Wednesday 10 September - Class Session 05

Homework:

Read Budny: Sec 4.6, 4.9, 4.10
Programming Assignment 3: Due Wednesday 17 September

Class Activities:

1.   *Problem Statement*: A cable of length l_0 is needed to suspend an object of mass m_{obj} from the ceiling. The load, $T = m_{obj}g$, is the force that the mass exerts on the cable. The deflection (elongation) of the cable under the load must be less than Δl_{max}. Ignoring the mass of the cable (m_{cable}, which adds to the load), what cable mass is required to just support the load without permanent deformation?

Background: This is a stress-strain problem ($S = Ee$). Permanent deformation occurs when the stress on the cable exceeds the yield stress, S_y, i.e., when $S > S_y$.

$$\text{Stress:}\quad S = \frac{T}{A_0} \quad \text{where} \quad A_0 = \frac{\pi d^2}{4} \quad ==> \quad S = \frac{4T}{\pi d^2}$$

S: stress, T: tension (load supported), A_0: cable cross-sectional area, d: cable diameter

$$\text{Strain:}\quad e = \frac{\Delta l}{l_0} \quad \text{where} \quad \Delta l = l - l_0$$

e: strain, l_0: initial cable length, Δl: change in cable length, l: cable length under load

$$\text{Mass:}\quad m_{cable} = \rho V \quad \text{where} \quad V = A_0 l_0 = \pi d^2 l_0 / 4$$

m_{cable}: mass, ρ: cable density, V: cable volume

E: Elastic (Young's) modulus, S_y: yield stress, and ρ: cable density are material properties than can be looked up in tables of material properties.

Design an approach to solving this problem.
a.   What are you looking for?
b.   What must be specified in order to get the solution?
c.   Write a succinct statement identifying what will result and what is required
d.   What steps must be taken to get to the required solution?
                Hint: look at the equations.
                State what, rather than how, you would proceed.
                Don't forget: specifying needs and displaying results are steps.

        Turn in a single piece of paper with parts c and d. Your "header" biographical
information must be written in the upper right corner of your paper.

2.   *Problem Statement*: Your boss at the Internal Revenue Service (IRS) has asked you to develop a program that will determine how much taxes are due based upon a taxpayer's annual salary. The tax due is based upon the following table:

Salary Range, $	Base Tax, $	Percentage on Excess, %
0 - 14,999	0	15
15,000 - 29,999	2,250	18
30,000 - 49,999	5,400	22
50,000 - 79,999	11,000	27
80,000 & above	21,600	33

The percentage on excess is to be applied to salary over the minimum in a given range. Total tax is the base tax plus the percentage on excess.

Design an approach to solving this problem.
a.   What are you looking for?
b.   What must be specified in order to get the solution?
c.   Write a succinct statement identifying what will result and what is required
d.   What steps must be taken to get to the required solution?
            State what, rather than how, you would proceed.
            Don't forget: specifying needs and displaying results are steps.

        Turn in a single piece of paper with parts c and d. Your "header" biographical information must be written in the upper right corner of your paper.