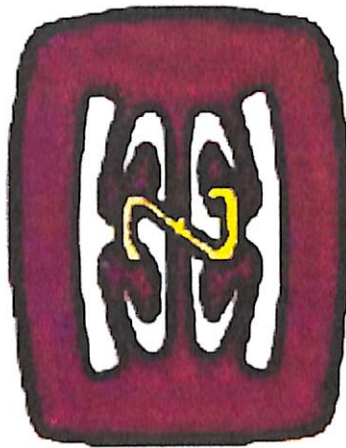


**PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING**

EXAMINATION QUESTION PAPERS



**ME 424
FAILURE ANALYSIS
SEMESTER TWO - 2022**

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
MECHANICAL ENGINEERING DEPARTMENT
2022 SEMESTER TWO – FINAL EXAMINATIONS
ME424 – FAILURE ANALYSIS
THURSDAY OCTOBER 27th, 2022
TIME ALLOWED: TWO HOURS

INSTRUCTIONS TO STUDENTS:

- > Answer all the question directly rather than writing too many unnecessary information.
- > Write clearly, precisely and succinctly.
- > Write your NAME and NUMBER clearly on the front page. Do it now.
- > Mobile Phone, Calculators, Notes and Textbooks are not allowed.
- > **CHEATING WILL BE PUNISHED SEVERELY!!!!**

MARKING SCHEME: 40

[20 MARKS]

PART I: MULTIPLE CHOICES QUESTIONS

1. A material capable of absorbing large amount of energy before fracture is known as
 - a) Ductility
 - b) Toughness
 - c) Shock proof
 - d) Plasticity.
2. Corrosion is the deterioration of a substance or its properties due to
 - a) Mechanical overload
 - b) Reactions with its environment
 - c) Fatigue
 - d) Wear.
3. The energy absorbed in a body, when it is strained within the elastic limits, is known as
 - a) Strain energy
 - b) Proof resilience
 - c) Modulus of resilience
 - d) Toughness.
4. Corrosion accelerated by an oxygen concentration cell will occur
 - a) Within a crevice
 - b) Outside a crevice
 - c) Both inside and outside of a crevice
 - d) Everywhere.
5. Crevice corrosion It may occur at the following except:
 - a) Washers
 - b) Under barnacles and sand grains
 - c) Flat surfaces
 - d) Under applied protective films, and at pockets formed by threaded joints.
6. In the tensile test, the phenomenon of slow extension of the material, i. e. stress increasing with the time at a constant load is called
 - a) Yielding
 - b) Breaking
 - c) Creeping
 - d) Plasticity.
7. Two forms of localized attack are:
 - a) Erosion and Crevice corrosion
 - b) Pitting and intergranular corrosion
 - c) Stress Cracking and High Temperature corrosion
 - d) Pitting and Crevice corrosion.
8. Pitting corrosion can be controlled by
 - a) Materials Selection
 - b) Protective Coatings
 - c) Cathodic protection
 - d) All the above.
9. In a tensile test on mild steel specimen, the breaking stress as compared to ultimate tensile stress is
 - a) More
 - b) Less
 - c) Same
 - d) More/less depending on composition.
10. During a tensile test on a specimen of 1 cm cross-section, maximum load observed was 8 tons and area of cross-section at neck was 0.5 cm². Ultimate tensile strength of specimen is
 - a) 4 tons/cm²
 - b) 8 tons/cm²
 - c) 16 tons/cm²
 - d) 22 tons/cm².
11. Crevice corrosion It may occur at the following except:
 - a) Washers
 - b) Under barnacles and sand grains
 - c) Flat surfaces
 - d) Under applied protective films, and at pockets formed by threaded joints.
12. The impact strength of a material is an index of its
 - a) Tensile strength
 - b) Capability of being cold worked
 - c) Toughness
 - d) Hardness.
13. Tensile strength of a material is obtained by dividing the maximum load during the test by the
 - a) Area at the time of fracture
 - b) Original cross-sectional area
 - c) Average of (a) and (b)
 - d) Minimum area after fracture.

14. In designing equipment and facilities, it is important to consider the various factors that make up the service conditions, these factors including the following except:
- Temperature
 - Material
 - Velocity
 - Pressure.
15. Corrosion inhibitors generally control corrosion by:
- Forming thin films that modify the environment at the metal surface.
 - Removing the oxygen from the system
 - Changing the pH
 - Changing the temperature.
16. The ultimate tensile stress of mild steel compared to ultimate compressive stress is
- More
 - Same
 - Less
 - More or less depending on other factors.
17. Stainless steels are normally classified based on their microstructure, and usually are defined as iron-based alloys having at least
- 11% Lead
 - 11% Carbon
 - 11% Copper
 - 11% Chromium.
18. Problems associated with welds that may affect their corrosion resistance include:
- Brittle failures
 - Heat-affected zones
 - Porosity
 - B and C.
19. Two forms of localized attack are:
- Erosion and Crevice corrosion
 - Pitting and intergranular corrosion
 - Pitting and Crevice corrosion
 - Stress cracking and high temperature corrosion.
20. is often the result of the wearing a way of a protective scale or coating on the metal surface.
- Corrosion Stress Cracking
 - Crevice Corrosion
 - Erosion Corrosion
 - High Temperature Corrosion.

PART II: SOLVE THE FOLLOWING PROBLEMS**[20 MARKS]**

1. (8 marks) A ceramic matrix composite contains internal flaws as large as 0.001 cm in length. The plane strain fracture toughness of the composite is 45 and the tensile strength is 550 MPa. Will the flaw cause the composite to fail before the tensile strength is reached? Assume that $f = 1$.

2. (12 marks) Of those metals listed in Table below:
- Which will experience the greatest percent reduction in area? Why?
 - Which is the strongest? Why?
 - Which is the stiffest? Why?
 - Which is the hardest? Why?

Metals	Yield Strength MPa	Tensile Strength MPa	Strain at Fracture MPa	Fracture Strength MPa	Elastic Modulus GPa
A	310	340	0.23	265	210
B	100	120	0.40	105	150
C	415	550	0.15	500	310
D	700	850	0.14	720	210
E	Fracture before yielding			650	350