



PROGRAM : NATIONAL DIPLOMA
METALLURGICAL ENGINEERING

SUBJECT : **MECHANICAL METALLURGY**

CODE : **TMP 31-1**

DATE : SUMMER EXAMINATION 2015
19 NOVEMBER 2015

DURATION : (SESSION 1) 08:30 - 11:30

TIME : 8:30 - 11:30

WEIGHT : 40 :60

TOTAL MARKS : 100

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MODERATOR : MR JM PROZZI 5103

NUMBER OF PAGES : 4 PAGES

INSTRUCTIONS : CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT)

INSTRUCTIONS TO STUDENTS:

ANSWER ALL QUESTIONS.

QUESTION 1

- 1.1. How can you prevent hydrogen embrittlement? (4)
- 1.2. What is meant by the stress intensity threshold for stress corrosion cracking? (4)
- 1.3. Show with a graph why you cannot always rely on the room temperature result of an impact test. Discuss (5)

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QUESTION 2

- 2.1. Creep deformation mechanism maps can be useful. Explain how you would use them. (4)
- 2.2. Discuss high temperature alloys and the factors that will ensure strength durability at high temperatures. (6)
- 2.3. How can a creep curve be used? Show one and discuss. (5)

[15]

QUESTION 3

- 3.1. Residual stress is a very important feature in fatigue, show how it can be used to improve fatigue life. (5)
- 3.2. How will corrosion affect fatigue properties? (4)
- 3.3. How can you limit fatigue through metallurgical surface modification? (4)

[13]

QUESTION 4

- 4.1. Fracture toughness depends on specimen thickness and it is important to determine a valid fracture toughness value. Show this relationship and discuss how to determine a valid fracture toughness value. (12)

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- 4.2. Name and discuss the three most important features when considering fracture mechanics. (6)
- [18]
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QUESTION 5

- 5.1. What is the nature of a ductile fracture when viewed under a scanning electron microscope? Explain why. (4)
- 5.2. Show the difference between stress distribution at a notch under plane strain and plane stress conditions. Which of these will give the most severe condition? (8)
- [12]
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QUESTION 6

- 6.1. Explain how dislocation movement can be influenced in an aluminium-copper alloy with either coherent or non-coherent precipitates, and what will be the effect on strain hardening. (9)
- 6.2. Show and explain the yield point phenomenon. (6)
- 6.3. What can be done to ensure composite strength when considering the fibers of a composite. (4)
- [19]
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QUESTION 7

- 7.1. How would double cross slip occur and explain the role of edge and screw dislocations. (5)
- 7.2. Show the stages of strain hardening of FCC single crystal with a flow curve and explain. (5)
- [10]
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TOTAL MARKS : 100
