

Advanced Mechanics of Materials (C131)  
HOMEWORK XII (due after Thanksgiving Holiday)

**Problem XII-1**(Ugural and Fenster 10.21) (15 points)

Calculate the vertical displacement of joint E of the truss depicted in Fig. P10.21. Each member is made of a nonlinear elastic material having the stress-strain relation  $\sigma = K\epsilon^{1/3}$  and the cross-sectional area A. Apply the Crotti-Engesser theorem.

**Problem XII-2**(Ugural and Fenster 10.23) (10 points)

A frame of constant flexural rigidity EI carries a concentrated load P at point E (Fig. P10.23). Determine (a) the reaction R at support A, using Castigliano's theorem; (b) the horizontal displacement  $\Delta_h$  at the support A, using the virtual force method.

**Problem XII-3**(Ugural-Fenster 10.24) (15 points)

A bent bar ABC with fixed and roller supported ends is subjected to a bending moment  $M_0$  as shown in Fig. P10.24. Obtain the reaction force R at the roller using the virtual force method.

**Problem XII-4**(Ugural-Fenster 10.29) (15 points)

A hinge-ended beam of length L rests on an elastic foundation and is subjected to a uniformly distributed load of intensity p. Derive the equation of the deflection curve by applying the principle of virtual work.

**Problem XII-5**(Ugural-Fenster 10.34) (15 points)

A cantilever beam carries a uniform load of intensity p (Fig. P10.31). Take

$$v = a \left( 1 - \cos \frac{\pi x}{2L} \right)$$

where a is an unknown constant. Apply the Rayleigh-Ritz method to find the deflection at the free end.

**Problem XII-6**(Ugural-Fenster 10.34) (15 points)

Determine the midspan deflection of the fixed-ended symmetrical beam of stepped section shown in Fig. P10.34. Take  $v = a_1x^3 + a_2x^2 + a_3x + a_4$ . Employ the Rayleigh-Ritz method.