A Summary for what we have learnt from

Ch 1 ⇒ Ch 3-5 → 3-12 ⇒ Ch 5 von mises + tresca.

Ch 1 ↓ You might get asked to find FOS or reliability using data given.

Ch 3-5 → 3-12 ↓ asked about maximum shear stress and principal stresses.

[1] Find critical section, which will be farthest away from forces, and has the least diameter or ابعاد, and will not be at the neutral axis N.A of this section.

[2] We want to ننقل the forces given on every "حالة تغير طعجة" ... in the bar/rod to see what kind of moment they make, is it bending or torque? using ناتج

$M / T = \vec{r} \times \vec{F}$ depending on the direction

($\vec{r}$: take the whole distance.)

[3] Using right hand rule, we use our thumb as direction to see how this moment تلف so we can know what we need to know about σ, τ

[4] $$\tau_{max\ shear} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$\left(\frac{\sigma_x - \sigma_y}{2}\right)$ ↓ we consider these bending moment + normal ~~principal~~ forces

τ_{xy}^2 ↓ we consider this shear stress from torque.

if for example the bending moment goes around z axis then its initiated stress should be:

$$\sigma_{xx \text{ or } yy} = \frac{M_z\, y}{I_{zz}} \rightarrow (r \text{ in case of rod})$$

$$\sigma_{xx \text{ or } yy} = \frac{F}{A}$$

→ if any are both in xx or yy You can sum them up.

of ... normal stresses

$$\tau_{max \text{ (from torque)}} = \frac{T\,r}{J}$$

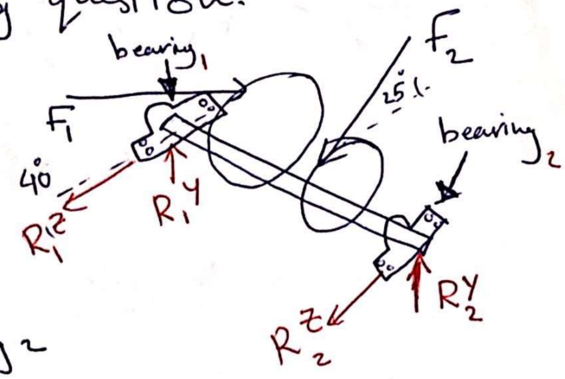
after this, you should be able to find max shear stress, you can also find principal stresses:

$$\sigma_{1,2 \; max, min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

and θ_s, θ_p, and $\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2}$

Lastly, You could get asked about Mohr's circle which is on OneNote.

Solving a gear-bearing question:



Selecting the right bearing:

Only radial force

1. $R_{\text{system pair}} = R_{\text{bearing 1}} \times R_{\text{bearing 2}}$

$\sqrt{R_{\text{system}}} = R_{\text{of one bearing}}$ (what C_{10} equation will you use?)

2. $\Sigma T = 0$ around shaft

$\Sigma M^Y = 0$ on one of the bearings (we look at forces in z direction) + use reaction too

$\Sigma M^Z = 0$ on one of bearings (we look at forces in y direction) + use reactions t

$\Sigma F^Y = 0$

$\Sigma F^Z = 0$

$T = r \times F$ — r: on what it is going around, $M = r \times F$ — r: to where it will bend about

$\hat{i} \times \hat{j} = \hat{k}$, $\hat{j} \times \hat{k} = \hat{i}$, $\hat{k} \times \hat{i} = \hat{j}$

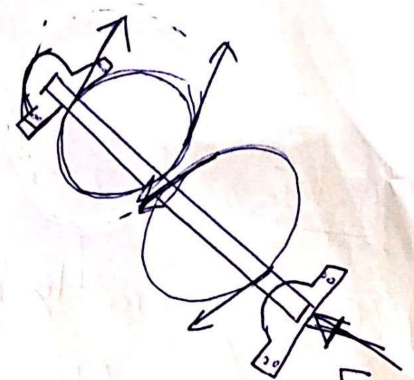
③ $R_1 = \sqrt{R_1^{y^2} + R_1^{z^2}}$

$R_2 = \sqrt{R_2^{y^2} + R_2^{z^2}}$

we take larger, and this is F_D "

④ C_{10} then table 11-2.

Selecting the right bearing
Radial and thrust forces



① We do everything I wrote having a radial force.

② We do not find C_{10} just yet, we go to

$$F_e = X_i V F_r + Y_i F_a \rightarrow \text{thrust force.}$$

F_r ↓ use reaction force of the bearing equal to thrust force

1- use $i=2$ $X_2 = 0.56$ $Y_2 = 1.63$ at first.

2- C_{10} at this value, $C_{10} = a_f F_e \left(\frac{x_D}{x_0 + (\theta - x_0)(1-R_D)^{\frac{1}{b}}} \right)^{\frac{1}{a}}$

3- $\frac{F_a}{C_0}$ → get this from C_{10}

4- e at this value

5- $\frac{F_a}{V F_r}$ < $\leq e$ $i=1$
  > e $i=2$ → at what value?

6- calculate Fe at new $i=2$

7- C_{10} = , ~~does~~ is this the same bearing as before? if yes stop, if no do this again.

↓

the one directly before it, ~~&~~ we do this for تأكّد

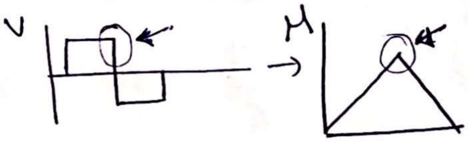
Shaft design :

Failure-fatigue analysis:

① We first begin as we did in chapter 11, $\Sigma T = 0$ $\Sigma M = 0$ $\Sigma F = 0$ to find reactions of bearings and force values.

② We make a shear + moment diagrams for all forces, we find in y direction, and z direction.

③ We find from the diagrams the point on which has maximum stress



and find $M_a = \sqrt{M_{y_{max}}^2 + M_{z_{max}}^2}$ on that point.

$T_m = r \times F$

④ We begin with Ch6 moves until we get to Kf, Kfs and find them.

⑤ We end up using goodman failure criterion n and see if it failes or not.