(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2023/2024 ACADEMIC YEAR

FOURTH YEAR SECOND SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF TECHNOLOGY EDUCATION IN ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE CODE: TEE 424

COURSE TITLE: POWER ELECTRONICS

DATE: WEDNESDAY, APRIL 24TH 2024 TIME: 8:00 AM - 10:00 AM

INSTRUCTIONS TO CANDIDATES:

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: *2 Hours*

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (30 MARKS)

a. Define the following terms as used in power electronics

i. Inverter (1 Mark)

ii. Rectifier (1 Mark)

b. Using a schematic diagram explain the structure of a power diode. (4 Marks)

c. There are three major modes that a silicon-controlled rectifier (SCR) can operate in. Using the voltage current (V-I) characteristic diagram of an SCR discuss the three modes. (10 Marks)

d. A half-wave 3-phase rectifier is constructed using three individual diodes and a 120 VAC 3-phase star connected transformer. If it is required to power a connected load with an impedance of 50Ω, Calculate:

i. The average DC voltage output to the load. (3 Marks)

ii. The load current. (2 Marks)

iii. The average current per diode. Assume ideal diodes. (2 Marks)

e. Using a schematic diagram explain a first quadrant or type A chopper. (7 Marks)

QUESTION TWO (20 MARKS)

a. A half-wave rectifier is used to supply 50 Vdc to a load resistive load of 800 Ω. The diode has a resistance of 25 Ω. Calculate the a.c voltage required. (4 marks)

b. The excellent electric braking methods are available which eliminate the need of brake lining levers and other mechanical gadgets. Using relevant schematics, describe the Rheostatic or dynamic braking method used for shunt motors. (10 Marks)

c. Outline 3 differences between a power MOSFET and a power BJT. (6 Marks)

QUESTION THREE (20 MARKS)

a. List 4 methods of turning on a silicon-controlled rectifier (SCR) type of thyristor. (4 Marks)

b. Draw the (V-I) characteristic curve of a triac type of a thyristor. Describe what you infer from your graph. (10 marks)

c. A 250-volt d.c shunt motor has armature resistance of 0.25 ohm, on load it takes an armature current of 50A and runs at 750 r.pm. If the flux of motor is reduced by 10% without changing the load torque, find the new speed of the motor. (6 Marks)

QUESTION FOUR (20 MARKS)

a. List three factors that can be used to control the speed of a motor. (3 Marks)

b. Using a schematic diagram describe the drain current vs. drain-to-source voltage characteristics curves of a power MOSFET. (8 Marks)

c. Using a simple possible single-phase input to single-phase output with a pure resistance as a load, describe the principle of the cycloconverter. (9 Marks)

QUESTION FIVE (20 MARKS)

a. Using a schematic diagram explain the voltage-current (V-I) of a diac type of thyristor. (4 Marks)

b. With the aid of relevant diagrams, describe in detail the construction and operation of an IGBT. (8 Marks)

c. Using a schematic circuit diagram describe the operation of a Single Phase Half Bridge Inverter with Resistive Load. (8 Marks)