THE UNIVERSITY OF ADELAIDE
DEPARTMENT OF MECHANICAL ENGINEERING

EXAMINATION FOR THE DEGREE OF B.E.

4103: MACHINE DYNAMICS

NOVEMBER, 2001

TIME: 3 HOURS & 10 MINUTES

[Students are advised to devote 10 minutes to reading the paper and planning their approach.]

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

Attempt **ALL FOUR** questions [Total: 100 marks].

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1. For the four-bar linkage shown in Figure 1, assume that the angular velocity of link 2 is 50 rad/s clockwise and that the angular acceleration of link 2 is 1600 rad/s^2 clockwise.

   Assuming that the mechanism is exactly to scale, construct the velocity and acceleration polygons and compute the following graphically:

   a) the velocity of point *B* [1 mark]
   b) the velocity of point *C* [2 marks]
   c) the velocity of point *E* [3 marks]
   d) the angular velocity of link 3 [2 marks]
   e) the angular velocity of link 4 [2 marks]
   f) the angular acceleration of link 3 [5 marks]
   g) the angular acceleration of link 4 [5 marks]
   h) the acceleration of point *E* [5 marks]

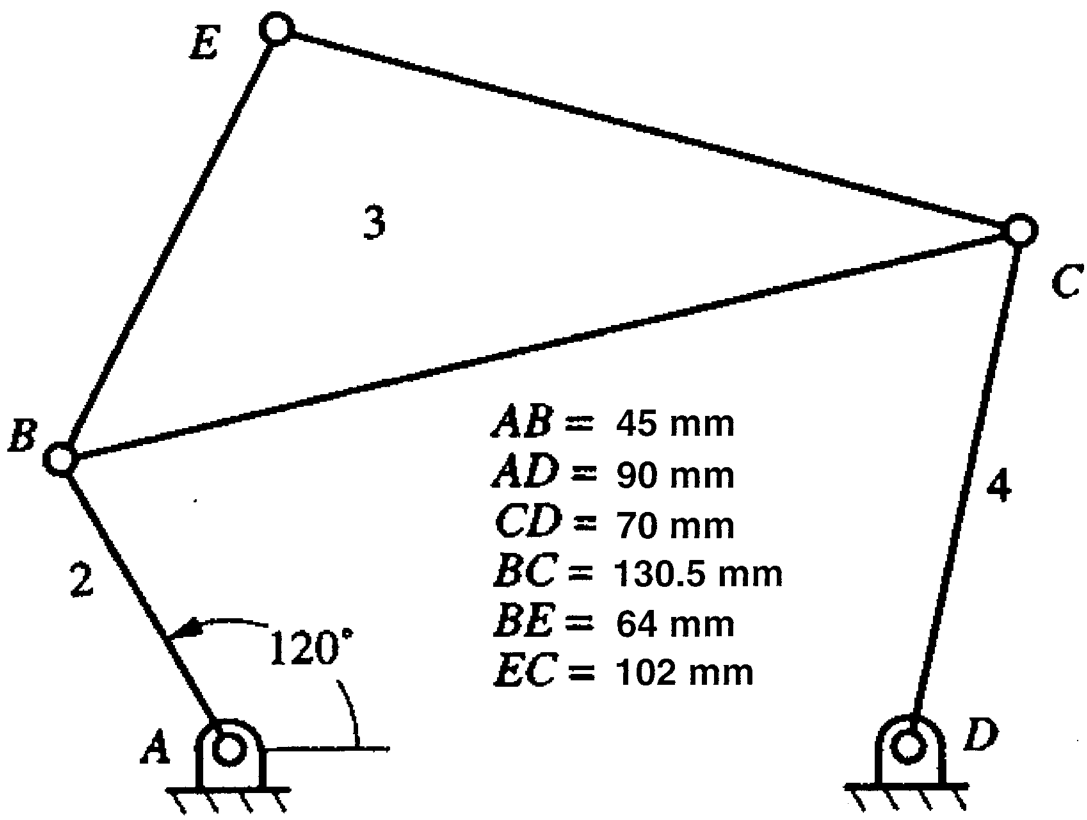

Figure 1

2. A mechanism is shown in Figure 2. For one revolution of the arm in the direction shown, find the number of revolutions of gears 3, 4 and 5 and their directions of rotation. The gears are non-standard. The number of teeth on each gear is indicated in brackets.

[15 marks]

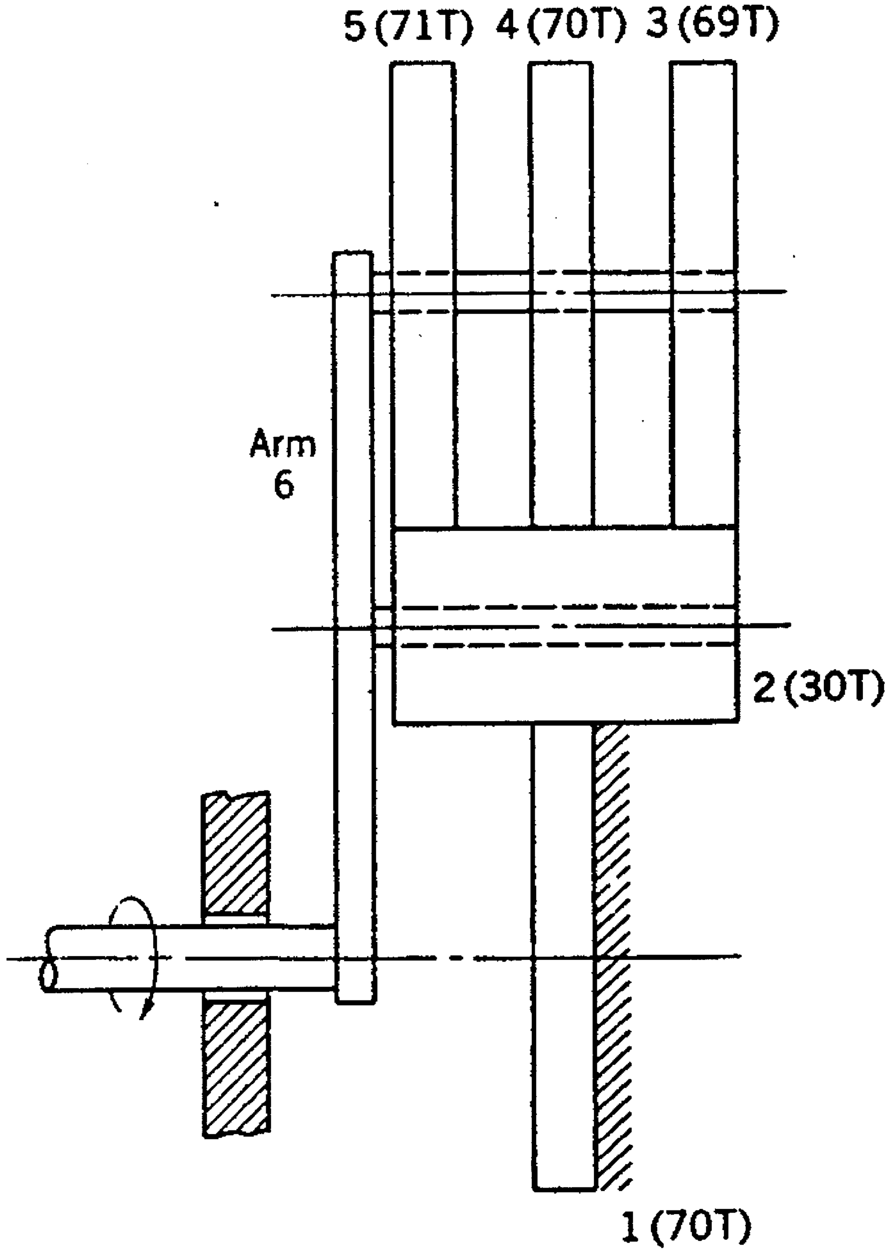

Figure 2

3. For the rigid rotor of Figure 3 shown with two masses m_1 and m_2, determine the masses m_A and m_B in planes *A-A* and *B-B*, respectively, which put the rotor in dynamic balance for a rotor speed of 500 rpm.

[15 marks]

Determine also the angular positions of the balancing masses.

[10 marks]

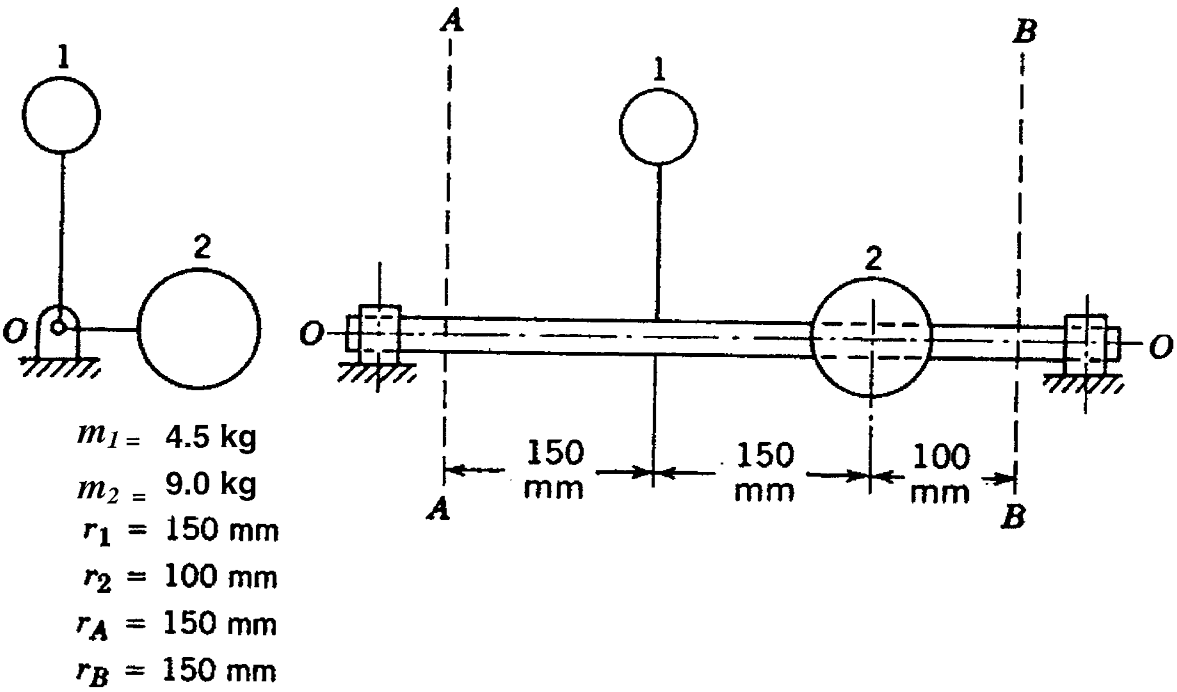

Figure 3

4. In the mechanism shown in Figure 4, link 2 rotates at an angular velocity of 20 rad/s clockwise and angular acceleration of 140 rad/s^2 clockwise. Using a graphical solution, find the torque which must be applied to link 2 to maintain equilibrium. Link 2 is balanced so that its centre of mass is at the pivot point O_2. The centre of mass of link 3 is at A. The mechanism moves in the horizontal plane. Friction may be neglected.

   Assume that the mechanism is drawn to scale.

[35 marks]

$O_2A = CA = 100$ mm $\quad m_3 = 0.74$ kg $\quad I_{G2} = .00205$ kg-s^2-m

$m_4 = 0.32$ kg $\quad I_{G3} = .0062$ kg-s^2-m

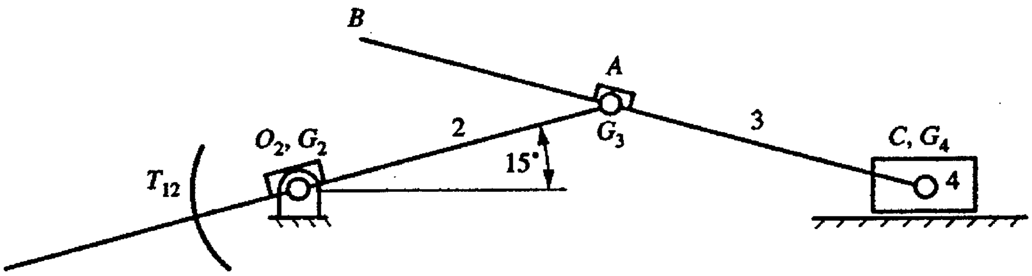

Figure 4