



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 2308: POWER ELECTRONICS I.

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: SEPTEMBER 2018

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of five questions. Question one is compulsory. Answer **QUESTIONS ONE** and any other **TWO**. Questions

Do not write on the question paper.

Question ONE

(a)(i). Define the following terms as used with power rectification systems.

(I). Distortion factor

(II). Form Factor.

(ii). Explain the advantages of using controlled rectification in industrial applications instead of uncontrolled type. (iii). State any two applications of DC powers.

(iii). A fully controlled single phase half wave power converter has an input ac voltage of 230V at 50Hz. If the converter is connected to a 1000watts load which receives 800watts, determine

(I). Rms output voltage (II). Firing angle α . (III). Rms load current (**10 Marks**).

(b)(i). State any two applications of cyclo-converters.

(ii). With the aid of a diagram, explain how a cyclo-converter can be operated with a down frequency ratio of 3:1.

(iii). Explain the effects of any group converter failure in a cyclo-converter **(9 Marks)**

(c)(i). Explain the in the following word as used in power electronics devices.

(I). Holding Current (II). Latching Current.

(ii). Differentiate between a triac and a Diac. State one application for each device.

(iii). Draw and explain the construction of the VI characteristics for a forward biased thyristors. **(11 Marks)**

Question TWO

(a)(i). Explain the difference between burst and phase firing for thyristor switching

ii) State any two required properties for a thyristor to be used in switching. **(5 marks)**

(b)(i). Draw a schematic diagram of a Diac and explain its operation.

iii). Explain the formation of VI characteristics for the device of (bi). **(10 marks)**

(c). For the circuit of Fig Q2, the firing angle for the thyristor is set at 30° . The motor has a sensitivity of 25 revolutions/volt/seconds. Determine,

I) Rms output voltage across A and B

II) Rms output power across R2

III) Rms motor revolution per minute. **(5 marks).**

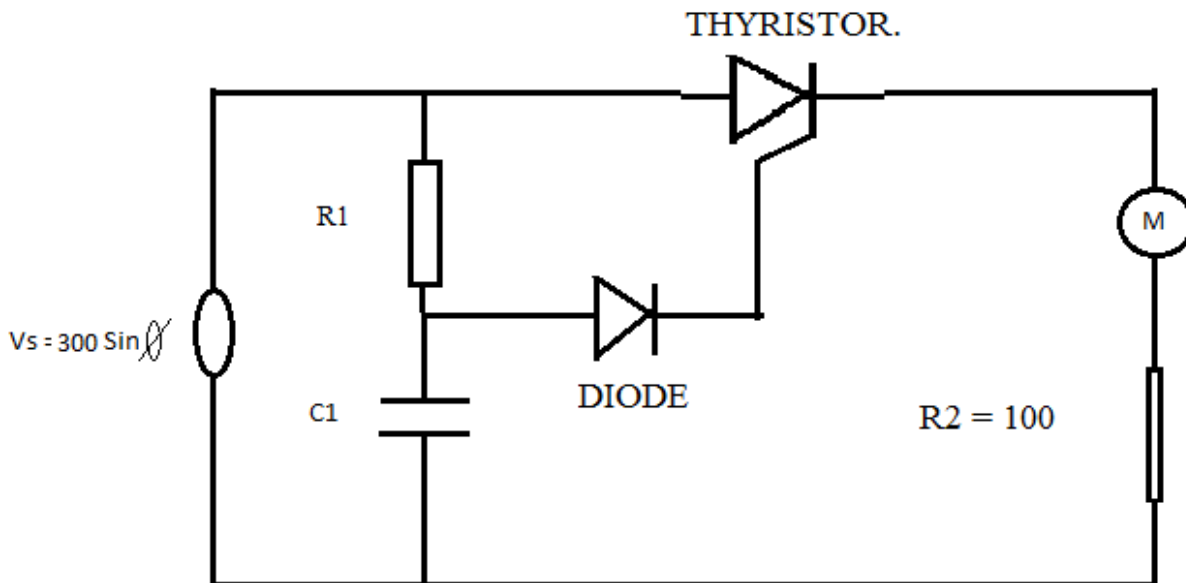


Fig Q 2

Question THREE

a i) Define the following terms as employed in power rectification;

(I).Rectification efficiency. (II)Ripple factor

ii).State two Advantages of employing controlled rectification power supplier compared to a non-controlled type. **(6 marks)**.

(b)(i). Draw a full wave thyristor controlled R-L loaded rectifier circuit and explain its operation.

ii).Derive the Rms output voltage for the circuit of (i).

iii).Illustrate the shape for the input and output waveforms the current of (i). **(10 Marks)**.

c). A full wave rectifier has an input of 240V at 50Hz. If the firing angle is $\alpha=40^0$ and has an inductive load whose resistance is 15Ω . Determine;

(i) Rms output voltage and current. (ii) Rms output power. **(4 Marks)**.

Question FOUR

ai) Define a cycloconverter, hence state any two (I).Applications of a cyclo-converter.

(II) Disadvantages of modern cyclo-converters.

(ii).Explain the behaviour of a cyclo converter whose positive group converter has failed. **(5 marks)**

(b)(i).With the aid of a diagram explain the operation of a cyclo converter whose frequency ratio is 2:1.

ii).Derive the Rms output voltage formula for the cyclo converter in. (i). **(10 Marks)**.

c). A cyclo converter is fed with an input voltage of 400V at 60Hz and feeds an inductive load of $(10+jx)$. If the inductance of the load is 80mH, determine the following if the conversion ratio is 3:1.

I).Rms output voltage and current. II).Power dissipated by the resistor. **(5 marks)**

Question FIVE

ai). Differentiate between a half bridge and a full bridge inverter. Explain why it is preferable to use full bridge inverters in domestic applications.

ii).State how inverters can be used in the following applications;

(I).HVDC Transmission.

(II)Motor speed control. **(7 marks)**

b(i).With the aid of a diagram, Explain the operation of a three phase 120 degrees mode inverter.

ii).Explain why inverter input terminals must have a very large capacitor across them.

(8 marks)

C) A full bridge inverter has an input voltage of 60V and supplies power to a 12Ω resistor in series with a $300\mu\text{F}$ capacitor.

(i) Rms load current. (ii) Rms power dissipated by the resistor.

(5 marks)