



University of Choice

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

**BACHELOR OF MECHANICAL AND INDUSTRIAL
ENGINEERING**

MAIN EXAM

COURSE CODE: MIE 262

COURSE TITLE: ENGINEERING DESIGN I

DATE: 27.04.2022

TIME: 12.00 - 14.00

INSTRUCTIONS TO CANDIDATES

Answer question ONE (1) as compulsory; then answer any other TWO (2) additional questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 2 Printed Pages. Please Turn Over

QUESTION ONE (30 marks)

Q1(a) Determine the diameter of the shaft, neglecting the bending moment on the shaft, given that the line shaft rotating at, $N = 200$ r.p.m., is to transmit 20 kW. Assume the shaft is made of mild steel with allowable shear stress of 42 MPa. [5]

Q1(b) Prove that the tensile strength of the joint for double fillet weld, $P = 1.414 s \times l \times \sigma_t$, where [5]

σ_t	-	allowed tensile strength,	t	-	throat thickness
s	-	thickness of plate	l	-	length of weld

Q1(c) Name and sketch the profiles of FIVE possible welded joints. [5]

Q1(d) With the help of a sketch, explain the characteristic features, functions, TWO advantages and TWO disadvantages of a woodruff key. [5]

Q1(e) What is stress concentration factor; and what are cause effect impact. [5]

Q1(f) Sketch a cross section of a bolt and that of a nut and then label the following parts:

angle of thread, pitch diameter line, slope, pitch, lead,
depth of thread, nominal dia, crest, minor dia shank

QUESTION TWO (20 marks)

Q2(a) It is always necessary to determine the stresses in screw fastening due to both static and dynamic loading in order to determine their dimensions. Static loading is composed of both initial tightening and external loadings. Explain FIVE stresses that make up initial tightening of a nut over a screw? **5@2marks = [10]**

Q2(b) Two shafts are connected by means of a flange coupling to transmit torque of 25 N-m. The flanges of the coupling are fastened by four bolts of the same material at a radius of 30 mm. Find the size of the bolts if the allowable shear stress for the bolt material is 30 MPa. [10]

QUESTION THREE (20 marks)

Q3(a) Explain at least TEN considerations to bear in mind when designing a machine component. [10]

Q3(b) A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig.Q3(b).The

maximum tensile and shear stresses are 70 MPa and 56 MPa respectively. Find the length of each parallel fillet weld. **[10]**

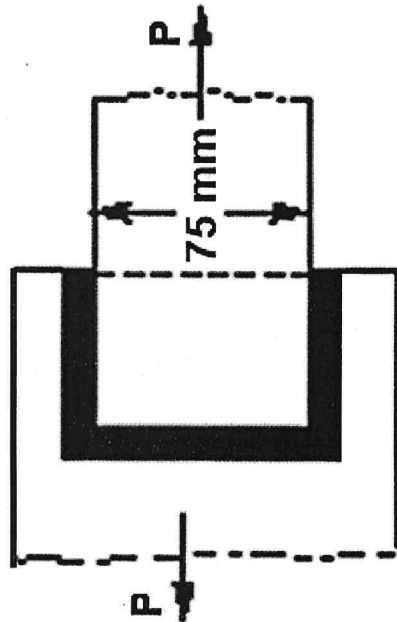


Fig. Q3(b) Traverse and parallel welded joint

QUESTION FOUR

(20 marks)

Q4a. A double riveted lap joint is made between 15 mm thick plates. The rivet diameter and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are $\sigma_{tu} = 400$ MPa in tension, $\sigma_{su} = 320$ MPa in shear, and $\sigma_{cu} = 640$ MPa in crushing, find the minimum force, P per pitch which will rupture the joint. If the above joint is subjected to a load such that the factor of safety, $FS = 4$, find out the actual stresses σ_{ta} , τ_a and σ_{ca} the actual tearing, shearing and crushing stresses produced developed in the plates and in the rivets respectively. **[10]**

Q4(b) With help of sketches and verbal description, illustrate the use of FIVE of the following locking devices: **[10]**

- (i) Jam (or lock, or check) nut,
- (ii) Castle nut
- (iii) Sawn nut
- (iv) Penn (or ring, or grooved) nut
- (v) Locking with (or taper, or split, or cotter) pin
- (vi) Locking with plate
- (vii) Locking with washer

