TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING

EEP 2307: HEATING ,AIRCONDITIONG ,REFRIGERATION & VENTILATION

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

DATE: APRIL 2025

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt **ANY THREE Questions**

Do not write on the question paper.

Question ONE

(a) Explain the Impact of Industrial Ventilation on Health and Safety **(4marks)**

(b) Describe the following techniques and architectural features used to ventilate building and structures
   (i) Local exhaust ventilation(LEV)
   (ii) Demand-controlled ventilation (DCV **(6marks)**

(c) For a given room explain how to work out the correct BTU size of an air conditioning unit **(6marks)**

(d) Briefly explain the following as applied to air conditioning systems
   (i) Air conditioner BTU
   (ii) Refrigeration unit **(4marks)**

Question TWO

a) With the aid of sketches explain the principle of operation of Dielectric Heating **(6marks)**

b) With the aid of a diagram, the electrical equivalent circuit and phasor diagram for dielectric heating derive the expression for power dissipated in heating a dielectric material subjected to high frequency f and a supply voltage V

(8marks)

c) A 200W of power at a frequency of 20MHz is required for dielectric heating of a slab 2cm thick and $150\,cm^2$ area The material has a permittivity of 5 and a P.f of 0.05. Determine the voltage necessary and the current which will flow through the material. Take $\varepsilon_0 = 8.85 \times 10^{-12}$ **(6marks)**

Question THREE

(a) State the expression for heat dissipated by a heating element according to Stefan's Law, and explain each parameter **(6marks)**

(b) A 30kw single phase 240V resistance oven employes a nickel chrome strip 0.254mm thick for a heating element If the wire temperature is 1100^0 C and that of the charge is 700^0C ,Estimate a **suitable width** for the strip assuming emissivity = 0.9, efficiency = 0.5 and resistivity = 101.6×10^{-8} **(7marks**

(c) List any THREE factors and parameters that affect the performance and use of a typical heating element, **(3marks)**

(d) Explain any TWO heating Element Properties **(4marks)**

Question FOUR

a) Describe the various sectors of the economy using comfort air conditioning systems **(4marks)**

b) Draw the basic block diagram of the refrigeration cycle and explain its principle of operation **(9marks)**

c) (i) Explain any FOUR possible faults in refrigeration
(ii) Explain any THREE types of refrigerants used in air-conditioning **(7marks)**

Question FIVE

(a) Explain skin effect in reference to induction heating **(3marks)**

(b) Draw and explain the graphical representation of induced eddy current variation from the surface towards the centre of the work piece **(5marks)**

(c) Derive the expression of the power developed in induction heating per square meter of area πdl entering a metallic of a cylindrical work piece, **(6marks)**

(d) The depth of penetration in the case hardening of a steel pulley required is 1.5mm. The relative permeability is unity and the specific resistance for steel is $5 \times 10^{-7}\Omega$m. Determine the frequency required **(6marks)**