Homework 7

1) A 50-mm-diameter ball is pressed into a spherical seat of diameter $75\ mm$ by a force of $500\ N$. The material is steel ($E = 200\ GPa$, $\nu = 0.3$). Calculate (a) the radius of the contact area, (b) the maximum contact pressure, and (c) the relative displacement of the centers of the ball and seat.

2) Calculate the maximum contact pressure p_o in Prob 1 for the cases when the 50-mm-diameter ball is pressed against (a) a flat surface and (b) an identical ball. For case (b), determine the yield strength of a material for which the described loading will take the material to the verge of failure, using the maximum distortion energy criterion. Note how the determined yield strength compares to the maximum contact pressure.

3) A concentrated load of $2.5\ kN$ at the center of a deep steel beam is applied through a 10-mm-diameter steel rod laid across the 100-mm beam width. Compute the maximum contact pressure and the width of the contact between rod and beam surface. Use $E = 200\ GPa$ and $\nu = 0.3$.

4) Determine the maximum pressure at the contact point between the outer race and a ball in the single-row ball bearing assembly shown. The ball diameter is $40\ mm$; the radius of the grooves is $22\ mm$; the diameter of the outer race is $250\ mm$; and the highest compressive force on the ball is $F = 1.8\ kN$. Take $E = 200\ GPa$ and $\nu = 0.3$.