40

(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER

EXAMINATIONS FOR THE DIPLOMA

IN

MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: DME 089

COURSE TITLE: REFRIGERATION AND AIR CONDITIONING

DATE: 13TH APRIL 2023 **TIME: 8:00 – 10:00 AM**

INSTRUCTIONS TO CANDIDATES

Answer Question **ONE** and any other **TWO** questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE **(30 MARKS)**

a) Define the following terms:

i. Psychrometry **(1mk)**

ii. Dehumidification **(1mk)**

iii. Dry bulb temperature **(1mk)**

iv. Dew point temperature **(1mk)**

v. Throttling process **(1mk)**

b) Describe the function of the main components of a vapour compression refrigeration cycle. **(8mks)**

c) The following data refers to an air conditioning system to be design for an industrial process for hot and wet climates;

Outside conditions; 30 ^{0}C DBT, and 70% RH

Required inside conditions; 20 ^{0}C DBT and 60% RH

The required condition is to be achieved first by cooling and dehumidifying and the by heating. If 25 m^3 of air is absorbed by the plant every minute, Find:

i. Capacity of the cooling coil in tonnes of refrigeration (TR). **(9mks)**

ii. Capacity of the heating coil in kW. **(3mks)**

iii. Amount of water removed per hr. **(3mks)**

d) What is the use of a flash chamber in a refrigeration and air conditioning system. **(2mks)**

QUESTION TWO **(20 MARKS)**

a) Show that the COP of a heat pump is given by $COP_h = 1 + COP_r$ **(6mks)**

b) State any **FOUR** properties of refrigerants. **(4mks)**

c) Describe the principle of refrigeration. **(10mks)**

QUESTION THREE **(20 MARKS)**

a) Differentiate between the following terms; **(4mks)**

i. Heating load

ii. Cooling load

b) With the aid of a schematic diagram and a T-S diagram describe the processes involved in a Reversed Heat Engine Cycle. **(16mks)**

QUESTION FOUR **(20 MARKS)**

In the air cooling system of a jet aircraft, air is bled from the engine compressor at 3 bar, and is cooled in a heat exchanger to 105 ^{0}C. It is expanded to 0.72 bar in an air turbine, the isentropic efficiency of the process is 85%. The air is then delivered to the cockpit and then leaves the aircraft at 27 ^{0}C. **(20mks)**

a) Calculate the temperature at which air enters the cockpit and the mass flow rate of air for refrigerating effect of 4 kW.

b) If the air turbine is used to help to drive auxiliaries, calculate its contribution in power.