MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 216: WORKSHOP PROCESSES AND PRACTICE III

DATE:16/12/2021 **TIME: 8:30 – 10:30 AM**

INSTRUCTIONS

1) **The paper consists of Five questions**
2) **Question ONE is Compulsory and carries Thirty Marks**
3) **Choose any TWO other questions from the paper**

QUESTION ONE (30 MARKS)

a) Define the term **fusion weld**. (2 marks)

b) What is the difference between peripheral milling and face milling? (2 marks)

c) State and explain the three mechanisms of grinding wheel wear? (5 marks)

d) What is ***centerless grinding***? (3 marks)

e) Using simple indexing, with a Brown & Sharpe dividing head (40 teeth worm wheel), explain the procedure for cutting seven flutes. Use the table given below. (8 marks)

f) A face milling operation is used to machine 5 mm from the top surface of a rectangular piece of aluminum 400 mm long by 100 mm wide. The cutter has four teeth (cemented carbide inserts) and is 150 mm in diameter. Cutting conditions are: v = 3 m/s, f = 0.27 mm/tooth, and d = 5.0 mm. Determine: (a) time to make one pass across the surface, and (b) metal removal rate during cutting. (5 marks)

g) In a surface grinding operation the wheel diameter = 150 mm and the infeed = 0.07 mm. The wheel speed = 1450 m/min, work speed = 0.25 m/s, and the cross-feed = 5 mm. The number of active grits per area of wheel surface $C = 0.75$ grits/mm^2. Determine: (a) average length per chip, (b) metal removal rate, and (c) number of chips formed per unit time for the portion of the operation when the wheel is engaged in the work. (5 marks)

QUESTION TWO (20 MARKS)

a) Explain the different types of peripheral milling operations. (6 marks)

b) Describe the difference between up milling and down milling? (2 marks)

c) State the characteristics used to identify the capacities of a milling machine. (4 marks)

d) A T-slot is to be cut in a C.I. slab as shown in the figure below. Estimate the machining time.

Take cutting speed 25 m/min, feed is 0.25 mm/rev. Dia of cutter for channel milling is 80 mm. (8 marks)

QUESTION THREE (20 MARKS)

a) What is ***wheel structure***? (2 marks)

b) What are the five principal parameters of a grinding wheel? (3 marks)

c) Why are abrasive processes technologically and commercially important? (3 marks)

d) Why are specific energy values so much higher in grinding than in traditional metal cutting processes? (4 marks)

e) In a surface grinding operation performed on hardened plain carbon steel, the grinding wheel has a diameter = 200 mm and width = 25 mm. The wheel rotates at 2400 rev/min, with a depth of cut (infeed) = 0.05 mm/pass and a cross-feed = 3.50 mm. The reciprocating speed of the work is 6m/min, and the operation is performed dry. Determine: (a) the length of contact between the wheel and the work, (b) the volume rate of metal removed. (c) If $C = 0.64$ active grits/mm^2, estimate the number of chips formed per unit time. (d) What is the average volume per chip? (e)

If the tangential cutting force on the work = 30 N, compute the specific energy in this operation? (8 marks)

QUESTION FOUR (20 MARKS)

a) Define what an ***electrical arc*** is. (2 marks)

b) What are the advantages and disadvantages of welding compared to other types of

c) assembly operations? (3 marks)

d) Explain the lapping process. (5 marks)

e) The unit melting energy for a certain sheet metal to be spot welded is Um = 10.0 J/mm3. The thickness of each of the two sheets to be welded is 3.0 mm. To achieve required strength, it is desired to form a weld nugget that is 6.0 mm in diameter and 4.5 mm thick. The weld duration will be set at 0.2 sec. If it is assumed that the electrical resistance between the surfaces is 125 micro-ohms, and that only one-third of the electrical energy generated will be used to form the weld nugget (the rest being dissipated into the work), determine the minimum current level required in this operation. (5 marks)

f) A GTAW operation is performed on stainless steel, whose unit melting energy Um = 9.3 J/mm^3.The conditions are: E = 25 volts, I = 125 amps, $f1$ = 0.65, and $f2$ = 0.70. If filler metal wire of 3.0mm diameter is added to the operation, and the final weld bead is composed of equal volumes of filler and base metal. If the travel speed in the operation v = 5 mm/sec, determine: (a) cross-sectional area of the weld bead, and (b) the feed rate (in mm/sec) at which the filler wire must be supplied. (5 marks)

QUESTION FIVE (20 MARKS)

a) Describe the sequence of steps in the cycle of a resistance spot welding operation. (3 marks)

b) What are some of the design guidelines for weldments that are fabricated by arc welding? (3 marks)

c) Name some of the principal bonding materials used in grinding wheels. (5 marks)

d) A gas tungsten arc-welding operation is performed at a current of 300A and voltage of 20V. The melting factor f_2 = 0.5, and the unit melting energy for the metal U_m =10 J/mm^3. Determine (a) power in the operation, (b) rate of heat generation at the weld, and (c) volume rate of metal welded. (4 marks)

e) A gas tungsten arc-welding operation is performed at a current of 300A and voltage of 20V.The melting factor f_2 = 0.5, and the unit melting energy for the metal U_m =10 J/mm^3. Determine (a) power in the operation, (b) rate of heat generation at the weld, and (c) volume rate of metal welded. (5 marks)