



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 513: JIG, TOOL AND FIXTURE DESIGN

DATE: _____ **TIME:** _____

INSTRUCTIONS

- i. This examination contains **FIVE** questions.
- ii. You are required to answer **THREE** questions.
- iii. Question one is **COMPULSORY** and carries 30 Marks while the rest carry 20 Marks each.
- iv. Answer any two of the remaining questions

QUESTION ONE (30 MARKS)

- a) Jig and Fixtures are so closely related that, the terms are sometimes confused or used interchangeably. Use sketches to illustrate the key differences in the two (4 marks)
- b) With the help of sketches briefly describe the following classes of clamps
 - i. Strap clamps (3 marks)
 - ii. Cam clamps (3 marks)
 - iii. Toggle clamps (3 marks)
- c) 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. Briefly explain the roles of tool designer with reference to throughput, quality of products, and costs involved (6 marks)
 - ii. Briefly discuss the purpose of using jigs and fixtures to achieve realize the runaway product demand (6 marks)

- d) 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. (5 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 a multi-station jig and an indexing fixture (6 marks)
- b) The tool designer must make sure the part is precisely located and rigidly supported. In addition to properly positioning the part, they should ensure the tool is easily loaded and unloaded.
- Describe the basic rules of clamping (3 marks)
 - Enumerate the principles of clamping to meet the requirements in Qn 2 (b) (i) above (3 marks)
- c) 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. Use sketches to differentiate between open and closed jigs (2 marks)
- d) A key way of 12 mm width, 6 mm depth, and 40 mm long is to be milled on a 50 mm diameter shaft 100 mm long, at the middle of its length. Sketch a suitable fixture and indicate all the parts (6 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)

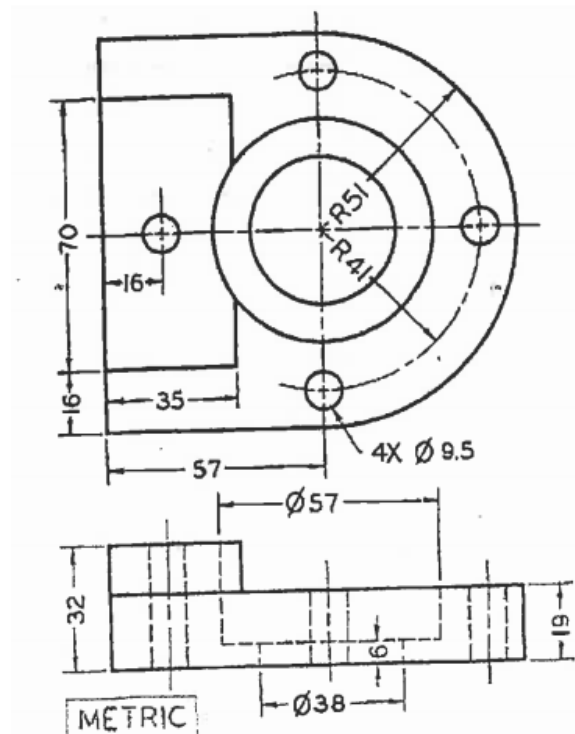


Fig Qn 3 (a)

- 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 in a car manufacturing company (8 marks)

QUESTION FOUR (20 MARKS)

- a) Analyze the part drawing and production plan shown in Fig. Qn 4 and determine all the relevant information necessary to design a channel or box Jig (15 marks)

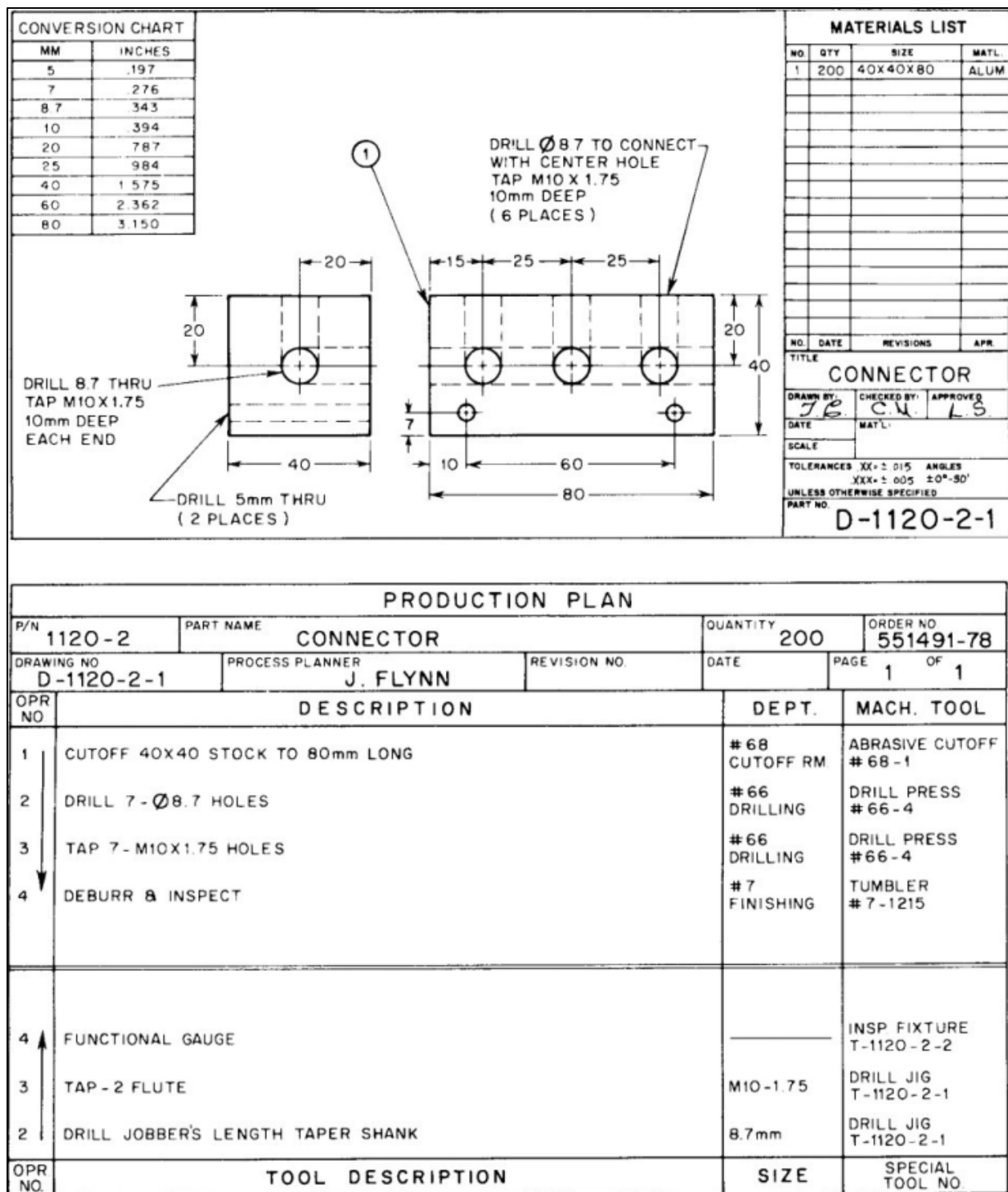


Fig. Qn 4 (a)

- b) Discuss the basic principles adopted while planning for locating blanks in fixtures (5 marks)

QUESTION FIVE (20 MARKS)

- a) Design and draw a channel jig for mild steel component as shown in Fig. Qn 5 (a) to drill a hole of 18 mm diameter. All dimension are in mm. (7 marks)

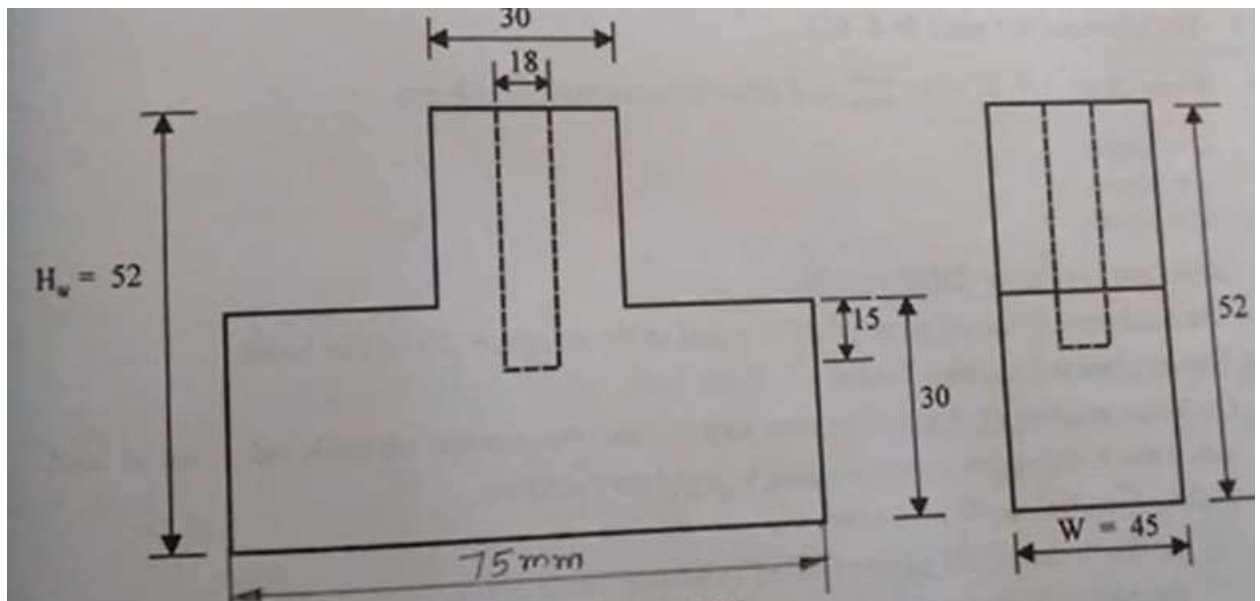


Fig Qn 5 (a)

- 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
- Briefly describe the principles of economic design (3 marks)
 - Five hundred guide plates must be milled to receive a locating block. The tool designer has determined three possible alternatives;
 - Have a tool maker who earns \$12/ hour, mill the plates at a rate of \$25/ hour.
 - 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.
 - 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

(10 marks)