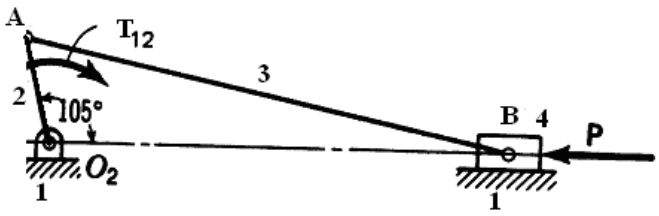
CONCORDIA UNIVERSITY
Faculty of Engineering and Computer Science
Department of Mechanical and Industrial Engineering

MECH 343/2 X: Theory of Machines 1, Fall 2011-12

Assignment 9:

Question 1:



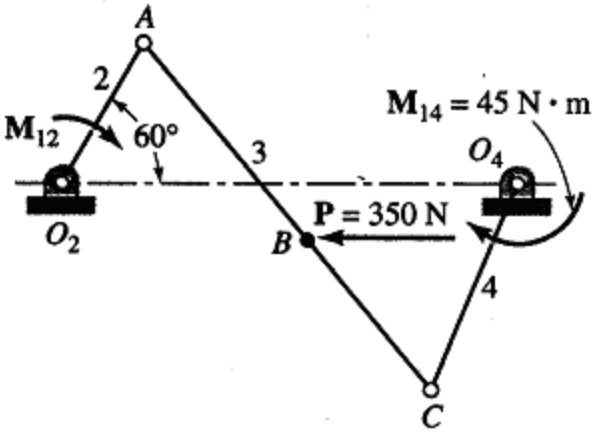
Crank-shaft exerts the reaction-moment T_{12} on crank 2 to balance the gas-load P = 1.0 kN on piston 4, as shown in Figure. Here, O_2A = 75 mm, AB = 350 mm and θ_2 =105˚. Draw the configuration to a scale of 1 cm = 50 mm.

(a) Determine the reaction moment T_{12} using static-force-analysis

(b) Determine the forces F_{12} and F_{14} exerted by the frame 1 on the mechanism

(c) For the configuration shown, the velocity v_4 of the piston in the leftward direction is related to the angular velocity ω_2 in CCW sense by the relation $v_4 = 0.06834\,\omega_2$ Determine the reaction moment using energy method.

Question 2:



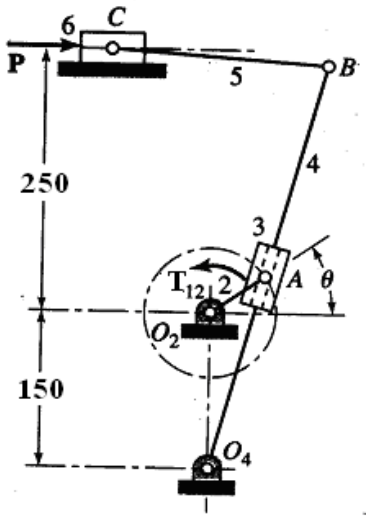
Reaction moment T_{12} on link 2 for the force P and moment T_{14} acting on the four-bar crank-rocker linkage is shown in Figure. Here, O_2O_4 = 700 mm, O_2A = 200 mm, AC = 700 mm, O_4C = 350 mm, AB = 400 mm and θ_2 = 60˚. Draw the configuration to a scale of 1 cm = 100 mm.

(a) Determine the reaction moment T_{12}, when

- (i) P = 350 N and T_{14} = 0 Nm
- (ii) P = 0 N and T_{14} = 45 Nm
- (iii) P = 350 N and T_{14} = 45 Nm

(b) For the configuration shown, the velocity analysis yields, ω_3 = - 0.06090 ω_2, ω_4 = - 0.6163 ω_2 and $\mathbf{v_B}$ = 0.2081 ω_2 @ 156.460˚. Here, the convention that the angular velocity in CCW is considered positive. Determine the reaction moment T_{12}, when P = 350 N and T_{14} = 45 Nm

Question 3:



For the shaper mechanism shown in Figure, a shaping force of P = 2.0 kN is required for the configuration, where θ = 30˚. Here, O_2A = 75 mm, O_4B = 400 mm BC = 200 mm . Draw the configuration diagram to a scale of 1 cm = 50 mm.

(a) Using static force analysis, determine the driving torque T_{12} needed on crank

(b) For θ = 30˚, when the crank rotates at angular velocity ω_2 rad/s in CCW sense, shaper C moves to the left at 0.1121 ω_2 m/s to the left. Using energy method, determine the driving torque T_{12}.

Question 4:

Crank of the slider-crank mechanism, shown in Figure, rotates at a constant angular velocity of 100 rad/s in CCW sense. Here, O_2A = 75 mm, O_2G_2 = 30 mm, m_2 = 0.45 kg, I_2= 0.0005 kgm^2, AB = 300 mm, AG_3 = 90 mm, m_3 = 1.60 kg, I_3 = 0.015 kgm^2, m_4 = 1.15 kg. Kinematic analysis for the configuration shown gives: ω_3 = 21.82 rad/s (CW), α_3 = 1200 rad/s^2 (CW), a_{G3} = 727.5 m/s^2 @ 158.85˚ and a_4 = 746.3 m/s^2 @ 180˚. For the configuration, the gas load P = 3.5 kN. Considering the inertia force effects, determine the turning moment T_{12} needed at crank to run the mechanism..