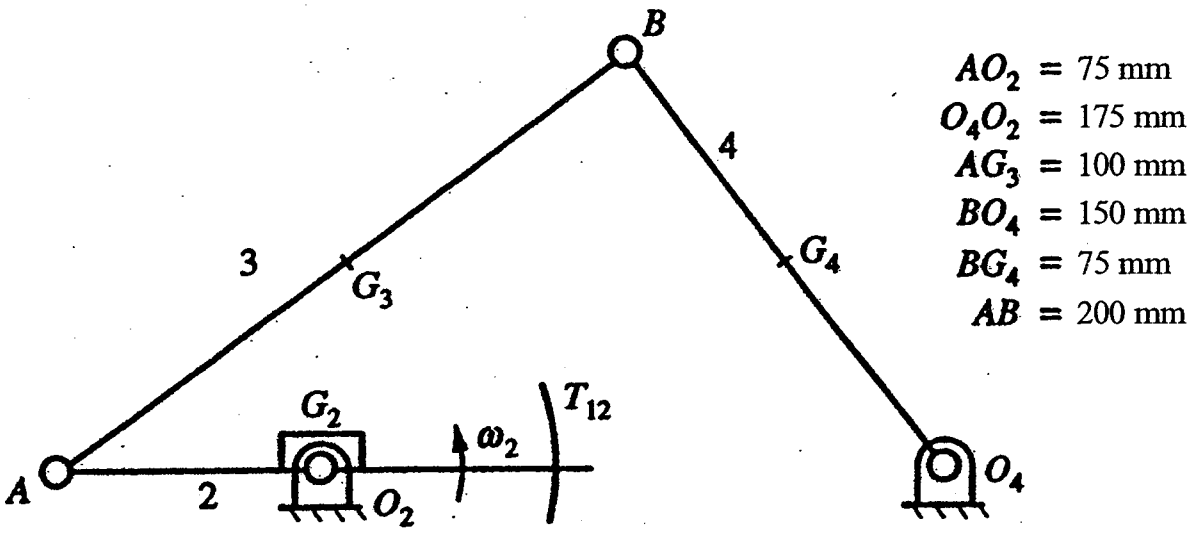

Figure 4