PROGRAM	:	BACCALAUREUS TECHNOLOGIAE *ENGINEERING: METALLURGY*
SUBJECT	:	**MECHANICAL METALLURGY IV**
CODE	:	**TMP42-2**
DATE	:	SUPPLEMENTARY EXAMINATION JULY 2019
DURATION	:	3 HOURS
WEIGHT	:	40:60
TOTAL MARKS	:	95

ASSESSOR	:	MR E. GONYA
MODERATOR	:	MR JM PROZZI FILE: NO 5138
NUMBER OF PAGES	:	3 PAGES

INSTRUCTIONS	:	ANSWER ALL QUESTIONS
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REQUIREMENTS	:	CALCULATOR

QUESTION 1 (25 marks)

1.1 Use the appropriate sketch to explain the relationship between the strength of the crystal and the dislocation density. **(5)**

1.2 Why are fine grain materials superior for low temperature applications? **(4)**

1.3 Using a suitable diagram explain why a shock loaded component can experience brittle fracture even at higher temperatures. **(6)**

1.4 High purity materials shows a wider range of ECT as compared to commercial pure metals. Explain. **(3)**

1.5 Explain the effect of the following metallurgical factors on DBTT.

1.5.1 Chemical composition (Manganese and Carbon) **(2)**

1.5.2 Coarse and fine grain size **(2)**

1.5.2 Sample orientation relative to rolling **(3)**

QUESTION 2 (40 Marks)

2.1 Determine the partial dislocations formed from (a/2)[$01\bar{1}$] on the ($\bar{1}\bar{1}\bar{1}$) in the FCC crystal structure **(12)**

2.2 Determine whether the dislocation dissociation is feasible on the reaction found in 2.1 (**8)**

2.3 A straight dislocation in copper has a burgers vector parallel to [110] and the dislocation line is parallel to [011] direction. Suppose that the angle between the dislocation line and the burgers vector is 60^o and the lattice parameter of copper is 0.362 nm. Determine the following:

2.3.1 What is the character and slip plane of the dislocation? **(8)**

2.3.2 The magnitude of the burgers vector **(2)**

2.4 A Cu-30% Zn alloy tensile bar has a strain hardening coefficient (n) of 0.50. The bar, which has initial diameter of 1cm and an initial gage length of 3cm, fails at an engineering stress of 120 MPa. At the moment of fracture, the gage length is 3.5cm and the diameter is 0.926cm. No necking occur. Calculate the true stress when the true strain is 0.05cm/cm **(10)**

QUESTION 3 (30 Marks)

3.1 Briefly discuss how the following metallurgical phenomena leads to a brittle failure.

- Temper embrittlement **(6)**
- Hydrogen embrittlement **(6)**

3.2 Discuss some advantages and disadvantages of strain hardening in the context of wire drawing. **(6)**

3.3 Use suitable mathematical relation to discuss the appearance of yield point phenomenon in the absence of interstitial atoms. **(7)**

3.4 What is the effect of yield point phenomenon during drawing of automobile body parts and how can it be avoided? **(5)**