



TECHNICAL UNIVERSITY OF MOMBASA

SCHOOL OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN ELECTRICAL & ELECTRONIC ENGINEERING

EEP2206 : POWER ELECTRONICS 1

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2024

TIME: 2 HOURS

DATE: AUGUST 2024

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

- Derive the expression for the output voltage of half wave controlled rectifier with R load. (6marks)
- Draw the input and output voltage waveforms of three phase half controlled rectifier with R load for a firing angle of 30° and hence derive its mean voltage expression (8marks)
- Identify fig Q1 and with the aid of waveforms explain its working (6marks)

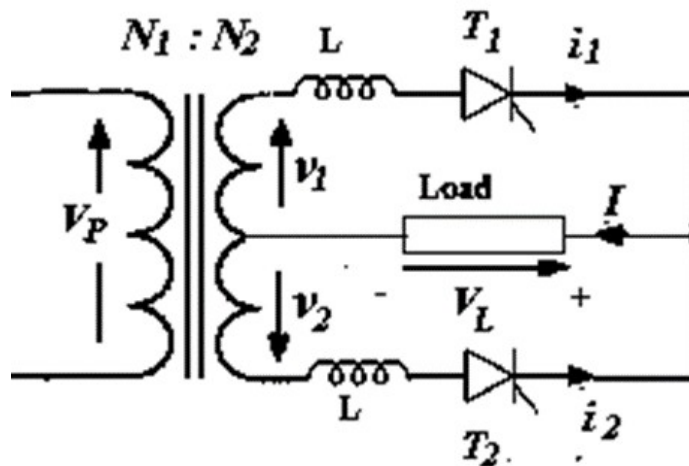
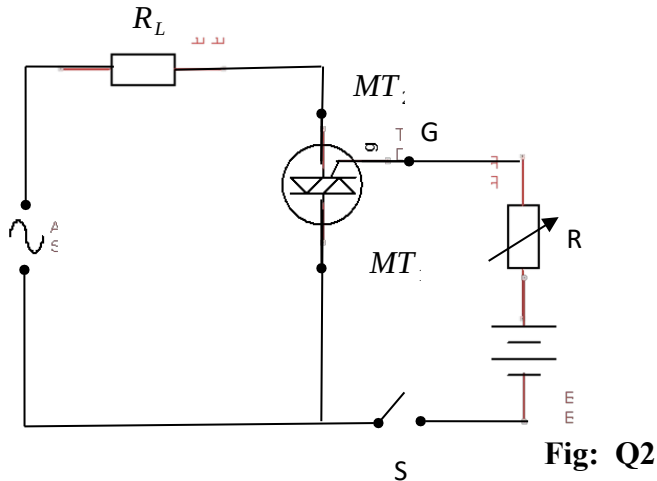


Fig Q1

Question TWO

- (a) Draw the circuit for four transistor analogy of the TRIAC and briefly describe the working (7marks)
- (b) Explain the operation of figure Q2 circuit below (6marks)



- (c) 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. (7marks)

Question THREE

- (a) (i) Draw the circuit for two transistor analogy of silicon controlled rectifier and briefly describe the working
- (ii) Prove that the anode current expression for SCR is :-

$$I_A = - \left[\frac{I_{CO1} + I_{CO2}}{1 - (\alpha_1 + \alpha_2)} \right] \quad (10\text{marks})$$

- (b) (i) For a single phase half controlled rectifier show that the mean d.c power output is:-

$$P_{mean} = \frac{V_{max}^2 (1 + \cos \alpha)^2}{4 \pi^2 R_L}$$

- (ii) A 100Ω resistance load is driven by $240 V_{r.m.s}$ voltage for firing angle of 60° , determine the average power output. (10marks)

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) Explain intrinsic stand-off ratio as used in UJT

(iii) The data sheet for a 2N2646 Unijunction Transistor gives the intrinsic stand-off ratio η as 0.65. If a 100nF capacitor is used to generate the timing pulses, calculate the timing resistor required to produce an oscillation frequency of 100Hz.

(9marks)

Question FIVE

(a) (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

(9marks)

(b) (i) Explain the difference between controlled rectification and uncontrolled rectification

(2marks)

(ii) With the aid of input and output waveforms explain the operation of fig Q5 circuit

(7marks)

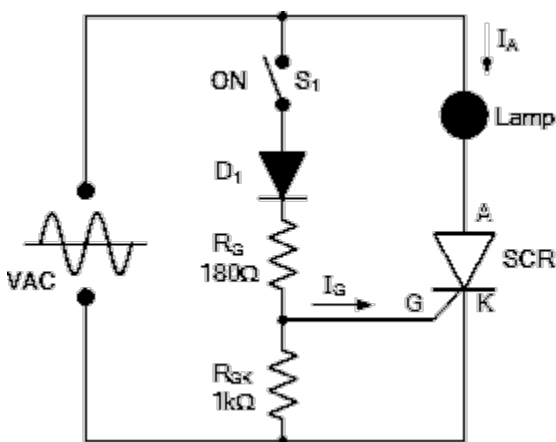


Fig Q5

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

(2marks)