



UNIVERSITY  
OF  
JOHANNESBURG

**PROGRAM** : NATIONAL DIPLOMA  
*ENGINEERING METALLURGY / EXTRACTIVE  
METALLURGY*

**SUBJECT** : MATERIAL TESTING: METALLURGY

**CODE** : MTM 3111

**DATE** : MAIN EXAMINATION  
JUNE 2018

**DURATION** : 3 hours

**WEIGHT** : 40: 60

**TOTAL MARKS** : 100

**FULL MARKS** : 100

**EXAMINER** : MISS TS TSHEPHE

**MODERATOR** : DR D NYBWE

**NUMBER OF PAGES** : 2 PAGES IN TOTAL

**INSTRUCTIONS** : ALL THE ANSWERS MUST BE COMPLETED  
IN THE EXAM SCRIPTS AND HANDED IN

**REQUIREMENTS** : 1 POCKET CALCULATOR  
NO CORRECTION FLUID SHALL BE USED  
ALL WORK SHALL BE HANDED IN.

**INSTRUCTIONS TO CANDIDATES:**

PLEASE ANSWER ALL THE QUESTIONS

### **QUESTION 1**

- 1.1. What are the three basic assumptions made when analysing the strength of material? (3)
- 1.2. Discuss the three general ways that causes failures in structural members and machine elements (6)
- 1.3. A piece of copper originally 305 mm long is pulled in tension with a stress of 276 MPa. If the deformation is entirely elastic, what will be the resultant elongation?  $E = 110\text{ GPa}$  (8)
- 1.4. A cylindrical specimen of steel having an original diameter of 12.8 mm is tensile tested to fracture and found to have an engineering fracture strength of 460 MPa. If its cross-sectional diameter at fracture is 10.7 mm, determine:
  - (a) The ductility in terms of percent reduction in area (5)
  - (b) The true stress at fracture (5)

### **QUESTION 2**

- 2.1. List the three general types of hardness measurements (3)
- 2.2. The Brinell hardness number (BHN or  $H_B$ ) is expressed as the load  $P$  divided by surface area of the indentation. Show the mathematical expression to calculate the Brinell hardness number. (2)
- 2.3. A 10-mm-diameter Brinell hardness indenter produced an indentation 2.50 mm in diameter in a steel alloy when a load of 1000 kg was used. Compute the  $H_B$  of this material. (3)

### **QUESTION 3**

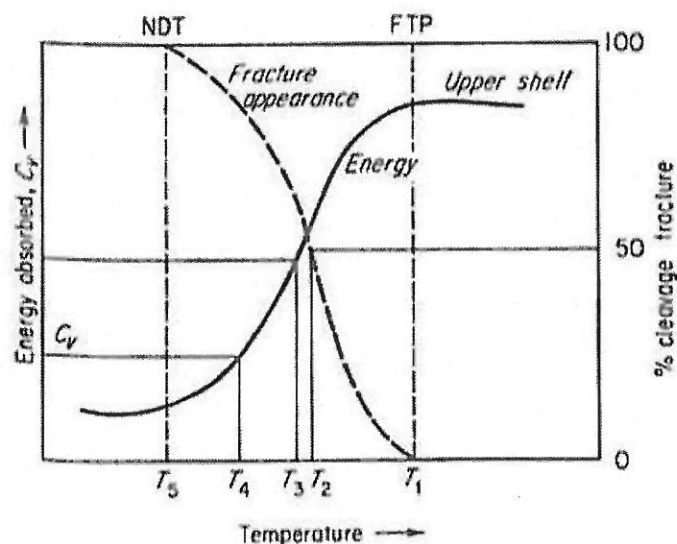
- 3.1. Discuss the three main creep deformation mechanisms (8)
- 3.2. Explain the difference between creep test and rupture test (4)
- 3.3. At what temperature can a material experience creep? (2)

#### QUESTION 4

- 4.1. What is fatigue? (2)
- 4.2. Discuss the three stages to fatigue failure (6)
- 4.3. Show the three types of fluctuating stress curves. Label each curve correctly. (9)
- 4.4. What are the three surface effects on fatigue? (3)

#### QUESTION 5

- 5.1. What type of test is done to determine the susceptibility of materials to brittle behaviour? (2)
- 5.2. Explain the following transition temperatures on the curve below. Explain  $T_1$ ,  $T_2$ ,  $T_3$ ,  $T_4$  and  $T_5$  (10)



- 5.3. Discuss the effects of crystal structure on the DBTT curve (10)
- 5.4. Briefly discuss the magnetic particle test. (9)

TOTAL

[100]