# Assignment/Tutorial 11
April 10, 2018
(Shafts)
ME-30602, 2017-18 Spring Semester

1. Problems 7.1(d), 7.3, 7.9, 7.10, 7.19, 7.20 (For fatigue failure use M-G criterion)
   From Chapter 7 of Shigley's Mechanical Engineering Design book. (Shafts).

Note: The problems are picked from 10th edition of the book. In case you have a different edition the problem numbers may change. You should check this.

Problem: An AISI 1020 CD steel shaft is to be designed to support the spur gear and overhanging worm as shown below. The shaft speed is 300rpm. The bearing at A takes pure radial load and the bearing at B can take axial thrust for rotation of worm in either direction. The radial loads on the gear and the worm are in the same plane. The torque transfer between gears and the shaft takes place through rectangular keys. Design the shaft by following the steps below.
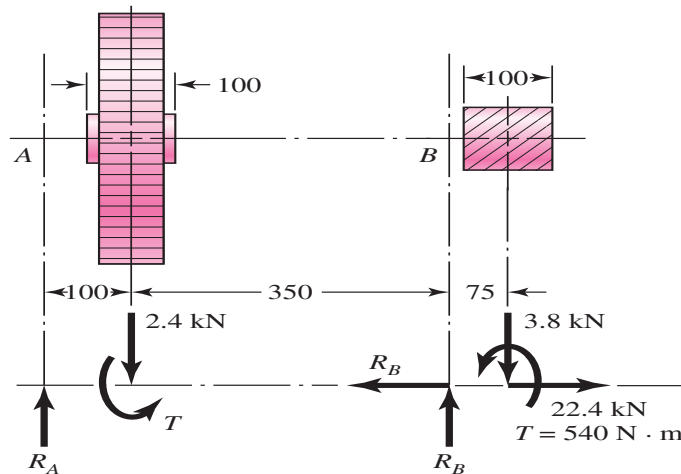
(a) Draw the diagrams corresponding to bending moment, torque and axial thrust.

(b) Identify the critical locations and determine the minimum shaft diameter at those locations based on a factor of safety of 2.5 for the shaft. Use static yielding and modified Goodman criteria. Maintain a diameter ratio *(D/d)* of 1.2 and fillet-radius to smaller diameter ratio *(r/d)* of 0.05 at each bearing location. The fatigue stress concentration factors at the keyways are 5.0 for bending and 3 for torsion.

(c) Check for the failure of keys for both the spur gear and the worm. The factor of safety for key should be 1.8. Key material is AISI 1020 HR steel.