



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY

Electrical Power Engineering
Instrumentation & Control Engineering
Electrical & Electronics Engineering
Computer Science Engineering

UNIT CODE: _____ MECHANICAL TECHNOLOGY

STAGE II SEMESTER I EXAMINATIONS

SERIES: FEBRUARY 2011 SERIES

TIME: 2 HOURS

Instructions to Candidates:

1. You are required to have the following for this examination;
 - Answer booklet
 - Scientific calculator
 - Transport and thermodynamics properties of fluids tables by Rogers and Mayhew
2. This paper consists of FIVE questions. Answer Question **ONE (COMPULSORY)** and any other **TWO** Questions.

Question ONE **(COMPULSORY)**

- a) Briefly explain the following terms:
- i) Principle stresses
 - ii) Poisson's Ratio
 - iii) Factor of safety
- (14marks)
- b) Explain the difference between static and dynamic balance for a shaft carrying eccentric masses stating two conditions for dynamic balance.
- c) i) Derive an expression for the tensile stress in a thin spherical shell of thickness **t** and internal diameter **d** when subjected to an internal pressure **p**. (4 marks)
- ii) A thin spherical pressure vessel is required to contain 18000 litres of water at a gauge pressure of 700kw/m^2 . Assuming the efficiency of all riveted joint to be 75%, determine the diameter of the vessel and the thickness of the plate. The stress in the material must not exceed 140MN/m^2 . (8 marks)
- d) A flat steel bar 10m long and 10mm square cross-section carries a tensile force of 12KN along its axis. Determine the change in length of the bar due to this force. $E = 200 \text{ EN/m}^2$. (8 marks)

(ANSWER ANY OTHER TWO QUESTIONS)

Question TWO

- a) Derive an expression for the ratio of the tensions on the two sides of a belt driver when the belt is about to slip. (9 marks)
- b) A ship is dragged through a lock by means of a capstan and rope. The capstan, which has a diameter of 500mm, turns at 30rev/min. If the rope makes 3 complete turns around the capstan and at the free end of the rope a pull of 100N is applied. Determine:
- i) The pull on the ship
 - ii) The power required to drive the capstan.
- (take $\mu = 0.25$) (11marks)

Question THREE

- a) Briefly explain the following terms as applied to steam:
- i) two phase fluid
 - ii) saturation temperature
 - iii) saturated liquid
 - iv) saturated steam
 - v) wet steam
 - vi) dry steam
 - vii) dryness fraction

- b) Calculate the enthalpy, entropy and internal energy of 0.45kg, steam at 26 bar and dryness fraction of 0.92. (20marks)

Question FOUR

- a) Explain the function of each of the following steam plant components and state the energy equation for each.
- i) Boiler
 - ii) Condenser
 - iii) Steam turbine (6 marks)
- b) A Carnot cycle using steam operates between pressures of 30 and 0.04 bar. Calculate the heat, work transfer cycle efficiency and work ratio for the cycle. (14marks)

Question FIVE

- a) Explain the function of the following components as used in refrigeration plant:
- i) Evaporator
 - ii) Condenser
 - iii) Throttle valve
 - iv) Compressor (8 marks)
- b) A refrigeration cycle incorporating a throttle valve operates between upper and lower temperatures of 30°C and -15°C respectively.
- i) Sketch the system and the T.S. diagram.
 - ii) Determine the refrigerating effect and the coefficient of performance using ammonia as the fluid. (12marks)