Example 4.6. Consider the following power transmission system. The shaft is driven by a pulley (240 mm diameter) at B and the power is delivered through the spur gear mounted at point C. The belt tensions are F_1=5 kN and F_2=3 kN (both acting in -z direction).

The resultant forces (on spur gear with a pitch diameter of 40mm) in transferring the power are: tangential force F_t (acting in +z direction) and radial force Fr (acting in –y direction). Relationships between forces on spur gear are: Fr=0.5Ft. Shaft is made of steel with Sy=700MPa, E=207 GPa.

a) Calculate all stress components at points 1,2 and 3. Elements 1 and 2 are on the top surface (lying in xz plane) and element 3 (lying in xy plane) is facing +z axis. Draw each stress element and show the stress components acting on them.
b) For the given configuration (assuming that the system is static), determine factor of safety based on
    i. Maximum shear stress theory of failure (MSST)
    ii. Distortion energy theory of failure (DET)