



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MEDICAL ENGINEERING

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN MEDICAL ENGINEERING

EHL 2301: MEDICAL ELECTRONICS III

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: 16 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 question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

QUESTION ONE

(a) With the aid of a diagram describe the construction of the following breakdown devices.

(i) UJT

(ii) SCR

(iii) diac

(15 marks)

(b). Failure of equipment can be caused by stresses that can be divided into two categories.

Discuss these categories:-

(i) Operating stress

(ii) Environmental stress

(10 marks)

(c) Outline any five applications of thyristors.

(5marks)

QUESTION TWO

(a) (i) Given the current applied to a thyristor circuit is $I_M \sin\theta$, derive an expression for the average current (I_{AV}) where I_M is the maximum current of the current wave in the

range(α to π .)

(6 marks)

(ii) Given $I_M = 5A$, determine the value of the average current when :-

(I) $\alpha = 0$

(II) $\alpha = \pi/2$

(4 marks) (b) A thyristor

converter is to be used to control the speed of a dc motor and the maximum average current is to be 10A. The supply voltage is 220 V rms and the armature current is to be limited by connecting a resistor in series with the armature. Using a suitable diagram calculate the minimum value of the resistance if the resistance of the armature is 1 ohm.

(10 marks)

QUESTION THREE

(a) A UJT with a $\eta = 0.6$ is used in a relaxation oscillator circuit to control the rate of a process in pulses per minute. If the capacitance is $50\mu F$ and the charging resistor is a series combination of $50K\Omega$ resistor and a $100K\Omega$ potentiometer.

Determine :-

(i) a possible circuit diagram

(ii) Minimum possible rate with this arrangement

(iii) Maximum rate of the process.

(12 marks)

(b) Describe the operation of the following devices

(i) Varactor diode

(ii) Tunnel diode

(8 marks)

QUESTION FOUR

(a) Fig. Q4 below shows a two stage high gain amplifier . Identify and state the faulty component and the nature of the fault for each of the faults shown in the table Q4.

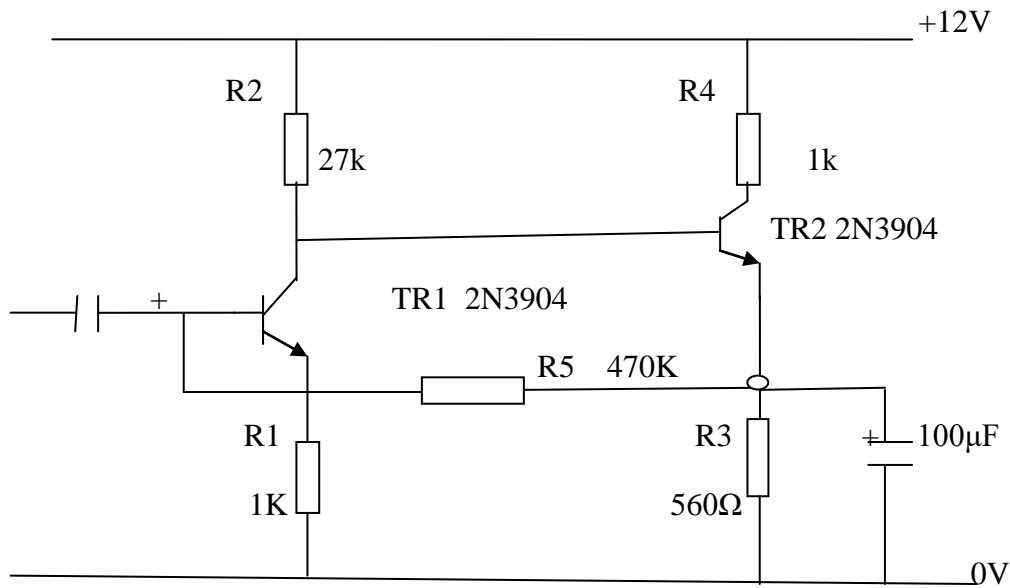


Fig. Q4.

TABLE Q4

Condition	TR1			TR2		
	C	B	e	c	b	E
NORMAL	3.3	0.9	0.3	7.4	3.3	2.6
Fault 1	0.4	0	0	12	0.4	0.6
Fault 2	4.2	1.3	0.7	4.2	4.2	4.2
Fault 3	3.2	1.0	0.3	12	3.2	2,7
Fault 4	4.2	4.2	0.3	5.9	4.2	3.5
Fault5	0.8	0	0	0.1	0.8	0
Fault6	5.1	0.3	0	4.5	5.2	4.4

(12 marks)

(b) Briefly explain the following terms.

(i) burn in

(ii) catastrophic failure

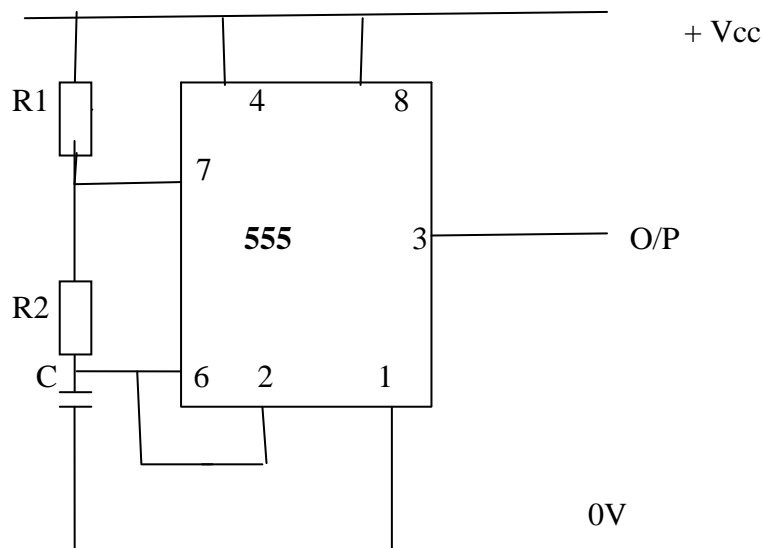
(iii) preventive maintenance

(iv) Redanduncy

(8 marks)

QUESTION FIVE

(a) Fig.Q5 is for an astable pulse generator using timer 555 .



FigQ5

(i) State an expression for t_{on} , the time when the output pulse is high in terms of $R_1, R_2,$ and C .

(ii) similarly for t_{off} , when the output pulse is low.

(iii) state the condition for the output to be a square wave.

(6 marks)

(b) given the values of the components as $R_1=1\text{ K}\Omega$, $R_2=150\text{ K}\Omega$, $C=1\mu\text{F}$.

Determine (i) pulse rate frequency

(ii) duty cycle

(6 marks)

(c) State the nature of failures common with the following components.

(i) resistors

(ii) variable resistors

(iii) capacitors

(iv) semiconductor devices.

(8 marks).