Homework 3: Torsion
Due date: Monday January 16, 2012

1. (Midterm 1/51)

Determine the required diameter $d$, for the segment $AB$ of the solid brass shaft shown, if the permissible shear stress is $\tau_{\text{all}} = 50$ MPa and the total angle of twist between $A$ and $C$ is not larger than $\phi_{AC} = 1.5^\circ$. The torques applied at point $B$ and end $C$ are $T_B = 2$ kN.m and $T_C = 0.5$ kN.m, respectively. Shear modulus for brass is $G_{\text{Brass}} = 40$ GPa. (20 points)

![Diagram of shaft AB with torques and dimensions]

2. (Midterm 2/50)

The design of gear-and-shaft system shown requires that steel shafts of the same diameter be used for both $AB$ and $CD$. Determine the required diameter of the shafts for the two cases below ($G_{\text{Steel}} = 77$ GPa):

(a) If it is required that max $\tau \leq 55$ MPa (3 marks)
(b) If it is required that the angle $\phi_D$ through which end $D$ of shaft $CD$ rotates not exceed $1.5^\circ$ (7 marks)

![Diagram of gear-and-shaft system with dimensions and torques]