



MACHAKOS UNIVERSITY

University Examinations 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF ENGINEERING IN MECHANICAL ENGINEERING

EMM 410: MANUFACTURING PROCESSES II

DATE: _____ **TIME:** _____

INSTRUCTIONS

- i. This paper contains five questions.
- ii. Question 1 is COMPULSORY
- iii. Question 1 carries 30 Marks while the rest carry 20 Marks each.
- iv. Attempt Question 1 and any other 2 Questions.

QUESTION ONE

- a) With an assist from sound that humans can't hear, machining can be a cooler and faster process, explain [2 Marks]
- b) Explain the two major categories of processes used to coalesce metals or thermoplastics. [3 Marks]
- c) With the aid of clearly labelled diagrams, explain the following:
 - i. Self-shielded flux-cored process
 - ii. The process that uses a blanket of powdered flux [18 Marks]
- d) A resistance spot-welding operation is performed on two pieces of 1.5-mm-thick sheet steel using 12,000 A for a 0.20 s duration. The electrodes are 6 mm in diameter at the contacting surfaces. Resistance is assumed to be 0.0001Ω , and the resulting weld nugget is 6 mm in diameter and 2.5 mm thick. The unit melting energy for the metal $U_m = 12.0 \text{ J/mm}^3$. What portion of the heat generated is used to form the weld nugget, and what portion is dissipated into the work metal, electrodes, and surrounding air? [7 Marks]

QUESTION TWO

- a) Using appropriate illustrations discuss exhaustively joining processes that employ heat transmitted from flames and cite their advantages and disadvantages. **[15 Marks]**
- b) In a controlled experiment, it takes 3700 Joules to melt the amount of bronze metal (Melting Point 1120 °K) that is in a weld bead with a cross-sectional area of 6.0 mm² and 150.0 mm long. If the heat transfer factor is 0.85 and the melting factor is 0.55 for a welding process, how much heat must be generated at the welding source to accomplish the weld? **[5 Marks]**

QUESTION THREE

- a) Using appropriate illustrations, discuss the processes that employ anodic dissolution for material removal and outline their advantages and disadvantages. **[13 Marks]**
- b) An ECM operation is to be used to cut a hole into a plate of aluminum that is 12 mm thick. The hole has a rectangular cross section, 10 mm x 30 mm. The ECM operation will be accomplished at a current = 1200 amps. Efficiency is expected to be 95%. Given that the specific removal rate C for aluminum = $3.44 \times 10^{-2} \text{ mm}^3/\text{A-s}$, determine feed rate and time required to cut through the plate. **[7 Marks]**

QUESTION FOUR

- a) For the following applications, identify one or more nontraditional machining processes that might be used, and present arguments to support your selection. Assume that either the part geometry or the work material (or both) preclude the use of conventional machining. **[8 Marks]**
- (i) A matrix of 0.1 mm (0.004 in) diameter holes in a plate of 3.2 mm (0.125 in) thick hardened tool steel. The matrix is rectangular, 75 by 125 mm (3.0 by 5.0 in) with the separation between holes in each direction = 1.6 mm (0.0625 in).
- (i) An engraved aluminum printing plate to be used in an offset printing press to make a 275 by 350 mm (11 by 14 in) poster.
- b) An electric discharge machining operation is being performed on two work materials: tungsten and tin. Determine the amount of metal removed in the operation after one hour at a discharge current of 20 amps for each of these metals. Use metric units and express the answers in mm³/hr. The melting temperatures of tungsten and tin are 3410°C and 232°C, respectively. **[12 Marks]**

QUESTION FIVE

- a) Using appropriate illustrations and real-life examples, discuss the defects commonly encountered in welding **[13 Marks]**
- b) A fillet weld is used to join 2 medium carbon steel plates each having a thickness of 5.0 mm. The plates are joined at a 90° angle using an inside fillet corner joint. The velocity of the welding head is 6 mm/sec. Assume the cross section of the weld bead approximates a right isosceles triangle with a leg length of 4.5 mm, the heat transfer factor is 0.80, and the melting

factor is 0.58. Given that the melting temperature of iron is 1700°K , determine the rate of heat generation required at the welding source to accomplish the weld. [7 Marks]