# MACHAKOS UNIVERSITY

**University Examinations 2023/2024**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING**

**FOURTH YEAR FIRST SEMESTER EXAMINATION FOR**

**BACHELOR OF ENGINEERING IN MECHANICAL ENGINEERING**

**EMM 409: MANUFACTURING 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 questions.

**QUESTION ONE (30MARKS)**

a) Explain the following processes: **[5 Marks]**

i. Blanking
ii. Punching
iii. Piercing
iv. Trimming
v. Slitting

b) Assume you are newly employed in an industry that seeks to install a powder metallurgy process. Using appropriate illustrations, develop an explanation to the company management the powder metallurgy (PM) production sequence and the typical heat treatment cycle of PM parts. **[10 Marks]**

c) A company wishes to manufacture a bush bearing out of bronze powder using the PM process. Given that a compacting pressure 207 MPa is required to produce a bearing of 44 mm outside diameter, 22 mm inside diameter and a length of 25 mm, determine the press tonnage required to perform the operation. **[ 3 Marks]**

d) What disadvantages would you associate forging processes with? **[3 Marks]**

e) Using an appropriate illustration explain concept of stretch forming, its advantages and disadvantages. **[9 Marks]**

**QUESTION ONE (20MARKS)**

a) Using neat illustrations, explain the process of metal rolling and the classification of rolling mills. **[6 Marks]**

b) You are required to reduce the thickness of a 300-mm-wide metal strip from 25-mm to 22mm using one (1) pass rolling between two powered rolls each of radius = 250 mm, at a speed of 50 revs/min. Given that the work material has a flow curve defined by **K** = 275 MPa and **n** = 0.15, and the coefficient of friction between the rolls and the work is 0.12. Determine whether or not, if the friction generated would be sufficient to allow the rolling operation to be accomplished. If so, calculate the roll force, torque, and power. **[14 Marks]**

**QUESTION THREE (30MARKS)**

a) Using clear and neat illustrations explain the following forging processes: **[ 8 Marks]**
   (i) Closed die forging
   (ii) Upset forging

b) A cylindrical workpiece of height 75 mm and 50mm diameter is to be reduced through a an upset forging operation to a height of 36mm. Given that the work material has a flow curve defined by **K**=350MPa and **n**=0.17, determine the force as the process begins, at intermediate heights of 62mm, 49 mm, and at the final height of 36 mm under the following assumptions; coefficient of friction of 0.1, constant volume, and neglecting barreling.
**[ 12 Marks]**

**QUESTION ONE (20MARKS)**

a) Using appropriate illustrations, compare **direct** and **indirect** extrusion processes. **[10 Marks]**

b) A cylindrical billet of 25mm diameter and length 75mm is to be extruded in a direct extrusion operation with extrusion ratio rx = 4.0 and die angle (half-angle) of $90^{o}$ to produce an extrudate of round cross section. Given that the work metal has a strength coefficient = 415 MPa, and strain-hardening exponent = 0.18, apply the Johnson formula with a = 0.8 and b = 1.5 to estimate extrusion strain, then determine the pressure applied to the end of the billet as the ram moves forward. **[10 Marks]**

**QUESTION ONE (20MARKS)**

a) Using clear illustrations explain the classification of material removal processes. **[ 7 Marks]**

b) From commercial and technological perspectives, explain the importance of machining. **[ 4 Marks]**

c) Briefly explain the following machining processes:- **[ 4 Marks]**
   (i) Form turning,
   (ii) Threading,
   (iii) Boring.

**QUESTION ONE (20MARKS)**

A peripheral milling operation is performed on the top surface of a rectangular workpart which is 400 mm long by 60 mm wide. The milling cutter, which is 80 mm in diameter and has five teeth, overhangs the width of the part on both sides. Cutting speed = 70 m/min, chip load = 0.25 mm/tooth, and depth of cut = 5.0 mm. Determine:- **[ 5 Marks]**

a) the actual machining time to make one pass across the surface and
b) the maximum material removal rate during the cut.