MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR SPECIAL/SUPPLIMENTARY EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 315 MATERIALS FORMING PROCESSES I

DATE: 26/3/2021 **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

QUESTION ONE (30 MARKS)

a) Draw a neat sketch of a die–punch assembly with accessory parts / components. Also explain how cutting operations such as blanking or piercing differ from deep drawing operation
(10 marks)

b) Enumerate the defects in deep drawing (5 marks)

c) You are required to reduce a low carbon steel plate of yield strength 174 MPa and tensile strength 290 MPa from a thickness of 42.0 mm to 34.0 mm in one pass rolling operation. Given that the plate widens by 4% as the thickness is reduced, the entrance speed of the plate is 15.0 m/min, the roll radius is 325 mm and the rotational speed is 49.0 rev/min, determine

i. the minimum required coefficient of friction that would make this rolling operation possible,

ii. exit velocity of the plate, and

iii. forward slip. (15 Marks)

QUESTION TWO (20 MARKS)

a) Explain at least two types of machines used for forging work (8 marks)

b) A cylindrical part is warm upset forged in an open die. The initial diameter is 45 mm and the initial height is 40 mm. The height after forging is 25 mm. The coefficient of friction at the diework interface is 0.20. The work material has a flow curve defined by a strength coefficient of 600 MPa and a strain hardening exponent of 0.12. Determine the force in the operation

i. just as the yield point is reached (yield at strain = 0.002),

ii. at a height of 35 mm, and

iii. at a height of 25 mm. (12 marks)

QUESTION THREE (20 MARKS)

a) What are the general factors that determine the properties of a composite material? (6 marks)

b) Give some examples of commercial products which are laminar composite structures (4 marks)

c) A fiberglass composite is composed of a matrix of vinyl ester and reinforcing fibers of E-glass. The volume fraction of E-glass is 35%. The remainder is vinyl ester. The density of the vinyl ester is 0.882 g/cm^3 and its modulus of elasticity is 3.60 GPa. The density of E-glass is 2.60 g/cm^3 and its modulus of elasticity is 76.0 GPa. A section of composite 1.00 cm x 50.00 cm x 200.00 cm is fabricated with the E-glass fibers running longitudinal along the 200 cm direction. Assume there are no voids in the composite. Determine the;

i. mass of vinyl ester in the section,

ii. mass of E-glass fibers in the section, and

iii. the density of the composite. (10 marks)

QUESTION FOUR (20 MARKS)

a) Identify some of the important advantages of shape casting processes. (6 marks)

b) What are the advantages and disadvantages of sand casting over investment casting? (6 marks)

c) A large steel sand casting shows the characteristic signs of penetration defect - a surface consisting of a mixture of sand and metal.

i. What steps can be taken to correct the defect?

ii. What other possible defects might result from taking each of these steps? (6 marks)

d) If a true centrifugal casting operation were to be performed in a space station circling the Earth how would weightlessness affect the process? (2 marks)

QUESTION FIVE (20 MARKS)

a) What are some of the reasons why the plastic shaping processes are important? (5 marks)

b) List the main categories of plastics shaping processes, as classified by the resulting product

c) geometry. (5 marks)

d) Using a clear illustration, identify the major components and sections of an extrusion moulding machine. (5 marks)

e) Explain the processes by which polymer foams are produced (5 marks)