

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

MECHANICAL ENGINEERING DEPARTMENT

2023 SEMESTER ONE – FINAL EXAMINATIONS

ME312 – MACHINE DESIGN

MONDAY JUNE 5TH, 2023

TIME ALLOWED: TWO HOURS

INSTRUCTIONS TO STUDENTS:

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

MARKING SCHEME: 40

PART ONE: MULTIPLE CHOICE QUESTIONS

[20 MARKS]

1. A term used to describe sudden applied force or disturbance.
 - a) Shock
 - b) Impact
 - c) Creep
 - d) Load
2. It is the capacity of a material to absorb energy when it is deformed elastically and then, upon unloading, to increase this energy. What is the capacity of a material?
 - a) Resilience
 - b) Toughness
 - c) Rigidity
 - d) Ductility
3. It is called as the transformation of concepts and ideas into useful machinery. What is this?
 - a) Design
 - b) Synthesis
 - c) Analysis
 - d) Theorem
4. What is the ability of the material to absorb energy up to fracture?
 - a) Toughness
 - b) Rigidity
 - c) Resilience
 - d) Stiffness
5. How do call the size to which limits or deviations is assigned and is the same for both members of the fit; it is the exact theoretical size?
 - a) Basic size
 - b) Nominal size
 - c) Maximum size
 - d) Minimum size
6. What is the algebraic difference between a size and the corresponding basic size?
 - a) Tolerance
 - b) Deviation
 - c) Allowance
 - d) Limit
7. What is the difference between the maximum and minimum size limits of a part?
 - a) Allowance
 - b) Tolerance
 - c) Deviation
 - d) Basic size
8. How do you call the strain energy per unit volume required to stress a material from an unloaded state to the point of yielding?
 - a) Modulus of roughness
 - b) Modulus of resilience
 - c) Modulus of elasticity
 - d) Modulus of rigidity
9. It refers to the collision of two or more masses with initial velocities.
 - a) Shock
 - b) Impact
 - c) Creep
 - d) Load
10. In designing equipment and facilities, it is important to consider the various factors that make up the service conditions. These factors include the following, except
 - a) Temperature
 - b) Material
 - c) Velocity
 - d) Pressure

11. Which one of the following is not part of the materials selection process?
 - a) Application
 - b) Material
 - c) Marketing
 - d) Properties
12. Which does not contain a mechanical property of a material?
 - a) Stiffness, creep and strength
 - b) Creep, strength and fatigue
 - c) Creep, density and hardness
 - d) Ductility, hardness and strength
13. The maximum load per cross sectional is:
 - a) Yield Strength
 - b) Fracture Strength
 - c) Ultimate Tensile Strength
 - d) Bicep Strength
14. Which of the following property is essential for spring materials?
 - a) Stiffness
 - b) Ductility
 - c) Resilience
 - d) Plasticity
15. A shaft is subjected to
 - a) Bending stresses
 - b) Shear stresses
 - c) Combined bending and shear stresses
 - d) All of these
16. The algebraic difference between the maximum limit and the basic size is called
 - a) Lower deviation
 - b) Actual deviation
 - c) Mean deviation
 - d) Upper deviation
17. Failure of a material is called fatigue when it fails
 - a) At the elastic limit
 - b) Below the elastic limit
 - c) At the yield point
 - d) Below the yield point
18. Any of the above Gear box is used
 - a) To produce torque
 - b) To increase efficiency of system
 - c) To damp out vibrations
 - d) To obtain variable speeds
19. The main objective of design synthesis is
 - a) Maximization
 - b) Minimization
 - c) None of the above
 - d) Optimization
20. Which of the following factor(s) is (are) considered for selecting a material.
 - a) Availability
 - b) Mechanical properties
 - c) Cost
 - d) All of the above

PART TWO: SOLVE ANY FOUR FROM THE FOLLOWING FIVE PROBLEMS [20 MARKS]

1. A 15 mm long and 13 mm diameter sample shows the following behaviour in a tensile test. Load at 0.2% offset – 6800 kg, maximum load – 8400 kg, fracture occurs at 7300 kg, diameter and length after fracture – 8 mm and 65 mm respectively. Determine the following standard mechanical properties:
 - a) Tensile strength
 - b) Proof stress
 - c) Breaking stress
 - d) Percentage of Elongation
 - e) Percentage of Area reduction?
2. A shaft is transmitting 100 kW at 160 r.p.m. Find a suitable diameter for the shaft, if the maximum torque transmitted exceeds the mean by 25%. Take maximum allowable shear stress as 70 MPa.
3. A wrought iron bar 50 mm in diameter and 2.5 m long transmits shock energy of 100 N-m. Find the maximum instantaneous stress and the elongation. Take $E = 200 \text{ GN/m}^2$.
4. An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm, what is the corresponding stress and the value of unknown weight? Take $E = 200 \text{ kN/mm}^2$.
5. The dimensions of the mating parts, according to basic hole system, are given as follows:
Hole: 25.00 mm, 25.02 mm
Shaft: 24.97 mm, 24.95 mm
Find the hole tolerance, shaft tolerance and allowance?