



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING.

EMM 513: JIG, TOOL AND FIXTURE DESIGN

DATE: 22/10/2020

TIME: 8.30-10.30 AM

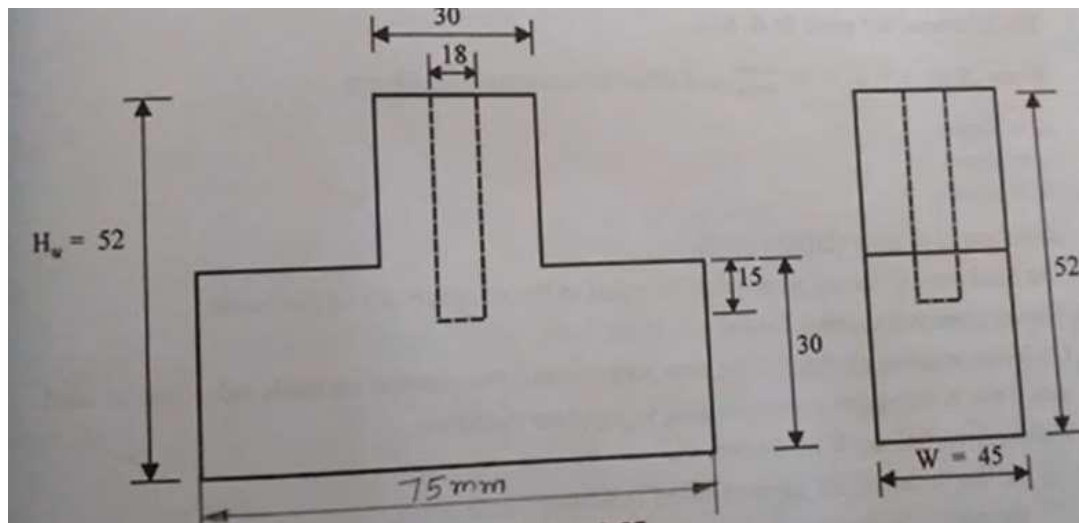
INSTRUCTIONS

- i. This examination contains **FIVE** questions.
- ii. You are required to answer **THREE** questions.
- iii. Question one is **COMPULSORY**.
- iv. Answer question one and any other two questions

QUESTION ONE (30 MARKS)

- a) Jig and Fixtures are so closely related that, the terms are sometimes confused or used interchangeably. Briefly define the two terms and clearly point out the key difference
(4 marks)
- b) Manufacturing for global competitiveness and the need to bridge the supply and product demand requires the success of concurrent engineering combined with less human interventions in the manufacturing processes. Tool designers involved in product design and production require pertinent knowledge of jig and fixtures to yield fewer errors.
 - i. Define the term tool design (2 marks)
 - ii. Briefly explain the roles of tool designer with reference to throughput, quality of products, and costs involved (4 marks)

- iii. Briefly discuss the purpose of using jigs and fixtures to achieve realize the runaway product demand (4 marks)
- c) A flange-plate adapter costs Ksh. 24 per part to mill without a fixture, and costs Ksh 10 per part when a fixture is used. Assuming the fixture costs Ksh 12,800, how much will the fixture save over a production run of 1500 parts. (8 marks)
- d) Design and draw a channel jig for mild steel component as shown in Fig. Qn 1 (d) to drill a hole of 18 mm diameter. All dimensions are in mm. (8 marks)



QUESTION TWO (20 MARKS)

- a) During mass production, increased throughput is realized by the use of efficient work holding devices that save on set-up and handling times. In addition the tool designer must make sure the part is precisely located and rigidly supported. This can only be achieved through the use of jigs and fixture. Discuss the main design considerations for such work holding/locating devices. (8 marks)
- b) Plate Jig are basically modified or improved template jigs. While performing the same locating function as templates, they incorporate a means of securing the part.
- Differentiate between open and closed jigs (2 marks)
 - With the help of a sketch compare the principle differences between plate and template jigs (6 marks)
- c) Sketch a Trunnion jig and briefly explain its function (4 marks)

QUESTION THREE (20 MARKS)

- a) For the part shown in Fig. Qn 3 (a), assume the last operation is to mill out the 57 mm counter bore.
- Sketch a proper locating layout for this operation. In the sketch, include the name of locators, the main dimensions and tolerances. (8 marks)
 - What techniques are used to ensure that the work piece is correctly located and oriented (4 marks)

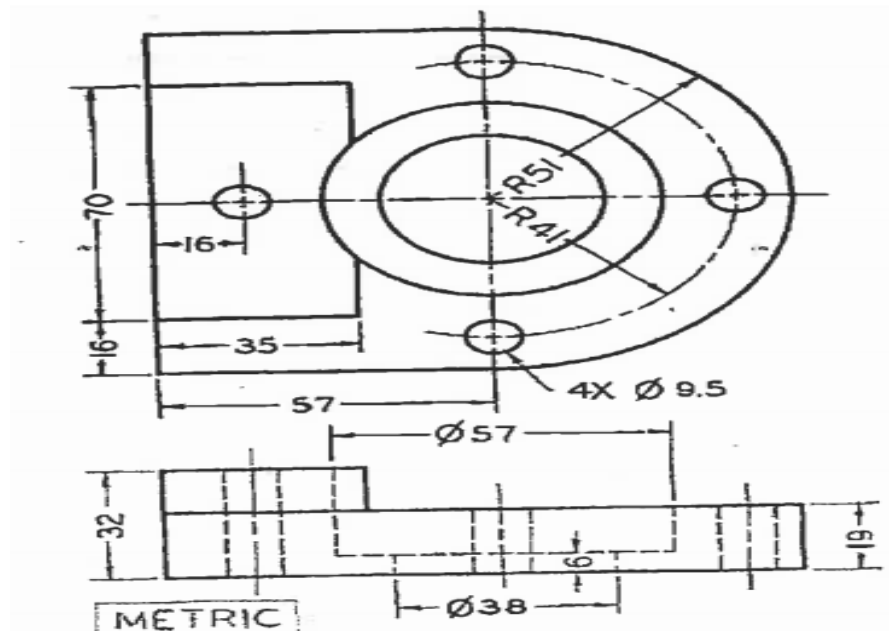


Fig Qn 3 (a)

- b) The properties of tool, jig and fixture materials that concern the tool designer are hardness, toughness, machinability, brittleness, tensile and shear strengths. With reference to the aforementioned material traits, name and explain at least FOUR materials suitable for making jigs and fixtures (8 marks)

QUESTION FOUR (20 MARKS)

- a) Analyze the part drawing and production plan shown in Fig. Qn 4(a) and determine all the relevant information necessary to design a channel or box Jig (10 marks)

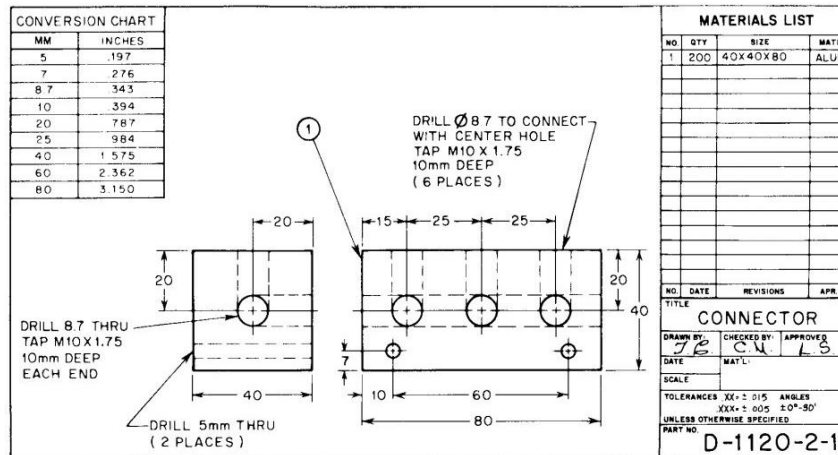


Fig. Qn 4(a)

- b) Discuss the basic principles adopted while planning for locating blanks in fixtures (10 marks)

QUESTION FIVE (20 MARKS)

- a) With help of a sketch, briefly describe the following types of milling fixtures
- Indexing fixture (3 marks)
 - Multi station fixtures (3 marks)

- iii. Profiling fixtures (3 marks)
- b) Design economy begins with tool designers ideas and is carried through to the completion of the tool. The demands of modern industry for maximum productivity at minimal cost are a challenge to the tool designer
- i. Briefly describe the principles of economic design (3 marks)
- ii. Five hundred guide plates must be milled to receive a locating block. The tool designer has determined three possible alternatives;
- 1. Have a tool maker who earns \$12/ hour, mill the plates at a rate of \$25/ hour.*
 - 2. Use limited tooling that costs \$35 in the production department. The machine operator in this department, who earns \$7/ hour, can make a part every 1.2 minutes.*
 - 3. Use a more expensive tool that costs \$110 but is capable of producing a part every 24 seconds. This would be done in the production department, where the machine operator earns \$7/ hour.*

Which alternative should the tool designer select as the most efficient and economical?

(8 marks)