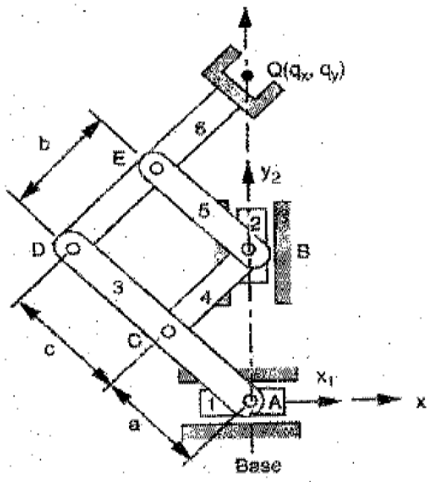
Kafrelsheikh University
Faculty of Engineering
Dept. of Mech. Engineering
Year: second Year
Subject: Theory of Machines

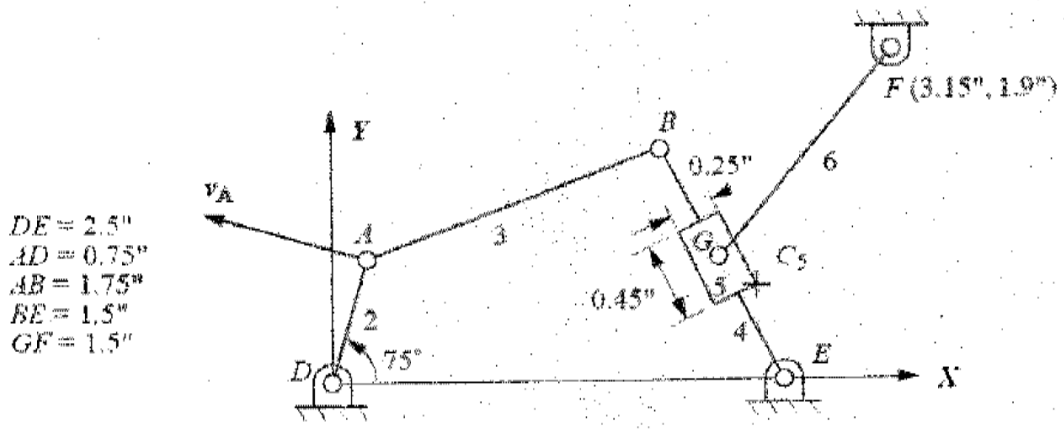
1st Semester
Final Examination
Date: Jan. 11th, 2018
Time allowed: 3 hours
Full Mark: 100

1. a. **(8 Marks) (ILO a.4.1)** For the linkage shown in the figures, determine the number of degrees of freedom of the mechanisms.

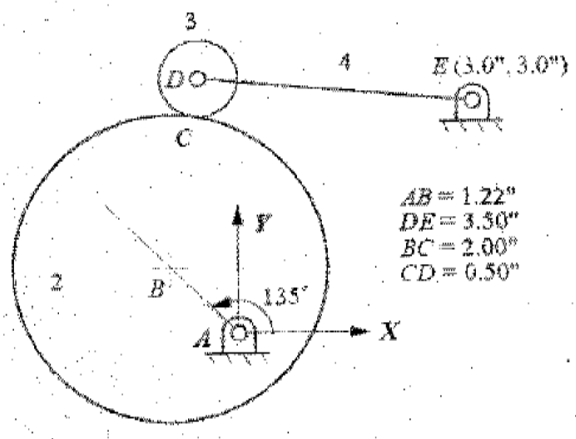


b. **(8 Marks) (ILO a.4.3)** Assume that you have a set of the following lengths: 20 mm, 30 mm, 45 mm, 56 mm, and 73 mm. Design a four-bar linkage that can be driven with a continuous-rotation electric motor. Justify your answer with appropriate equations, and make a freehand sketch of the resulting linkage. Label the crank, frame, coupler, and rocker (follower).

2. **(16 Marks) (ILO c.13.2)** If the velocity of point A on link 2 is 10 in/s as shown, use the instant center method to find the velocity of point C on link 5.

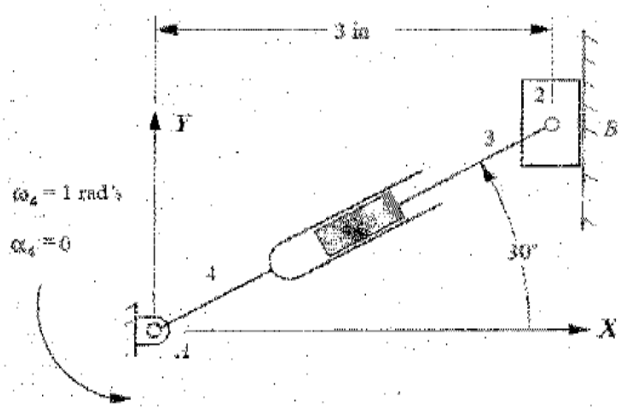


3. **(16 Marks) (ILO c.13.2)** The circular cam shown is driven at an angular velocity $\omega_2 = 15$ rad/s (CW) and $\alpha_2 = 100$ rad/s^2 (CW). There is rolling contact between the cam and the roller, link 3. Draw the velocity diagram and find the angular velocity of the oscillating follower, link 4. Use velocity scale 1 cm : 3 in/s.

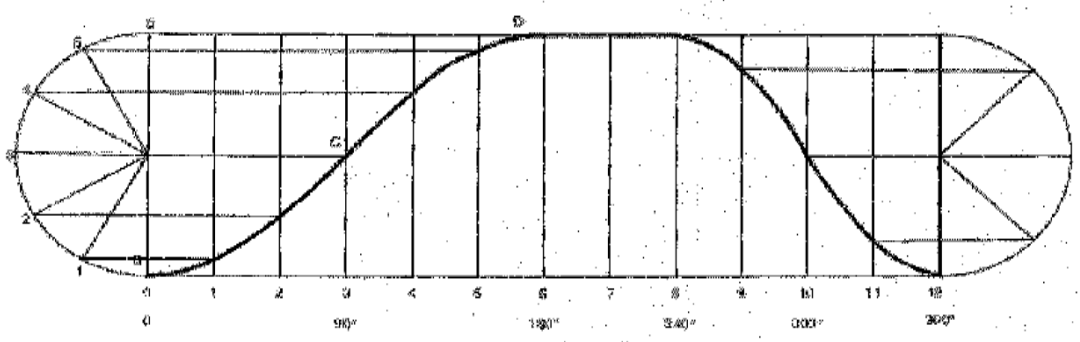


O_v +

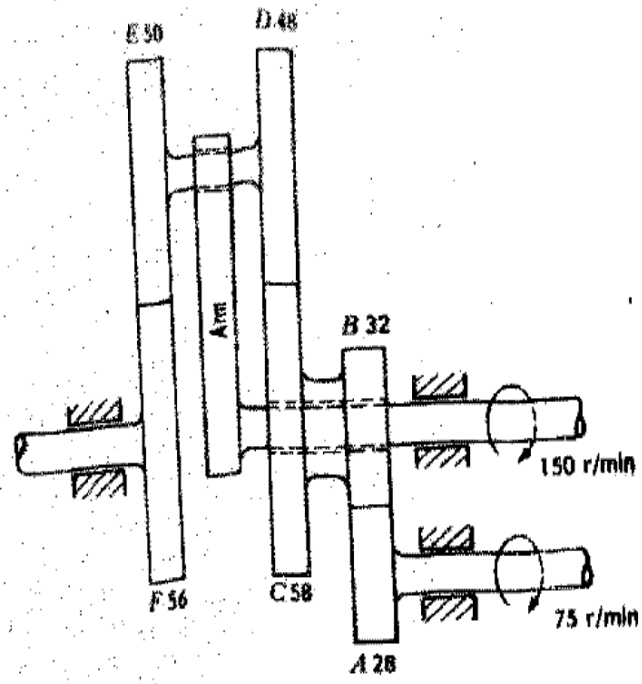
4. **(18 Marks) (ILO c.13.2)** In the mechanism shown, $\omega_4 = 1$ rad/s CW (constant). Using the analytical method, determine the velocity and acceleration of point *B*.



5. **(12 Marks) (ILO c.13.1)** Construct the cam profile using the given displacement diagram. The cam is to have a radial roller follower with 20 mm diameter. The cam will rotate clockwise, and the base circle diameter is 80 mm. determine the maximum pressure angle.



6. **(16 Marks) (ILO b.2.2)** In the gear train shown, determine the angular velocity of the gear F.



7. **(16 Marks) (ILO b.2.1)** a double-piston mechanism shown in the figure is assumed to be in equilibrium under the action of external forces ***P*** and ***S*** and an input torque $\mathbf{T_2}$. Find the input torque $\mathbf{T_2}$ and the pin forces at A, C, O_2 as well as the contact force between the pistons and their guides.