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 2404: POWER ELECTRONICS 2.

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2HOURS

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 attempt any other TWO questions.

Do not write on the question paper.

Question ONE

(a)(i).Explain the meaning of the following as used in DC to DC voltage converters.

(I).Continuous Mode. (II).Ripple Voltage.

(ii).Draw and explain the operation of a boost converter. Derive the input and output voltage relationship of the converter.

(ii).A boost converter has an input of 5V and an output of 15V. The circuit operates at a frequency of 25 kHz and is required to deliver an output current of 0.5A.Given the output capacitance and inductance to be 220µF and 150µH respectively, determine,

(I).Duty Cycle and inductor ripple current. (II).Ripple capacitor voltage and output load resistance.
(11 Marks).

(b)(i).Define a DC chopper and hence distinguish between a constant and a variable frequency operation.

(ii).Draw a bidirectional thyristor operated single phase AC regulator and explain its operation.

(iii). A full wave AC regulator is supplied with an input voltage of 150V (rms) at 50 Hz. If the load has an impedance of 15Ω in series with an inductor of 60 mH, calculate the following given the firing angle $\alpha = \pi/4$.

(I).Rms output voltage (II).Rms power dissipated output power. **(9 Marks).**

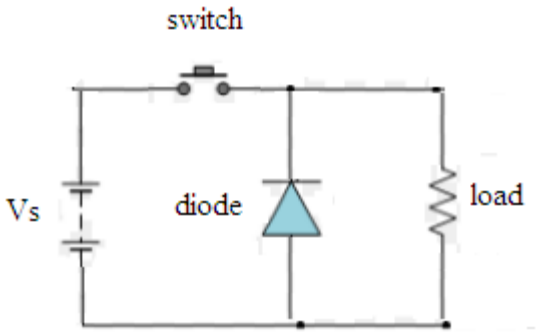

Fig Q 1

Question TWO

(a)(i).Differentiate between ON/OFF and phase control types of AC voltage regulators.

(ii).State the advantage of employing ON/OFF control technique compared to phase control.

(5 Marks).

b (i).With the aid of a single phase diagram of a ½ wave AC regulator, explain how it can be used to vary the intensity of a bulb.

(ii).Using the output waveforms of the circuit of bi, derive the rms output voltage expression for the circuit.

(12 Marks).

(c).A single phase half wave AC regulator has a resistive load of 15Ω.If the input power supply is 180V (rms) at 50 Hz, determine the following if the firing angle is set at $\alpha = \pi/4$.

(I).Output power and input VA. (II).Input power factor. **(3Marks)**

Question THREE

(a)(i).Define the following terms as applied to thyristor circuit protection.

(I).Temperature rating. (II).dv/dt rating.

(ii).Explain why and how a thyristor switching a current through an inductive load must be protected.

(6 Marks).

(b)(i).Explain how natural commutation occurs in thyristors connected to an AC power supply.

(ii).Figure Q3 shows a basic snubber circuit. Identify the purpose of the circuit and explain how the purpose is achieved. **(10 Marks).**

(c). An SCR circuit designed to protect against dv/dt and di/dt has the following component values. Inductor L = 8µH, Capacitor C =6µF and Resistance R = 5Ω.If the power supply is 250V, find the maximum permissible values of

(I). dv/dt (II). di/dt **(4Marks).**

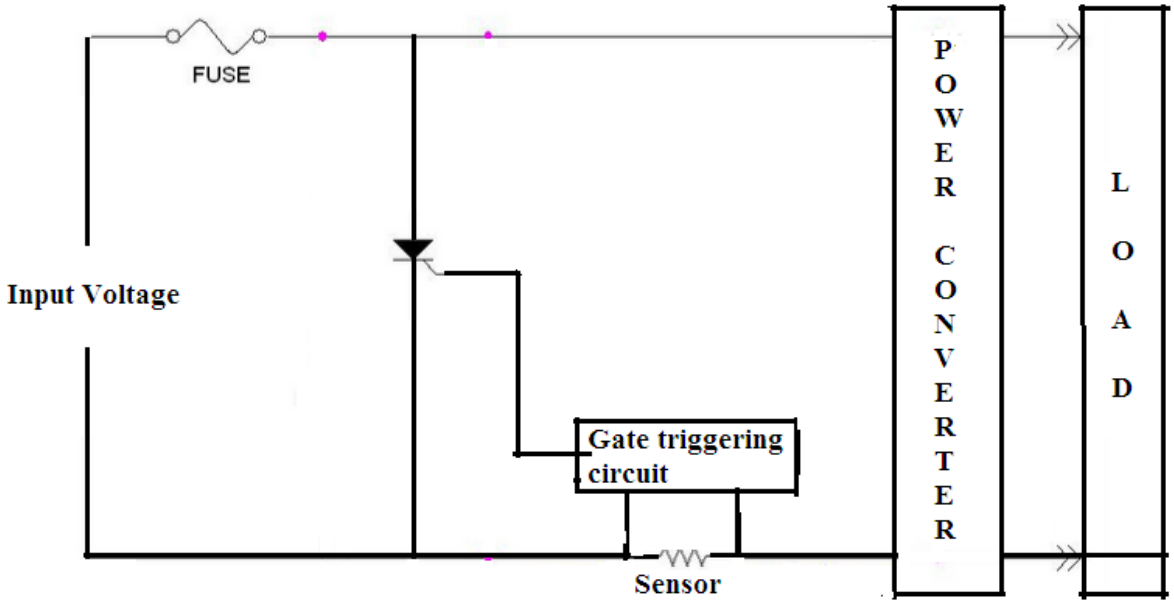

Figure Q 3

Question FOUR

(a)(i). Differentiate between class A and class C types of Choppers. And draw their operating quadrants.

(ii). State any two applications of choppers. **(4Marks)**

(b)(i).State any two sources of power supplies for choppers.

(ii).With the aid of a diagram, explain how a chopper can be used to step up a voltage across a motor. **(11Marks).**

(c).A step up chopper has an input voltage of 200V and an output voltage of 660V.If the ON state conducting time is 100µS, compute given the load resistance R as 12Ω.Determine

(I).Chopper Duty Cycle. (II).Non conducting time for the thyristor. (III).Input current to the chopper. **(5 Marks)**

Question FIVE

(a)(i).Explain the meaning of the following terms as used in DC to DC converters.

(I).Wave Distortion (II).Switching frequency

(ii).Explain why an ac linked DC to DC converter is expensive in construction. **(5 Marks).**

(b)(i).Draw and explain how a boost converter transforms a DC voltage.

(ii).Derive the input/output voltage relationship for the boost circuit. **(10 Marks).**

(c).A boost converter is supplied with a stable 10V supply. The output voltage is 25V with an average load current of 7.5amps.The filter circuit is made of an inductor and a capacitor of values 150 μH and 220 μF respectively. Given the switching frequency of 25 kHz, determine,

(I).Inductor ripple current and capacitor ripple voltage.

(II).Critical capacitor and inductor values. **(5Marks).**