



PROGRAM : BACHELOR OF ENGINEERING TECHNOLOGY IN
PHYSICAL METALLURGY

SUBJECT : MECHANICAL DEFORMATION TECHNOLOGIES 3A

CODE : MDEMTA3

DATE : SUPPLEMENTARY EXAMINATION
JULY 2019

DURATION : 3 HOURS

WEIGHT : 40:60

TOTAL MARKS : 80

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NUMBER OF PAGES : 3 PAGES

INSTRUCTIONS : ANSWER ALL QUESTIONS

REQUIREMENTS : CALCULATOR

QUESTION 1 (35 MARKS)

- 1.1 Apply the theory of deformation zone geometry to explain how will you go about increasing the deformation efficiency in wire drawing. (6)
- 1.2 What effect does high semi-die angle and low reductions values have on the interface pressure or ratio ($\frac{p}{2k}$). Illustrate your answer using an appropriate graph. (6)
- 1.3 Discuss the combine effect of temperature and strain rate on flow stress during hot working of metals. (4)
- 1.4 Hydrodynamic lubrication mechanism reduces wear of tools and give low friction values in metal-working process. However, it is still not a preferred lubrication mechanism. Explain this statement (4)
- 1.5 In wire drawing sometimes multiple passes are used to achieve a certain final diameter. Suppose you are asked to reduce number of passes in a process in order to reduce cost, explain how will you go about achieving the above. (6)
- 1.6 What are the consequences of insufficient lubrication in metal-working processes? (5)
- 1.7 Explain four (4) conditions that affect the temperature of the workpiece in metal working. (4)

QUESTION 2 (30 marks)

2.1 A deformation efficiency of a rolling process is given as 85%, suppose a total workdone during the rolling process is 800 MJ m^{-3} , calculate the plastic work done. (3)

2.2 The flow stress of an annealed metal after strain hardening is expressed by $\bar{\sigma} = 1400\bar{\epsilon}^{0.5}$. A 25mm-diameter rod of this metal is drawn down to 20mm. Given die angle (α) = 10° and $\mu = 0.09$, neglect the redundant work and calculate the following:

2.2.1 The drawing stress. (10)

2.2.2 The deformation efficiency. (5)

2.2.3 The maximum drawing reduction. (2)

2.2.4 Compare the maximum strain in drawing with that in tension and interpret the result. (5)

2.3 Explain using the appropriate diagram how data from the tensile test and drawing process used to determine the redundant work. (5)

QUESTION 3 (15 marks)

3.1 Discuss the microstructural development associated with dynamic recrystallisation during hot working. (8)

3.2 Why low stacking fault energy metals susceptible to dynamic recrystallisation? (4)

3.3 Explain why It is not possible to retain the as-worked structure in metals that undergoes the dynamic recrystallisation. (3)

Total = 80
