



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING

EEP2307 : HEATING, AIR CONDITIONING, REFRIGERATION & VENTILATION

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2024

TIME: 2 HOURS

DATE: AUGUST 2024

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) Describe the following techniques and architectural features used to ventilate building and structures
 - (i) Demand controlled ventilation (DCV)
 - (ii) Local exhaust ventilation (6marks)
- (b) Briefly explain the following air conditioning systems
 - (i) Portable evaporative system
 - (ii) Central air-conditioning unit (8marks)
- (c) Define the following as used in air-conditioning systems
 - (i) Seasonal energy efficiency ratio (SEER)
 - (ii) Refrigeration Unit
 - (iii) British Thermal Unit (BTU) as explained in SI metric system (6marks)

Question TWO

- a) With the aid of a diagram explain the operation of dielectric heating (6marks)
- b) Draw the electrical equivalent circuit for dielectric and use it to derive the expression for power dissipated in heating a dielectric material subjected to high frequency f and a supply voltage V (7marks)

- c) A piece of insulating material is to be heated by dielectric method. It's dimensions are 20cm x 20cm x 4cm. A frequency of 40Mhz is used and the power absorbed is 600W. If the power factor and the relative permittivity of the material are 0.05 and 5 respectively, calculate:-
- the voltage required for heating
 - the current flowing in the material (Take $E_0 = 8.85 \times 10^{-12}$) **(7marks)**

Question THREE

- Explain the TWO main causes of failure of heating elements **(4marks)**
- A resistance oven employing nichrome wire is to be operated from a 240V single phase supply and to be rated at 40kw. If the temperature of the element is to be limited to 1440°C and the average temperature of the charge is 800°C . Calculate the diameter and the length of the wire given $\mu = 0.6$, emissivity = 0.9 and $\rho = 1.016 \times 10^{-6}$ **(6marks)**
- State with reasons the most appropriate type of electric heating to be applied for each of the following:
 - Surface hardening of metals **(4marks)**
 - Curing of sand cores in foundries **(6marks)**
- Explain any THREE types of electric welding methods **(6marks)**

Question FOUR

- Draw the basic block diagram of the refrigeration cycle and explain its principle of operation **(8marks)**
- Explain the procedure of calculating the cooling capacity required for a given room size to be fitted with an air conditioner **(8marks)**
- Calculate the amount of heat needed in kJ to increase the temperature of 5Kg of water from 15°C to 50°C **(4marks)**

Question FIVE

- Explain the term “skin effect” in induction heating
 - With the aid of sketches explain the operation of eddy current heating **(8marks)**
- Derive the expression of heat developed in induction heating of a cylindrical work piece,
 - A non-magnetic cylinder is to be heated by induction. If the coil has 400,000 AT/m and dissipates 1600kw/m^2 in a material having $0.025\mu\Omega/\text{m}^2$ resistivity, calculate the depth the heated work piece **(12marks)**