UNIVERSITY OF SWAZILAND

MAIN EXAMINATION 2007/2008

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

TITLE OF PAPER: ANALOG ELECTRONICS II

COURSE NUMBER: E442

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:

1.   Answer any <u>FOUR</u> (4) of the following five questions.

2.   Each question carries 25 marks.

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THIS PAPER CONTAINS SIX(6) PAGES INCLUDING THIS PAGE

QUESTION 1

For the circuit in Fig. 1
(a) Find the frequency and gain condition for oscillation to take place.

[15 marks]

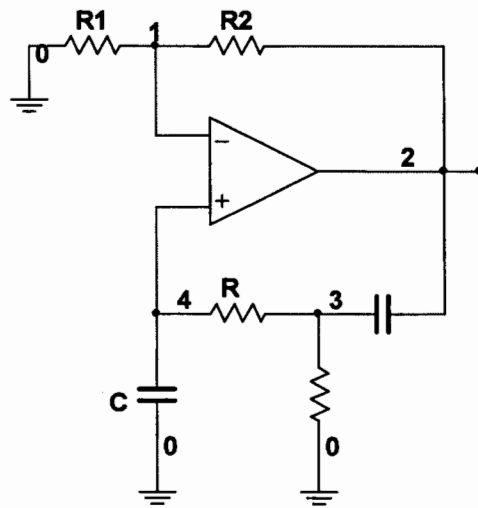(b) Select suitable components so that the circuit will oscillate at a frequency of 5 kHz.

[10 marks]

Fig. 1

QUESTION 2

(a)   Given a CA3080 operational transconductance amplifier (OTA) with a supply voltage $\pm V = \pm 10$ V and an I_{ABC} of 100 μA, find:

    (i)   the OTA transconductance g_m;

                                                 [5 marks]

    (ii)   the output voltage with an input of 10 mV and a load resistor of 1 KΩ;

                                                 [7 marks]

    (iii)   the I_{ABC} needed to give a I V output with a 120 mV input and a load resistance of 1 KΩ.

                                                 [7 marks]

For the CA3080 OTA,

$$g_m = \left(\frac{300}{V}\right)(I_{ABC})$$

(b)   What is the purpose of input diode linearization in the internal circuit of an OTA?

                                                 [6 marks]

QUESTION 3

(a)   An analog signal in the range 0 to +5 V is to be converted to a 12-bit digital signal.

    (i)   What is the resolution of the conversion in volts?
    (ii)   What is the digital representation of an input of 3.25 V?
    (iii)   What is the error made in the conversion of 3.25 V in absolute terms and as a percentage of the input?
    (iv)   What is the largest possible quantization error as a percentage of full scale?

[20 marks]

(b)   What is the maximum resistor ratio required by an 8-bit DAC utilizing a binary-weighted resistor network?

[5 marks]

QUESTION 4

(a)   The full-bridge converter shown in Fig. Q4a is fed with an input voltage of 230 V at 50 Hz. The thyristors are triggered at a firing angle of 70°. If R = 56 Ω, find the average current through R.
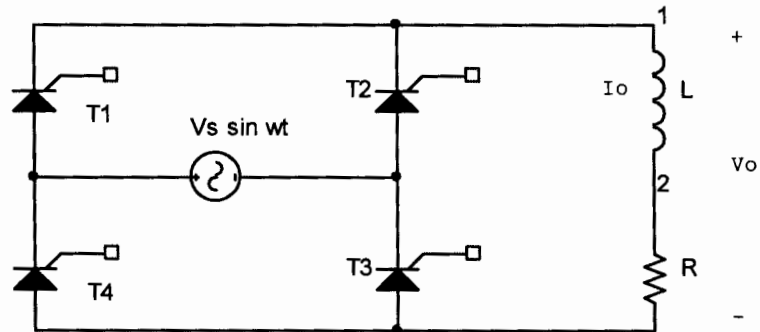
[12 marks]

Fig. Q4a

(b)   In Fig. Q4b, the diac has a breakover voltage of 32 V and an ON voltage of 1 V. If the triac has a trigger voltage of 0.7 V, what is the current through the 1.5 kΩ resistor just after the diac breaks over?

[13 marks]

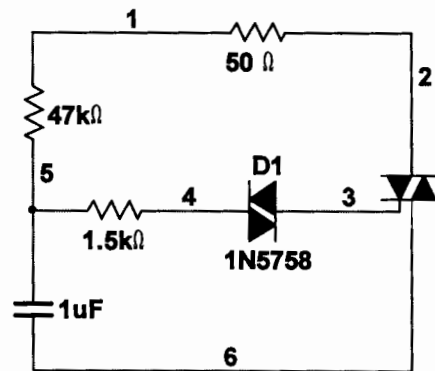
Fig. Q.4b

QUESTION 5

In Fig. Q5, the wiper is at the middle of its range. Assume $V_{BE} = 0.7$ V for all transistors.

(a) What is the output voltage of the regulator?
(b) What is the load current when current limiting starts?
(c) What is the minimum load resistance where regulation is lost?
(d) What is the power dissipation of the pass transistor when the load resistor is shorted?
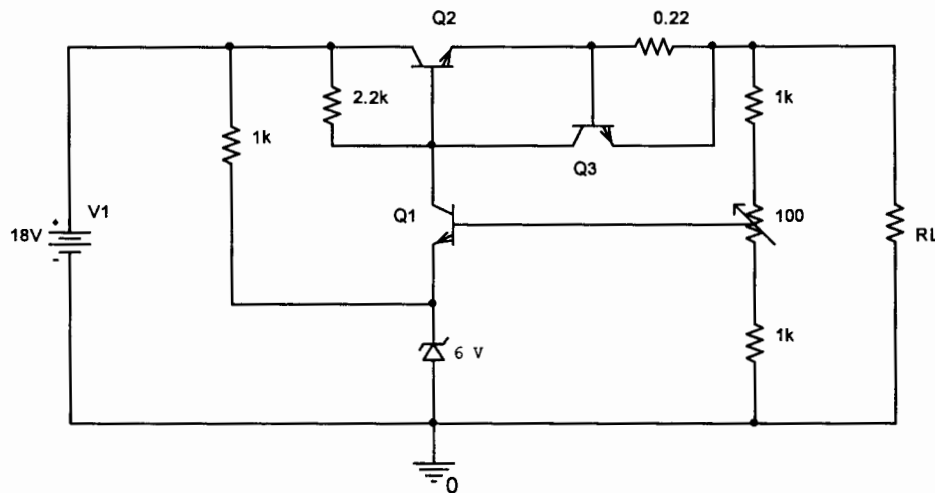
[25 marks]

Fig. Q5