315 Theory of Machines – Design of Elements

Fall 2023

HW No. 7, **Total 40 points**

## Assigned: 11/2 Due: one week, 11/9, On-line, pdf in **one single file**.

20 point each. In this practice, select the smallest possible bearings whose rating C (C1) is the closest to the calculated one. Use proper table in the eBook, Chapter 6. Note that in a real engineering work, bearing sizes must meet certain structural requirements.

1. A helical-gear shaft transmits a power of H = 52KW at n = 1300 rpm. The coupling is the input element. The gears have teeth Np = 20, NG = 51, their normal module is mn = 5mm, the pressure angle is n = 20 degree, and the helical angle is ψ = 170. The pinion and its shaft assembly are shown below. The gear torque is balanced by the coupling torque. Two bearings should be used and their L10 life is 11,000 hours. Application factor *Ap*=1.

# Are the force/moment directions all correct? If not, make the changes. Mark the helical direction of the tooth of the mating gear.

# Calculate the magnitudes of the radial reaction forces, A and B, at bearings A and B.

1. Estimate the shaft diameter at the coupling, *dmin*, with the torque on the shaft. The allowable stress is all = 200 MPa. Increase the calculated *dmin* by 5% to consider the keyway effect. Use a preferred number ending with 0 or 5 for the final result.
2. Select a pair of SKF single-row deep-groove ball bearings and use the same bearings for both supports. Make sure the bearing bore diameter is at least 5 mm larger than *dmin*. Show your work. List the bearing catalog number, 6xxx, the shaft diameter, *d*, the outside diameter, *D*, and the bearing width. (Assume that the bearing under the larger radial load takes the axial (thrust) load as well)

a=45 mm

b = 60 mm

Bearing A

Coupling

x

y

z

A

B

Bearing B

C

Coupling

Shaft FBD

M

Wr

Bearing axial load is not determined here.

Wa

Wt

T

T

**2.** For the same problem above, continue to

1) Select a pair of Timken ISO 355 bearings and use the same bearings for both supports in a face-to-face mounting. Also make sure the bearing bore diameter is at least 5 mm larger than *dmin*. Show your work. List the bearing catalog number, 3xxxx, the shaft diameter, *d*, and the bearing outside diameter, *D*, and *T*. Make sure the axial loading direction is correctly determined.

2) Repeat above but select a pair of Timken ISO 355 bearings for the use in a back-to-back mounting.

You may use the calculated C value from the last step of Problem No. 1 for the first trial selection.