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: MAY 2016

TIME: 2 HOURS

DATE: MAY 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) (i) With he aid of a diagram describe the effects of an inductive load in single phase controlled rectifier circuits

(ii) Draw the current and voltage waveforms of a(i) above if the input is sinusoidal a.c.

(iii) 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.

(13marks)

(b) (i) State any TWO advantages of a thyristor as a switch over mechanical switching

(ii) Draw the anode characteristics of the SCR and explain the shape.

(7marks)

Question TWO

(a) (i) Draw a labelled circuit diagram of a UJT relaxation oscillator.

(ii) Sketch the output waveforms for the circuit in a(i) and show that its output frequency is expressed as

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

where f = frequency of the output waveform

η = intrinsic stand-off ratio

(10marks)

(b) (i) Draw the UJT characteristics and explain its shape

(ii) The intrinsic stand-off ratio for a UJT is determined to be 0.6. If the interbase resistance is 10kΩ, determine:-

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

(10marks)

Question THREE

(a) (i) Explain the TWO transistor analogy for an SCR using suitable diagrams.

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

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

(10marks)

(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 $240V_{r.m.s}$ voltage for firing angle of 60^0, determine the average power output.

(10marks)

Question FOUR

(a) (i) Explain with aid of a diagram the operation of a TRIAC as a switch.

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

(9marks)

(b) (i) Draw the circuit diagram of a single phase cycloconvertor using a centre-tapped transformer

(ii) Draw the output waveforms of the circuit b(i) above.

c) A cycloconvertor designed for industrial application starts conducting from

$\left\{\frac{-\pi}{p}+\alpha\right\}$ to $\left\{\frac{+\pi}{p}+\alpha\right\}$

Given the general equation for a cycloconvertor to be:

$$V_O = \frac{1}{2\pi/_p} \int V_{max} cos\ wt\ dwt$$

Derive the expression for the mean voltage.

(11marks)

Question FIVE

(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 30^0

(7marks)