MUEO

MOI UNIVERSITY

OFFICE OF THE DEPUTY VICE CHANCELLOR
(ACADEMICS, RESEARCH & EXTENSION)

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF

BACHELOR OF ENGINEERING
IN
INDUSTRIAL & TEXTILE ENGINEERING

COURSE CODE: MIT 312

COURSE TITLE: ENGINEERING DESIGN I

DATE: 20TH AUGUST, 2018 **TIME:** 2.00 P.M. – 5.00 P.M.

INSTRUCTIONS TO CANDIDATES

- SEE INSIDE.

THIS PAPER CONSISTS OF (4) PRINTED PAGES

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MIT 312 ENGINEERING DESIGN I *2017/2018*

Instructions:
1. This paper contains seven questions, all carrying equal marks.
2. Attempt any five questions.
3. Do not write anything on the question paper.
4. Unauthorized electronic gadgets e.g. mobile phones are not allowed in the exam room.
5. Examination duration is 3 hours.

Question 1

(a) With regards to engineering design

(i) Define *1 mark*

(ii) Explain the two facets of the art of designing *2 marks*

(b) Discuss the impact of industrial design in an organization *6 marks*

(c) Describe any five competences of a design engineer *5 marks*

Question 2

(a) Analyze by showing the strength of a sunk keys is:

$$\frac{w}{t} = \frac{\sigma_c}{2\tau}$$

6 marks

(b) A 50 mm diameter shaft is made of steel with a yield strength of 500 MPa. A parallel key of size 12 mm wide and 8 mm thick made of steel with a yield strength of 360 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque. Use maximum shear stress theory and assume a factor of safety of 2.

8 marks

Question 3

(a) Describe the following factors that affect design decisions

(i) Compliance *2 marks*

(ii) Quality Assurance *2 marks*

(iii) Reliability *2 marks*

(b) Differentiate between a product design and a design system *2 marks*

(c) Explain the needs that drive a product or system design *6 marks*

Question 4

(a) Explain the two classification of fastenings and provide examples. *3 marks*

(b) Define the efficiency of a rivet and derive its formula. *3 marks*

(c) Calculate the efficiency of the following riveted joints :

(i) Single lap joint of 6 mm plates with rivets of 20 mm diameter and pitch of 50 mm

(ii) Double lap joint of 6 mm plates with rivets of 20 mm diameter and pitch of 50 mm

Assume, Permissible shearing stress in rivets = 80 MPa, Permissible crushing stress in rivets = 170 MPa. Permissible tensile stress in plate = 125 MPa. *8 marks*

Question 5

(a) The final phase of the design process is implementation. Discuss the various methods of implementation of solution to the design problem. **8 marks**

(b) With regards to design methodology, describe the following two steps in solving a design problem.

(i) Define the problem **3 marks**

(ii) Analyze and select a solution **3 marks**

Question 6

(a) From Fig.Q6 (a), the length of each side is known as a Leg or size of the weld and the perpendicular distance of the hypotenuse from the intersection of legs (i.e. BD) is known as throat thickness. The minimum area of the weld is obtained at the throat BD, which is given by the product of the throat thickness and length of weld.

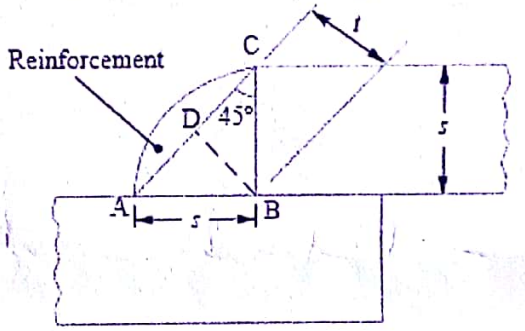

Fig. Q6 (a)

Show the tensile strength of the joint for double fillet weld, *P*. **6 marks**

(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. Q6(b). The maximum tensile and shear stresses are 80 MPa and 48 MPa respectively. Assume stress concentration factor for transverse welds is 1.5 and for parallel fillet welds is 2.7.

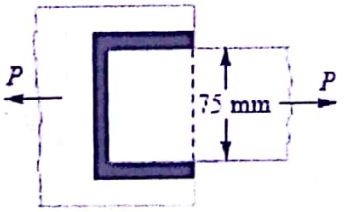

Fig. Q6(b)

Determine the:

(i) Length of each parallel fillet weld, if the joint is subjected to static loading. **4 marks**

(ii) Length of each parallel fillet weld if the joint is subjected to fatigue loading. 4 marks

Question 7

(a) Explain at least five reasons for using an appropriate factor of safety in design. 5 marks

(b) With regards to failure mode:

(i) Define 1 mark

(ii) Causes 2 marks

(iii) Effects 2 marks

(iv) Severity 2 marks

(c) Illustrate the two common failure modes in mechanical structures 2 marks