



# TECHNICAL UNIVERSITY OF MOMBASA

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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

## UNIVERSITY EXAMINATION FOR:

DIPLOMA IN TECHNOLOGY (ELECTRICAL POWER ENGINEERING)(DEPE4)

EEP2206 : POWER ELECTRONICS 1.

## END OF SEMESTER EXAMINATION

**SERIES:** MAY 2016

**TIME:** 2 HOURS

**DATE:** MAY 2016

### 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.**

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### Question ONE

#### QUESTION 1

(a)(i) Draw a labelled circuit diagram of a UJT relaxation oscillator and explain its operation.

(6marks)

(ii) Sketch the output waveforms for the circuit in (a)(i) above and show that its expression of output frequency is given by:-

$$f = \frac{1}{RC \ln\left(\frac{1}{1-\eta}\right)}$$

where f= frequency of oscillation

$\eta$  =intrinsic stand-off ratio

(5marks)

(b) (i) Draw and explain the characteristics of a UJT

(ii) The intrinsic stand off ratio for a UJT is determined to be 0.6. If the interbase resistance is  $10\text{k}\Omega$ , Determine the values of:-

- I.  $R_{B1}$
- II.  $R_{B2}$

(9marks)

### Question TWO

(a) Draw the thyristor static characteristics and use it to define the following terms:

- i. Holding current
- ii. Forward breakover voltage
- iii. Latching current

(6marks)\

(b)(i) Explain any TWO means of power loss in a thyristor

(ii) With the aid of diagrams and waveforms distinguish between integral cycling and phase control

(7marks)

c) With the aid of a circuit and waveform diagrams derive the expression of the mean voltage of a three phase half wave controlled rectifier circuit supplying a resistive load and a firing angle  $\alpha$

(7marks)

### Question THREE

(a)(i) State any TWO requirements of firing circuits in thyristor control

(ii) Describe any TWO methods of commutation

(6marks)

(b)(i) Draw and describe the DIAC static characteristics

(ii) Explain the operation of the lamp dimmer circuit of figure 1 below

(10marks)

c) With the aid of a circuit diagram explain any simple method of testing an SCR

(4marks)

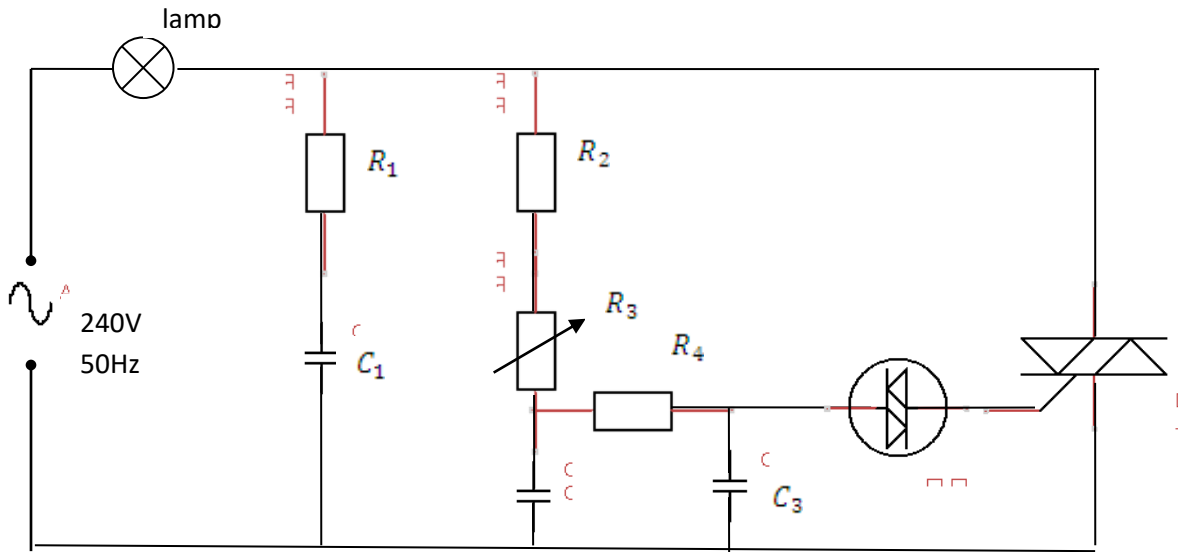


Figure 1

#### Question FOUR

(a)(i) With the aid of a diagram explain how simultaneous firing of two thyristors used in fully controlled rectifier circuit is achieved

(ii) Show that the mean output voltage for a single phase half wave thyristor controlled rectifier is given as:-

$$V_{mean} = 0.225V_{r.m.s}(1+\cos\alpha)$$

(8marks)

(b)(i) Derive the mean voltage expression for the circuit of figure 2

(5marks)

(ii) The brightness of a 60W,240V lamp is varied by controlling the firing angle of figure 2 circuit in Q3b(i) . If the r.m.s value of the a.c voltage appearing across each SCR is 240V, Calculate:-

- I.  $V_{r.m.s}$  in the lamp at  $60^\circ$  firing angle
- II.  $I_{r.m.s}$  in the lamp at  $30^\circ$  firing angle

(7marks)

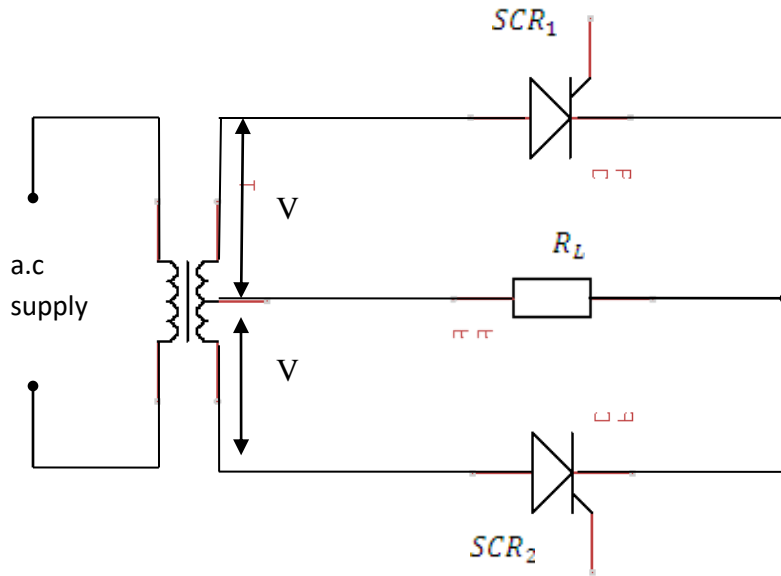


figure 2:

### Question FIVE

(a)(i) Draw the transistor equivalent circuit of a TRIAC and explain its operation

(ii) With the aid of a circuit diagram explain how a TRIAC can be used to control the average a.c power to a load.

(12 marks)

(b)(i) Explain the importance of free wheeling diode in controlled rectification

(ii) With the aid of a diagram and waveform explain how the speed of a d.c motor can be varied using a thyristor.

(8marks)