Name / Surname: **ID Number:**

Fall 2020-2021

MKT 3821 Machine Elements Midterm *(60 min)*

Question	1	2	3	4	TOTAL
Grade					

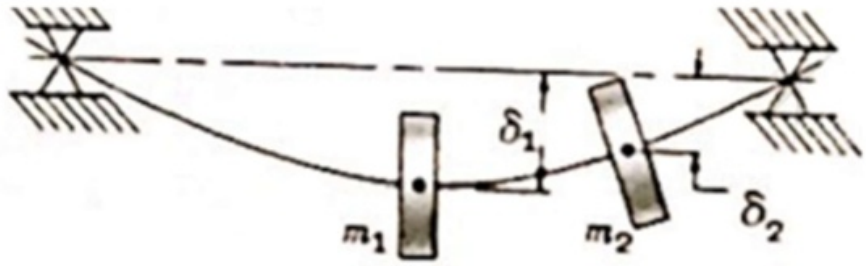
Write your solution clearly, neatly and bold using a pen or pencil. USE the RIGHT DATA SET.
Put your ID card on the answer sheet before scanning.
Scan your answer sheet into PDF format.
Upload the PDF to UZEM. In case you run into a problem, upload your file to G-Classroom.

1. *(25 Pts)* Design diameter of a SAE 10XX steel (with Sy and Su given below) driveshaft that transmits X kW at 3000 rpm with a bending moment of Mb N-m. Axial load is negligible and Factor of Safety is assumed as 2,5. First draw the sketch of this shaft putting all the loads on it. Then;

a) Calculate the shear stress on the shaft
b) Calculate the diameter of the solid shaft using Tresca's maximum shear stress theory

ID No's ending with	0, 1	2, 3	4, 5	6, 7	8, 9
Sy	350	450	550	650	750
Su	500	600	700	800	900
X (kW)	60	70	65	75	80
Y (rpm)	3000	2500	3200	2200	3300
Mb (N-m)	80	90	100	110	120

2. *(25 pts)* The shaft shown in the figure below holds a gear m1 weighing 20 kg and a flywheel m2 weighing 60 kg. The calculated static deflections d1 and d2 are 3 and 1,5 mm, respectively. Determine the shaft critical speed (in RPM) ignoring its mass. (use g = 10 m/s2) (use the Raleigh-Ritz method)

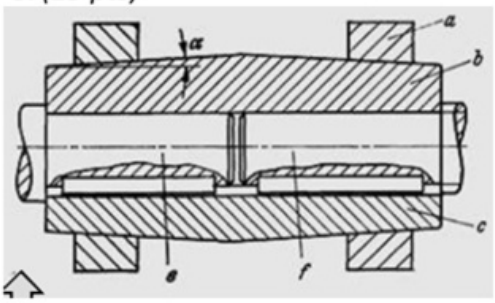


ID No's ending with	ODD	EVEN
m1 (kg)	25	35
M2 (kg)	60	50
d1 (mm)	3	4
d2 (mm)	2	3

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3. *(25 pts)*

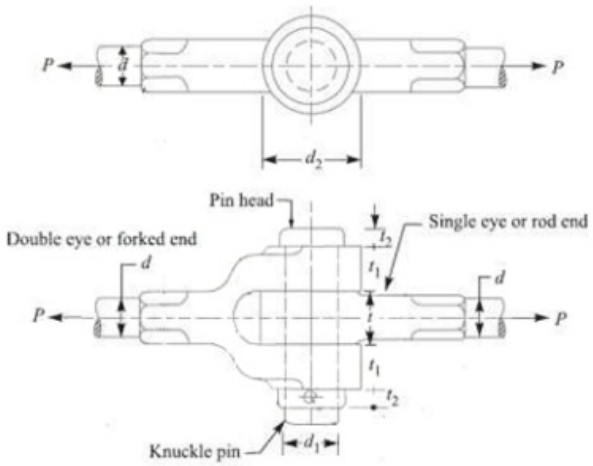


Square keys are used in the ring coupling shown with a shaft diameter 60 mm and coupling diameter 90 in the middle. Both the shaft and the key are made from the same steel alloy with a tensile strength of 400 MPa and it transmits 120 kW at 1500 rpm. Assuming factor of safety ay 3 and key width and height as 8 mm;

a) Select the material for the ring (of the coupling)
b) Design the length of the keys on both sides
c) Design the length of the ring.

ID No's ending with	0, 1	2, 3	4, 5	6, 7	8, 9
Shaft Dia (mm)	60	50	75	80	40
Coupling Dia (mm)	90	80	100	110	60
Yield Strength MPa)	350	450	500	600	400
Power (kW)	110	90	120	130	80
Speed (rpm)	1400	1500	1500	1600	1800
Square Key Size (mm)	8	6	10	12	6

4. *(25 pts)* Design the pin connection in a knuckle joint is subjected to an axial force of 60 kN. Assuming the width of the eye (*t*) as 1,5 times the diameter of the pin, and the normal and shear yield strength of the knuckle element and the pin steel is selected as 480 MPa and 290 MPa, respectively; and the factor of safety proposed is 3. (Design means determine the necessary dimensions as shown in the figure)



ID No's ending with	ODD	EVEN
F (kN)	75	60
Eye width ratio	1,6	1,5
Sy	560	480
Ssy	380	290
FoS	2,5	3

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