King Saud University
Department of Mechanical Engineering
ME305 Machine Design
Homework No. (7)

Question 1

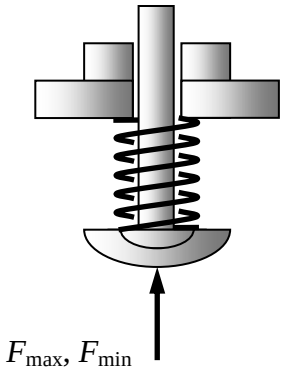
A helical compression spring is made of hard-drawn spring steel wire 2 mm in diameter and has an outside diameter of 22 mm. The ends are plain and ground, and there are $8\frac{1}{2}$ total coils.

(*a*) The spring is wound to a free length, which is the largest possible with a solid-safe property. Find this free length.
(*b*) What is the pitch of this spring?
(*c*) What force is needed to compress the spring to its solid length?
(*d*) Estimate the spring rate.
(*e*) Will the spring buckle in service?

Question 2

A helical compression spring of feed mechanism for a high speed cutter is made of A313 steel. The spring has a wire diameter of 2.3 mm, an outside diameter of 24.6 mm and spring rate of 1633.33N/m. The specifications of the spring are: unpeened, its ends are squared and ground, and its supported ends are fixed. If the fatigue factor of safety is n_f =2, the load line $r = F_a/F_m$=0.6363, and the load on the spring varies between F_{min} and F_{max}, determine:

1. The **maximum** and **minimum** forces that the spring is subjected to.
2. The spring **active** and **total** coil
3. The **solid length** of the spring
4. The **free length** of the spring
5. Will the spring buckle in service
6. The frequency of the spring if the specific weight of the spring is γ=76500 N/m^3



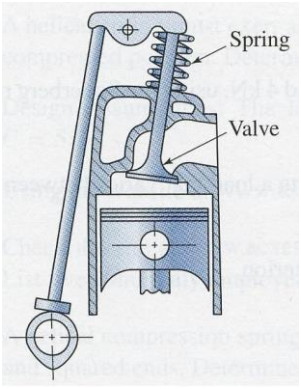
Question 3

An engine value spring must exert a force of 300N when the valve is closed as shown in figure and 500N when the valve is open.

Knowing that S_{us} = 720MPa, S_{es} = 330MPa, C = 6, G = 79GPa

Apply Goodman theory with a factor of 1.6 to calculate:

1. The wire diameter.
2. The number of active coils if the deflection of the spring between the maximum load and the minimum load is 8mm.



Question 4

The extension spring shown in the figure has full-twisted loop ends. The material is AISI 1065 OQ&T wire. The spring has 84 coils and is close-wound with a preload of 15 lbf.

(a) Find the closed length of the spring.
(b) Find the torsional stress in the spring corresponding to the preload.
(c) Estimate the spring rate.
(d) What load would cause permanent deformation?
(e) What is the spring deflection corresponding to the load found in part *d*?