UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACCALAUREUS INGENERIAE *MECHANICAL ENGINEERING*
SUBJECT	:	**Design (Mechanical) 2B**
CODE	:	**OWM2B21/OWMMCB2**
DATE	:	EXAMINATION November 2019
DURATION	:	3 hr
WEIGHT	:	50 : 50
TOTAL MARKS	:	105 (+10)

EXAMINER	:	Dr BW Botha
MODERATOR	:	Dr A Maneschijn
NUMBER OF PAGES	:	3 PAGES – Students to supply formula sheet.

INSTRUCTIONS	:	Question papers must be handed in.
REQUIREMENTS	:	Answer booklet.

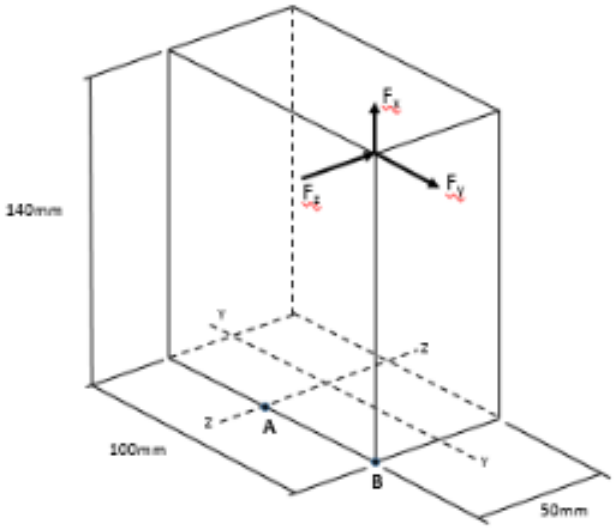
INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

35 Marks

A rectangular steel support is loaded with F_x = 150N, F_y = 40 N and F_z = 50 N as indicated in the figure. Calculate the stress at Points A and B respectively.

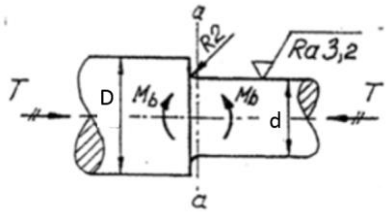


QUESTION 2

30 Marks

It is required that a shaft be designed using AISI 1040 cold drawn bar stock to accommodate a step with a ratio of D/d = 1.25 to effectively support a bearing. The shaft is to be exposed to a constant torsion of T = 300 Nm at a maximum temperature of 130°C. In addition it is also subjected to a rotating bending moment of M = 250 Nm due to the loading of the gear forces. The surface finish is to be "ground" while a reliability of 99.9% is also required. Due to the temperature it is required that the shaft has a factor of safety of at least 1.8. Assume a maximum notch radius of 2.0 mm. As a first estimate assume K_t = 1.7 and K_{ts} = 1.5.

Using the Soderberg approach calculate the required diameters for the proposed shaft design.



QUESTION 3

25 (+10) Marks

An attachment is to be bolted to a solid steel structure and is loaded as indicated in the picture. Assume attachment to be made from mild steel with a yield strength of Syt = 190MPa. Determine the critical bolt and calculate the stress and required bolt diameter using 8.8 rated bolts and a factor of safety of 2.5 (ignore effect of friction). Show all calculations.

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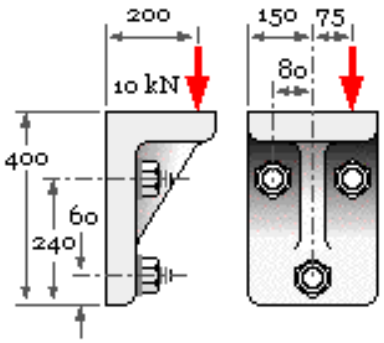

QUESTION 4

15 Marks

During a maintenance activity a pipe wrench is used to tighten a 50 mm pipe (OD) with a 2 mm wall thickness into its socket. Calculate the displacement of the wrench handle at Point P relative to Point A when applying a force of F = 25 kg. The force is applied at a distance of d = 380 mm from the pipe gripping at a distance of 750mm from Point A. (Assume the wrench to grip the pipe without any slippage and that the wrench is rigid enough to ignore any deformation of the wrench).

Assume the pipe to be made from a material with Young's Modulus = 200 GPa, Shear Modulus = 86 GPa, Poisson's Ratio = 0.29, Yield Strength = 215 MPa, Tensile Strength = 505 MPa, Density = 8000 kg/m^3