MACHAKOS UNIVERSITY

University Examinations for 2019/2020Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 410: MANUFACTURING PROCESSES II

DATE: 16/11/2020 **TIME: 8.30-10.30 AM**

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. Answer QUESTION 1 and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Explain how the ultrasonic machining process works. (2 marks)

b) Welding processes are dividing into two major categories, explain. (3 marks)

c) With the aid of clearly labelled diagrams, explain the following welding processes:

i. Flux-cored arc welding

ii. Submerged arc welding (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 J/mm^3. What portion of the heat generated was used to form the weld nugget, and what portion was dissipated into the work metal, electrodes, and surrounding air? (7 marks)

QUESTION TWO (20 MARKS)

a) Using appropriate illustrations discuss exhaustively the Oxy-acetylene welding process citing its advantages and disadvantages. (15 marks)

b) In a controlled experiment, it takes 3700 J to melt the amount of bronze metal (Melting Point 1120 ^{o}K) that is in a weld bead with a cross-sectional area of 6.0 mm^2 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 (20 MARKS)

a) Using appropriate illustrations, 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^{o}K, determine the rate of heat generation required at the welding source to accomplish the weld.

(7 marks)

QUESTION FOUR (20 MARKS)

a) Using an appropriate illustration, discuss the electrochemical machining process and outline its 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 = 3.44x10^{-2}mm^3/A-s, determine feed rate and time required to cut through the plate. (7 marks)

QUESTION FIVE (20 MARKS)

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.

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). (4 marks)

ii. 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. (4 marks)

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 mm^3/hr. The melting temperatures of tungsten and tin are 3410°C and 232°C, respectively. (12 marks)