



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN TECHNOLOGY (ELECTRICAL POWER ENGINEERING) (DEPE4)

EEE 2206 : POWER ELECTRONICS 1

END OF SEMESTER EXAMINATION

SERIES: DECEMBER 2016

TIME: 2 HOURS

DATE: DECEMBER 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.

Question ONE

(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 the TWO transistor analogy for an SCR using suitable diagrams.

(ii) Prove that the anode current expression for SCR is :-

$$I_A = \frac{I_{CO1} + I_{CO2}}{1 - (\alpha_1 + \alpha_2)}$$

(10marks)

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

(4marks)

Question TWO

- (a) (i) Explain the importance of a commutating diode in rectifier circuits
(ii) State any TWO advantages of pulse firing over other methods

(5marks)

- (b) With the aid of output voltage waveforms of three phase controlled rectifier separately illustrate the following:-

Overlap angle

Inversion mode of thyristor operation

(8marks)

- c)(i) Show that the mean output voltage of a three phase half wave controlled rectifier supplying a resistive load is given by:

$$V_{mean} = \frac{3\sqrt{3}}{2\pi} V_{max} \cos\alpha$$

Where α = firing angle

- (ii) Determine the mean output voltage of c(i) for a three phase input voltage of $415V_{r.m.s}$ if the firing angle is 30°

(7marks)

Question THREE

- (a)(i) Explain the operation of the TRIAC by use of figure 1 circuit below

(6marks)

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

(8marks)

- (b) (i) Draw the V-I characteristics of a DIAC and explain its shape.

- (ii) Explain with aid of a diagram any ONE application of a DIAC

(6marks)

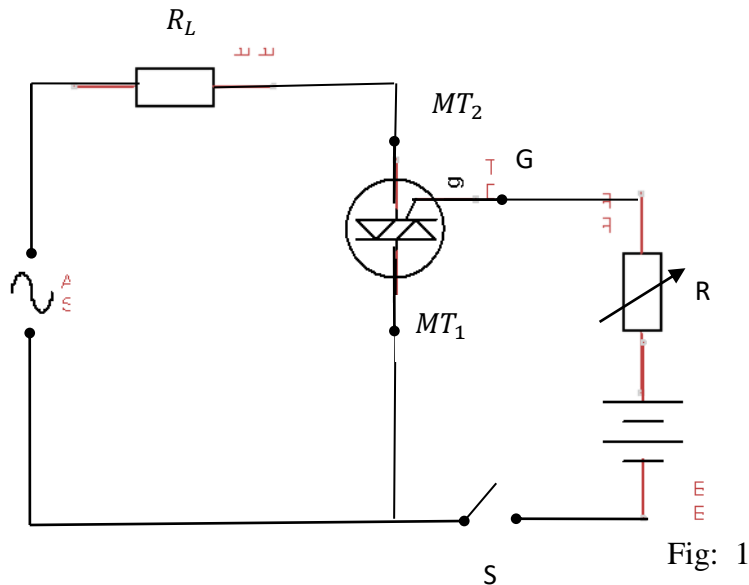


Fig: 1

Question FOUR

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

η =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 10k Ω , Determine the values of:-

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

(9marks)

Question FIVE

(a) Explain the operation of figure 1 below

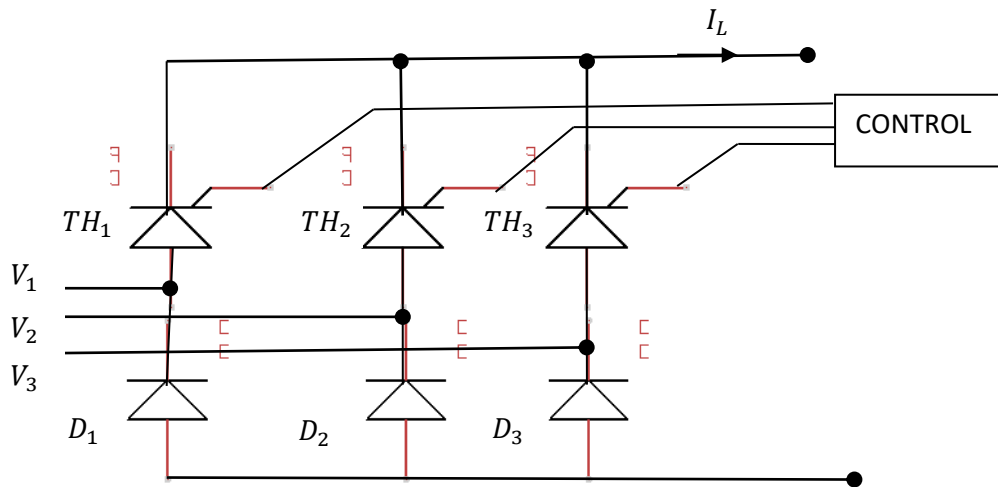


Figure1.

(6marks)

(b)(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)

(c) A half-wave rectifier circuit employing an SCR is adjusted to have a gate current limit. The forward breakover voltage is 100V for a gate current of 1mA . If a sinusoidal voltage of 200V peak is applied, determine:-

- i. The firing angle
- ii. The average voltage.

(6marks)