



*(University of Choice)*

**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**SECOND YEAR SECOND SEMESTER  
EXAMINATIONS FOR THE DIPLOMA  
IN**

**MECHANICAL AND INDUSTRIAL ENGINEERING**

**COURSE CODE: DME 053**

**COURSE TITLE: MECHANICAL ENGINEERING PRINCIPLES**

**DATE:** Wednesday 27<sup>th</sup> April, 2022      **TIME:** 12.00 pm - 2.00 pm

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**INSTRUCTIONS TO CANDIDATES**

Answer Question ONE and any other TWO questions

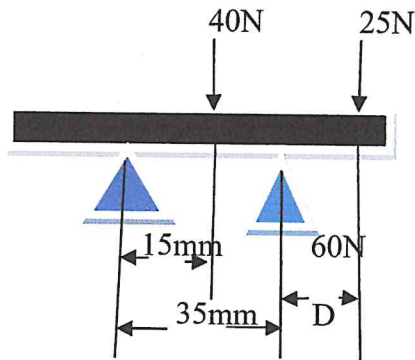
**TIME: 2 Hours**

**QUESTION ONE****30MKS**

- a) A split pin requires a force of 400N to shear it. The maximum shear stress before shear occurs is 120Mpa. Determine the Minimum diameter of the pin in millimeter. **(3mks)**
- b) A pipe has an outside diameter of 20mm, an inside diameter of 10mm and length 0.3M and it supports a Compressive load of 50KN. The pipe shortens by 0.6mm when the load is applied, determine
- The compressive stress **(2mks)**
  - The compressive strain in the pipe when supporting this load **(2mks)**
- c) Using a graphical sketch explain what happens in various stages when a work piece is subjected under tensile test. **(5mks)**
- d) Using examples distinguish between a scalar quantity and a Vector quantity. **(4mks)**
- e) A force of 60N is applied to a lever of a screw jack at a radius of 220mm. If the lever makes 25 revolutions, determine
- The work done on the jack **(1mk)**
  - The power, if the time taken to complete 25 revolutions is 40s **(2mks)**
- f) A motor connected to a shaft develops a torque of 3.5KNm. Determine the number of revolutions made by the shaft if the work done is 11.52MJ. **(3mks)**
- g) State and explain **THREE** measuring devices **(3mks)**
- h) Some ice, initially at -40 degree Celsius, has heat supplied to it at a constant rate until it becomes super-heated steam at 150 degree Celsius. Sketch a typical temperature/time graph expected and use it to explain the why the shape of the graph is appearing like that. **(3mks)**
- i) State **TWO** difference between Annealing and normalizing **(2mks)**

**QUESTION TWO****20MKS**

- a) A pile – diver of mass 400kg falls freely through a height of 1.2m on to a pile of mass 150kg. If, at impact, 2.5KJ of energy are lost due to heat and sound , the remaining energy being possessed by the pile and driver as they are driven together into the ground a distance of 150mm, determine;
- The common velocity after impact
  - The average resistance of the ground **(5mks)**
- b) The forces acting on a beam are shown in the figure below, neglecting the mass of the beam , find the value of  $R_A$  and distance  $D$  when the beam is in equilibrium



- c) A circular section bar is 2.5 m long and has a diameter of 60mm. When subjected to a compressive load of 30kN it shortens by 0.20mm, Determine Young's Modulus of elasticity for the material of the bar. **(5mks)**
- d) Distinguish between elasticity and plasticity giving one example of each **(3mks)**
- e) A wire is stretched by 1.5mm by a force of 300N. Determine the force that would stretch the wire 4mm, assuming the elastic limit of the wire is not exceeded. **(3mks)**

### QUESTION THREE

**20MKS**

- a) A hoist exerts a force of 500N in raising a load through a height of 20m. The efficiency of the hoist gears is 75% and the efficiency of the motor is 80%. Calculate input energy to the hoist. **(5mks)**
- b) When a circular hole of diameter 40mm is punched out of a 1.5mm thick metal plate, the shear stress needed to cause fracture is 100MPa. Determine
- The minimum force to be applied to the punch
  - The compressive stress in the punch at this value **(5mks)**
- c) Define the following terms
- Efficiency
  - Energy
  - Power
  - Work
  - Impulse
- d) A wheel is rotating at 1720rev/min and develops a power of 600W at this speed. Calculate
- The Torque
  - Work done in joules, in a quarter of an hour **(5mks)**

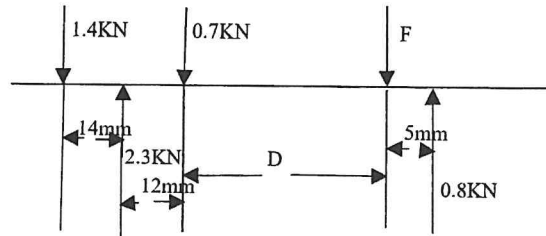
**QUESTION FOUR****20MKS**

a) Define the following terms

- i) Malleability
- ii) Ductility
- iii) Brittleness
- iv) Elastic limit

**(4mks)**

b) For the force system shown below, find the values of  $F$  and  $D$  for the system to be in equilibrium (5mks)



c) State and explain THREE non – destructive testing methods

**(6mks)**

d) A tennis ball of mass 60g is struck from rest with a racket. The contact time of the ball on the racket is 10ms and the ball leaves the racket with a velocity of 25m/s

Calculate

- i) The impulse **(2mks)**
- ii) The average force exerted by the racket on the ball **(3mks)**