



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING)

EMM 315: MATERIAL FORMING PROCESSES I

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. Answer QUESTION 1 and any other TWO (2) questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Explain the major drawbacks of hot working. (5 marks)
- b) Explain why parts produced through forging are more preferred than those produced through machining and welding process. (2 marks)
- c) In open-die forging operation, a disc of diameter 200 mm and height 60 mm is compressed without any barreling effect. The final diameter of the disc is 400 mm. Determine the true strain. (5 marks)
- d) The force requirement in a blanking operation of low carbon steel sheet is 5.0 kN. The thickness of the sheet is 't' and diameter of the blanked part is 'd'. For the same work material, if the diameter of the blanked part is increased to 1.5d and thickness is reduced to 0.4t. Determine the new blanking force in kN. (4 marks)
- e) An annealed copper wire of 25 mm diameter is drawn into a wire of 5 mm diameter. Determine the average yield stress in this operation if the curve of the material is given, $\sigma = 315 \epsilon^{0.54}$ MPa. (5 marks)

- f) A continuous and aligned glass fiber-reinforced composite consists of 40 vol% of glass fibers having a modulus of elasticity of 69 GPa (psi) and 60 vol% of a polyester resin that, when hardened, displays a modulus of 3.4 GPa (psi). (9 marks)
- Compute the modulus of elasticity of this composite in the longitudinal direction.
 - If the cross-sectional area is 250 mm² and a stress of 50 MPa is applied in this longitudinal direction, compute the magnitude of the load carried by each of the fiber and matrix phases.

QUESTION TWO (20 MARKS)

- a) Use a work formula approach to estimate the minimum pressure required to extrude aluminium curtain rail of I-section, 12 mm high with 6 mm wide flanges, all 1.6 mm thick, from 25 mm diameter bar stock. [The mean uniaxial yield stress for aluminium for heavy deformation at room temperature is 150 MPa. The minimum pressure, P_{min} , required is given by the formula

$$P_{min} = Y \ln \left(\frac{A_0}{A_1} \right)$$

where A_0 is the original cross-sectional area and A_1 is the cross-sectional area of the extruded I-section]. (9 marks)

- b) A 2 mm thick metal sheet is to be bent at an angle of one radian with a bend radius of 100 mm as shown in figure Q2 below. Given that the stretch factor is 0.5, determine the bend allowance. (5 marks)

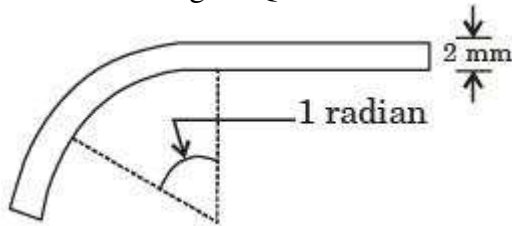


Fig Q2

- c) A solid cylinder of diameter 100 mm and height 50 mm is forged between two frictionless flat dies to a height of 25 mm. Determine the percentage change in diameter. (6 marks)

QUESTION THREE (20 MARKS)

- Discuss the application of investment casting in manufacturing and outline its advantages and disadvantages. (8 marks)
- Explain the characteristics and use of a gooseneck in hot chamber die casting. (2 marks)
- Using a clear illustration, explain the process of cold chamber die-casting and outline its advantages. (10 marks)

QUESTION FOUR (20 MARKS)

- Using an appropriate illustration, explain the steps in traditional sand moulding. (6 marks)

- b) In sand casting of hollow part of lead, a cylindrical core of diameter 120 mm and height 180 mm is placed inside the mould cavity. The densities of core material and lead are 1600 kg/m^3 and 11300 kg/m^3 respectively. Determine: (8 marks)
- (i) The net force (in N) will tend to lift the core during pouring of molten metal.
 - (ii) The mould filling time
 - (iii) The volume flow rate into the cavity
- c) List casting processes that are suitable for making hollow parts with (i) complex external features, (ii) complex internal features, and (iii) both complex external and complex internal features. Explain your choices. (6 marks)

QUESTION FIVE (20 MARKS)

- a) Explain the design considerations involved in replacing a metal beverage can with one made completely of plastic. (5 marks)
- b) A 2-L plastic beverage bottle of length $L = 230 \text{ mm}$ long and diameter $D = 110 \text{ mm}$ and wall thickness $t = 0.38 \text{ mm}$ is made by blow moulding a parison (pre-form) 125 mm long and with a diameter that is the same as that of the threaded neck of the bottle. Assuming uniform deformation during molding, estimate the wall thickness of the tubular portion of the parison. (5 marks)
- c) Using an appropriate illustration, describe the features of a screw extruder and its functions. (10 marks)