TECHNICAL UNIVERSITY OF MOMBASA

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: AUGUST 2019

TIME: 2 HOURS

DATE: AUGUST 2019

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) Explain the operation of figure Q1 circuit
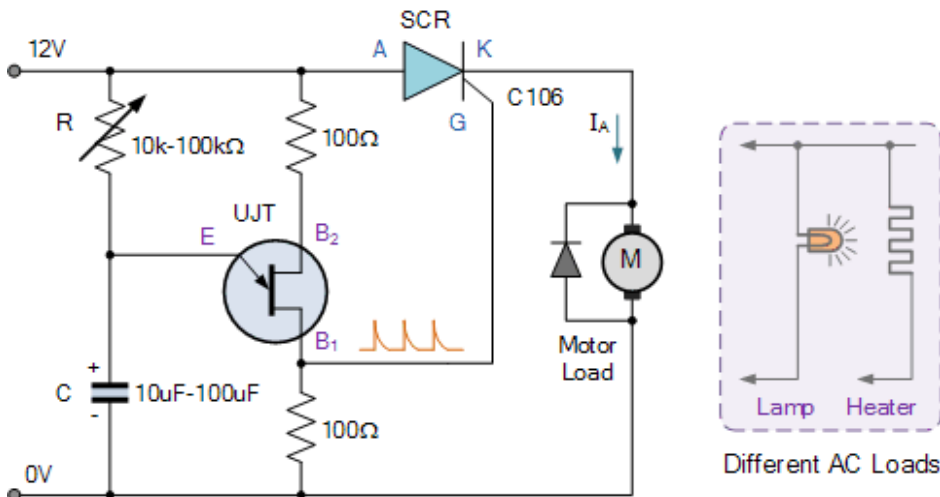

Figure Q1   **(5marks)**

(ii) Show that the expression of output frequency of the firing circuit in figure 1 is given by:-

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

where f= frequency of oscillation

η =intrinsic stand-off ratio **(4marks)**

(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 generator the timing pulses, Calculate the value of the timing resistor required to produce an oscillation frequency of 100Hz . **(3marks)**

(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 10kΩ, Determine the values of:-

I. R_{B1}
II. R_{B2} **(8marks)**

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 α **(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

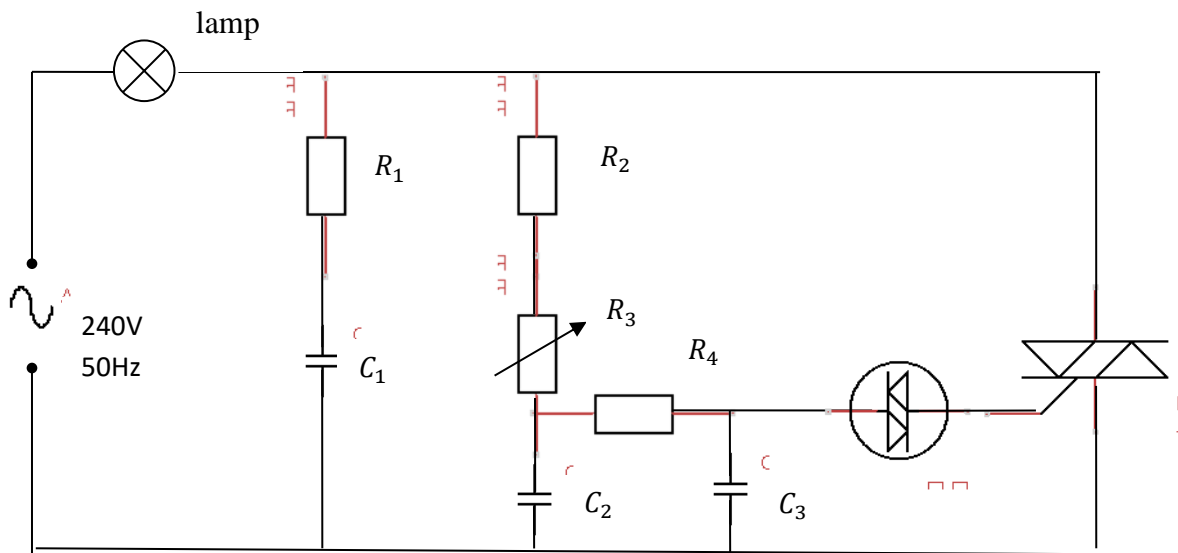(ii) Explain the operation of the lamp dimmer circuit of figure Q3 below **(10marks)**

Figure Q3

c) With the aid of a circuit diagram explain any simple method of testing an SCR   **(4marks)**

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 Q4   **(5marks)**

   (ii) The brightness of a 60W,240V lamp of figure Q4 circuit is varied by controlling the firing angle. 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° firing angle
II. $I_{r.m.s}$ in the lamp at 30° firing angle   **(7marks)**

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)**
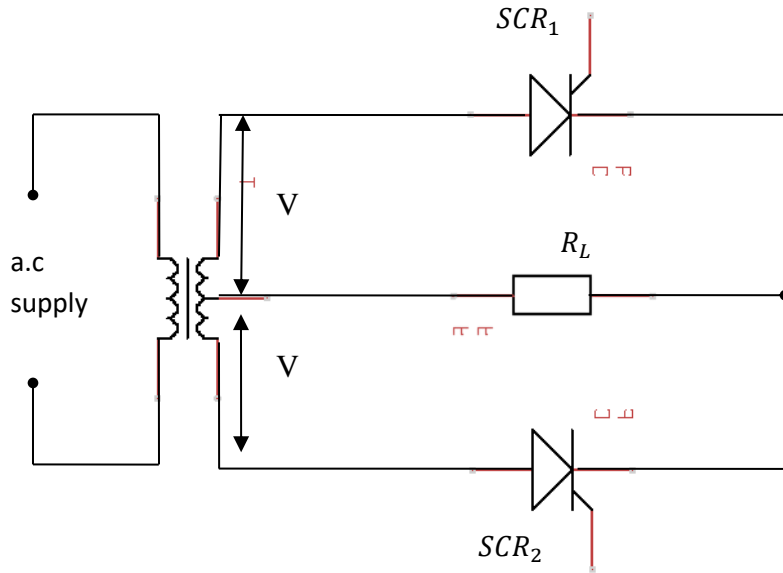
figure Q4:

SCR_1

SCR_2

R_L

a.c
supply

V

V