Mechanical Eng. Dept.
ME 352

Taibah University
College of Engineering

Mechanical Design II
March 2020
Mid. Term Exam
Time allowed: 1 hr.

Problem (1) Choose the correct answer:

a- Spur gears are:
1– has low working noise than helical gears
2- same noise as helical gears
3- has high working noise than helical gears

b- Gear module equals:
1- N/d where N is number of teeth and d is the pitch circle diameter
2- d x N
3- d/N

c- Rigidity of shafts is related to :
1- Resulted lateral defection
2- Resulted stresses
3- Resulted twisting angle

d- Rolling bearings can sustain:
1- Torsion and reaction forces
2- Bending and reaction forces
3- Reaction forces only

e- Sliding bearings has friction :
1- more than rolling bearings
2- less than rolling bearings

f- For the same power transmission, the helical gears have design factor of safety:
1- Equal to spur gears of same size
2- More than spur gear of same size
3- Less than spur gear of same size

g- V-belt has standard size and length:
1- Correct
2- False

h- The bending stress educed in gears teeth must be compared to:
1- Teeth surface hardness
2- Teeth strength
3- Material creep

i- The shaft rigidly depends on:
1- Axial load
2- Bending load
3- Torque load

j- In the 4-wheel drive cars, the real axle is considered as:

1- Shaft
2- Not shaft

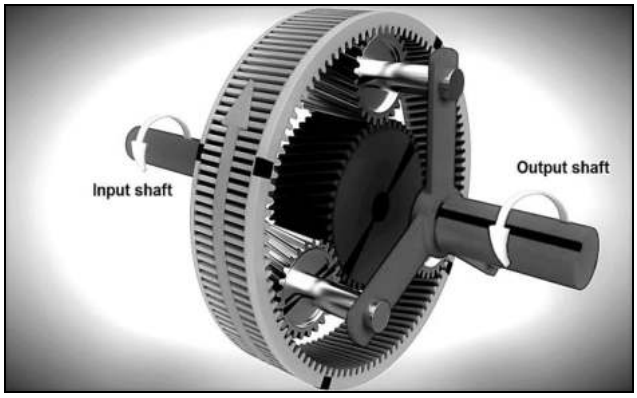
(B) A simply supported shaft, diameter **40 mm**, on bearing supports carries a radial load of **20 kN** at its center. The axial load on the bearings is **1.1 kN**. The shaft speed is **1500 RPM**. Find the bearing working hours if the bearing dynamic and static capacities are **28 kN** and **20 kN**, respectively**.**

Problem (2)

The following figure shows a planetary gear box used to transmits power of **10 kW.** The speed of the input shaft is **1500 RPM (CW)**. The number of teeth of gears are as follows:

Sun gear has **20** teeth, Each plant gear has **30** teeth, all gears have **4 mm** module. Find the following:-

a- The number of teeth on the ring gear.
b- The speed (and direction) of the output shaft, ***the ring gear is kept fixed.***
c- Torque applied on sun gear
d- Bending stress resulting in teeth of the sun **helical** gear (all the gears have **45 mm** width). (take $K_o=K_m=1.3$)

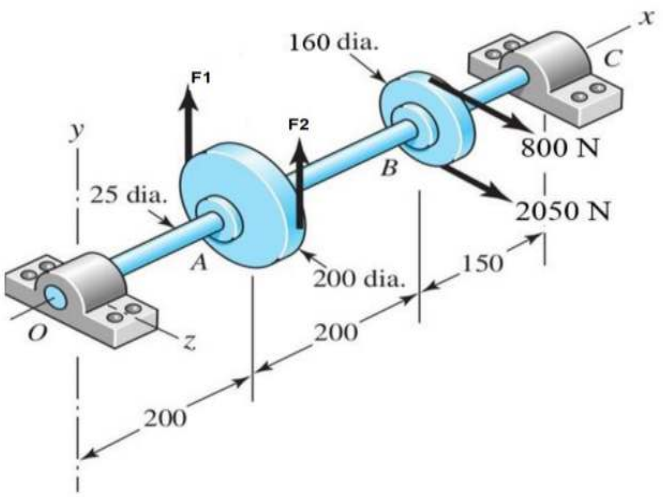


Problem (3)

The following figure shows a shaft transmits power from the shown pulley at **A** to the pulley at **B (**of diameter**= 160 mm)**. The shaft rotates at **1500 RPM**. Find the following:

a- Transmitted power between the two pulleys.
b- Belt forces at Pulley **A** (F_1 and **F2)**, take belt friction coefficient **= 0.3.**
c- Shaft diameter at critical section, if its material is **St.52** (S_{ut}**= 520 MPa) and** safety factor= **3** based on yielding strength**.**

Dimensions are in mm



Helpful Data

Bearing Selection

$$F_e = XVF_r + YF_a$$

$$L = \left[\frac{C}{F_e}\right]^3$$

		$F_a/(VF_r) \le e$		$F_a/(VF_r) > e$	
F_a/C_0	e	X_1	Y_1	X_2	Y_2
0.014*	0.19	1.00	0	0.56	2.30
0.021	0.21	1.00	0	0.56	2.15
0.028	0.22	1.00	0	0.56	1.99
0.042	0.24	1.00	0	0.56	1.85
0.056	0.26	1.00	0	0.56	1.71

Gear Design Data

The bending stress equation for helical gear teeth is given as

$$\sigma = \frac{F_t}{bmJ} K_v K_o (0.93 K_m)$$

$$K_v = \left[\frac{78 + (200V)^{0.5}}{78}\right]^{0.5}$$

ASME Eq. for shaft design

$$d_o = \left[\frac{16}{\pi S_{s\,allow.}(1-\lambda^4)} \sqrt{\left(k_b M_b + \frac{\alpha F d_o (1+\lambda^2)}{8}\right)^2 + (K_t M_t)^2}\right]^{1/3}$$

$$\theta = \frac{TL}{GJ} \quad (\text{rad .})$$