



(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  
ELECTRICAL AND ELECTRONICS ENGINEERING**

**COURSE CODE: DEE 096**

**COURSE TITLE: INDUSTRIAL ELECTRONICS**

**DATE: Wednesday 12<sup>th</sup> April, 2023**

**TIME: 9.00 a.m – 11.00 a.m**

---

**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

- 1.(a) List Any ten semi-conductor devices used as power switches. (5 marks)
- (b) Explain Three types of Thyristors. (3 marks)
- (c) Silicon Carbide (Sic) semiconductors are new option for power electronics designers looking to improve system efficiency. Describe Five features of such semiconductors. (5 marks)
- (d) what is triggering of a thyristor and state Five methods of triggering. (3 marks)
- (e) Tabulate Two differences between Natural and Forced commutation processes of a thyristor. (4 marks)
- (f) State Two ways in which a thyristor may be protected. (2 marks)
- (g) Calculate the average voltage which appears across a load in Chopper circuit connected to a 230V D.c supply. Assume the chopper remains ON for 25mS and OFF for 10 mS. (4 marks)
- (h) A step-up Chopper is required to deliver load of 660V from 220V D.c source. If the non-conduction time of the thyristor is 100mSec, Calculate the required pulse width. (4 marks)

## QUESTION TWO.

- 2.(a) Highlight Five applications of inverters. (5 marks)
- (b) The intrinsic Stand off ratio,  $\eta$ , for UJT is 0.6. If the inter-base resistance is 10 K $\Omega$ , what are the values of  $R_{B1}$  and  $R_{B2}$ ? (3 marks)
- (c) Design a commutating circuit. (5 marks)
- (d) Calculate the value of the commutating Capacitor in an SCR circuit designed in (c) above if the load current is 68A, DC supply voltage  $V_{dc}$ = 500V and the Turn OFF time = 525 $\mu$ S. (3 marks)
- (e) Calculate the output frequency of a series inverter circuit with the following parameters:
- Inductance,  $L=10\text{mH}$
- Capacitance,  $C=0.1\mu\text{F}$
- Load resistance,  $R=400\Omega$
- $T_{\text{off}}=0.2\text{mS}$  (4 marks)

### QUESTION THREE.

3. (a) (i) Enumerate Any Four disadvantages of series inverters. (4 marks)
- (ii) Explain the operation of a parallel inverter giving a circuit diagram. (5 marks)
- (b) Calculate the power rating of an SCR connected across an a.c supply of  $220 \sin 414t$  V and the current flowing through it is 15 A r.m. s (4 marks)
- (c) Draw a Three phase full wave fully controlled regenerative SCR bridge circuit and explain how it works. (7 marks)

### QUESTION FOUR.

4. (a) State ANY FOUR applications of power electronics. (4 marks)
- (b) Enumerate ANY FIVE advantages of thyristor inverters over Transistor inverters. (5 marks)
- (c) Derive an expression for the average voltage across a load in single-phase full-wave thyristor circuit with a delay angle of  $\alpha$ . (5 marks)
- (d) A single phase, half wave, phase-controlled thyristor circuit is energized from a 240 V supply gives current to a  $10 \Omega$  resistive load. Calculate:
- (i) The delay angle in degrees if the mean load current is 8A. (3 marks)
- (ii) The mean value of load current if the delay angle is  $60^\circ$  (3 marks)

### QUESTION FIVE.

5. (a) A silicon-controlled rectifier is rated for 1200 volts PIV. Calculate the voltage up to which the device can be operated if the value of voltage safety is 4. (4 marks)
- (b) An SCR of 600 volts PIV rating is connected in series with an electrical load of  $32 \Omega$  and inductance of 79mH. Find out the current flowing through the load (Take  $V_f=4$  and  $f=60$  HZ). (6 marks)
- (c) A series inverter circuit has an inductor of 15mH, a Capacitor of  $56\mu\text{F}$  connected in series with the load resistance of  $12\Omega$ . Calculate:
- (i) The time period of oscillations. (3 marks)
- (ii) The resonance frequency. (2 marks)

(d) (i) State Three ways in which DIAC is different from a Transistor constructionally.

(3 marks)

(ii) Enumerate ANY TWO advantages of UJT as semi-conductor power switch. (2 marks)