UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	ELECTRONIC CIRCUITS ANALYSIS AND DESIGN
COURSE CODE	:	BEL 30403
PROGRAMME	:	BACHELOR DEGREE OF ELECTRONIC ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015/JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) Figure **Q1(a)** shows a circuit to measure temperature. The temperature sensor in this circuit has a resistance R_T which changes with temperature according to the following equation:

$$R_T = 1000e^{-(T/25°)}$$

where T is the temperature in °C and R_T unit is in ohm (Ω).

The output voltage (V_o) is 0 V at -55°C. The meter used in the circuit will reach the full-scale deflection at 125°C and this is achieved when the current through the meter is at 1 mA. Design the circuit by finding the value of resistors R_X, R_T and R_Y to fulfill the specification of the circuit as described above.

(10 marks)

(b) Figure **Q1(b)** shows the waveforms of input voltage (V_i) and output voltage (V_o) of a Schmitt Trigger circuit. Based on this figure, design the Schmitt Trigger circuit that produces those waveforms using a feedback resistor of 15 kΩ. Draw the complete circuit and also the circuit transfer characteristic graph.

(10 marks)

Q2 (a) Consider the circuit in Figure **Q2(a)**, derive the gain transfer function, $H(s) = \frac{V_O(s)}{V_i(s)}$ of the circuit.

(8 marks)

(b) Second-order band pass filter can be constructed by cascading a second-order high pass filter and a second-order low pass filter as shown in Figure **Q2(b)**. For this circuit;

(i) Determine the value of capacitor of C_a and C_b in order to have the low cut-off frequency, f_{c1} of 1026Hz and high cut-off frequency, f_{c2} of 7186Hz.

(4 marks)

(ii) Calculate the centre frequency, f_o and quality factor, Q of the circuit.

(4 marks)

(iii) Draw the frequency response of this filter.

(2 marks)

(iv) If the filter is the Butterworth type, find out the needed value of R_F if the factors of polynominals $P_n(s)$ is as below;

$$s^2 + 1.414s + 1$$

(2 marks)

Q3 (a) For the circuit shown in Figure **Q3(a):**

(i) Determine the amplifier type and feedback topology

(2 marks)

(ii) Derive the input impedance with feedback, Z_{if} and state whether it is increased or decreased from that without feedback.

(5 marks)

(iii) If $A_f = 10$, $Z_{if} = 500\text{k}\Omega$, $Z_o = 2\text{k}\Omega$, and $Z_{of} = 25\text{k}\Omega$, calculate Z_i, A_{tc} and β.

(6 marks)

(b) An amplifier without feedback network has a gain of 200 and the gain bandwidth product (GBP) of 30 MHz. A negative feedback amplifier is imposed on this amplifier with the following feedback factor of $1+A\beta = 23.33$.

(i) Calculate the gain and the GBP for the amplifier with the feedback.

(3 marks)

(ii) If the low and high cut-off frequency without feedback is 3.5 kHz and 153.5 kHz respectively, compute the new low and high cut-off frequency with feedback.

(4 marks)

Q4 (a) State the name of the oscillator in Figure **Q4(a)** and draw the output waveform V_O. Design the oscillator circuit such that the output waveform V_O has a frequency of oscillation at 10 kHz.

(10 marks)

(b) A one-shot multivibrator circuit that uses a 555 timer generates a pulse waveform (V_o) at pin 3, when it receives an input trigger (V_T) at pin 2, as shown in Figure **Q4(b)**.

(i) Use a 555 timer IC as in Figure **Q4(b)(i)** to design the circuit. Draw and completely label the circuit. Use a 1 nF capacitor for the design.

(7 marks)

(ii) Explain why the trigger voltage V_T must be as shown in Figure **Q4(b)** to trigger the output.

(3 marks)

Q5 Figure **Q5** is a voltage regulator circuit.

(a) Briefly describe how the circuit operates when there is a slight increase in the regulated output voltage.

(4 marks)

(b) Find the value of the regulated output voltage.

(3 marks)

(c) Calculate the power dissipated by the transistor.

(9 marks)

(d) Obtain the range for R_S that can be used in the circuit to ensure the Zener diode is in the breakdown region. Given parameter: P_{Zmax} = 60mW and I_{Zmin} = 2mA.

(4 marks)

– END OF QUESTION –

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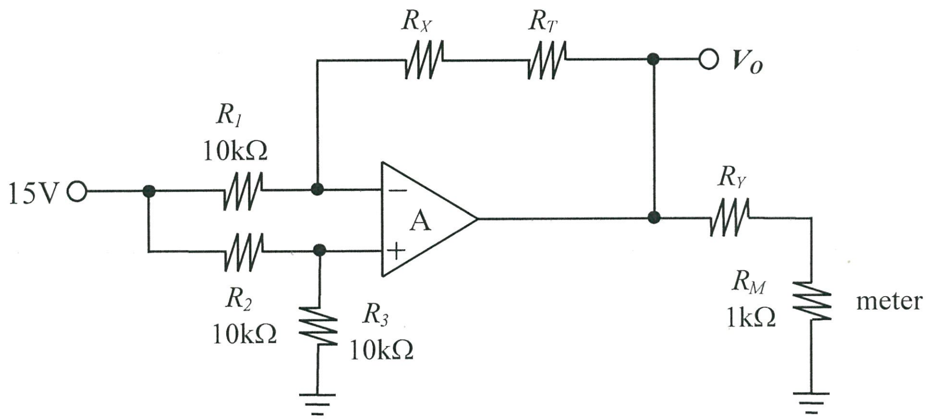

FIGURE Q1(a)

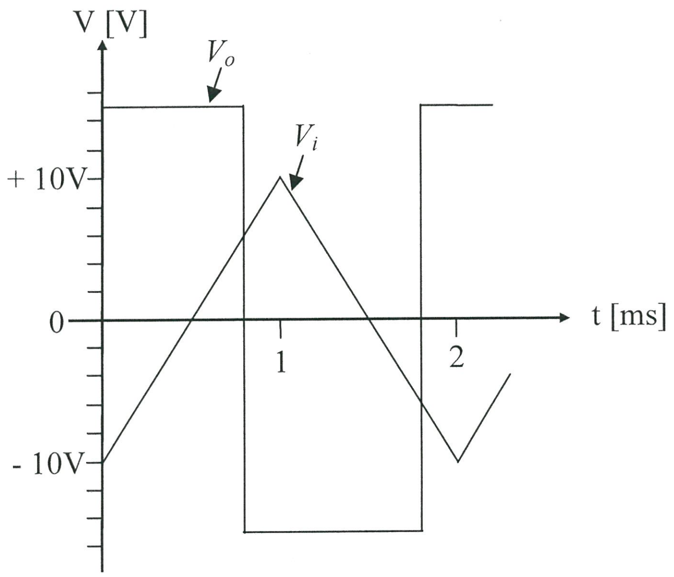

FIGURE Q1(b)

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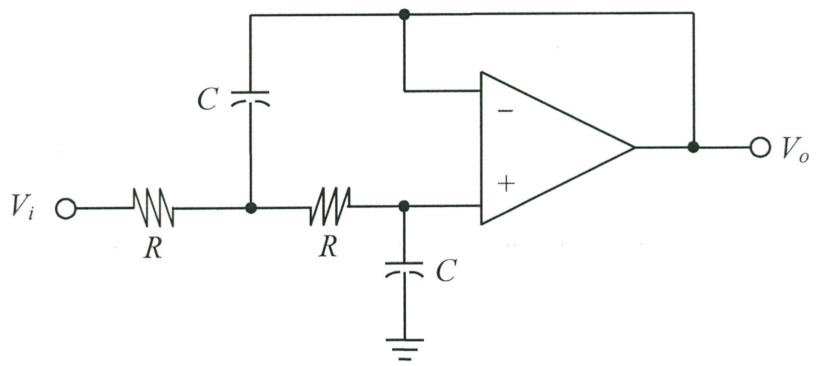

FIGURE Q2(a)

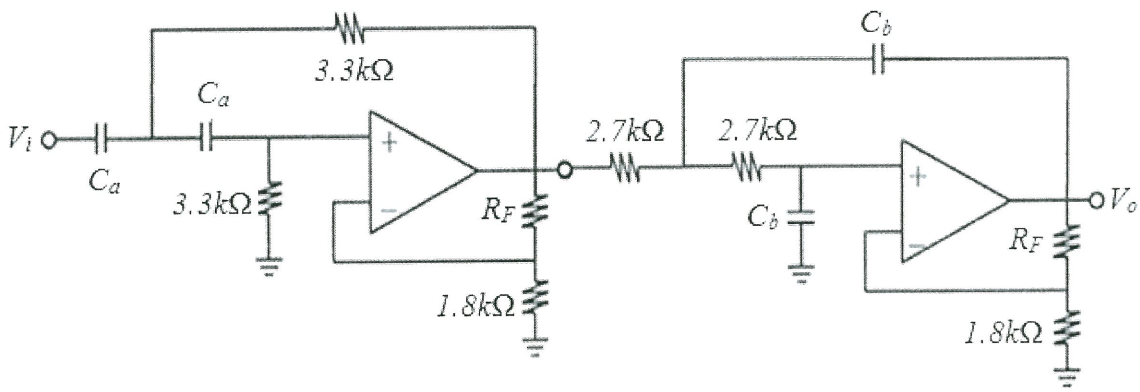

FIGURE Q2(b)

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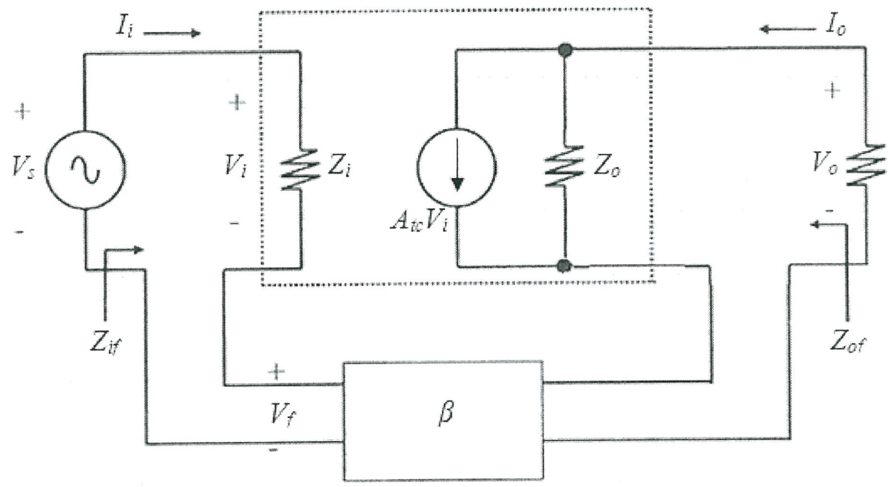

FIGURE Q3(a)

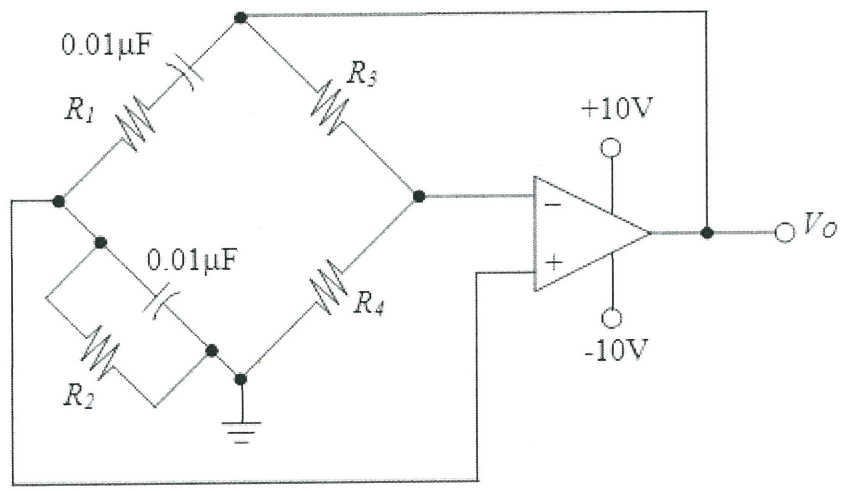

FIGURE Q4(a)

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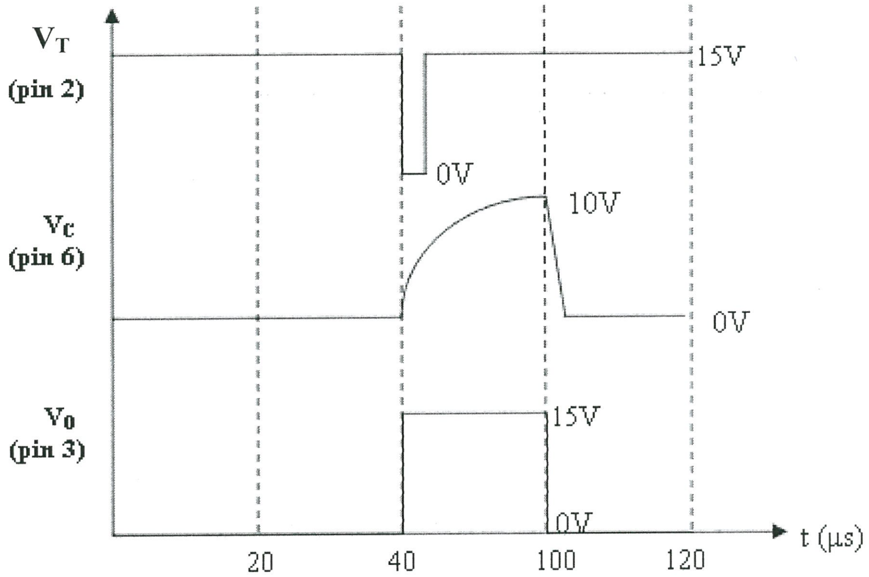

FIGURE Q4(b)

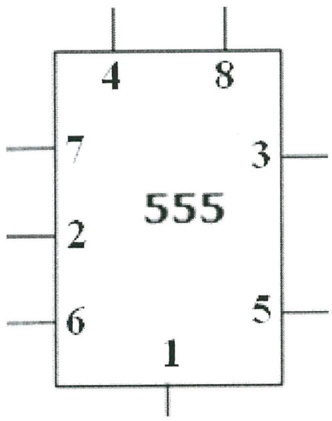

FIGURE Q4(b)(i)

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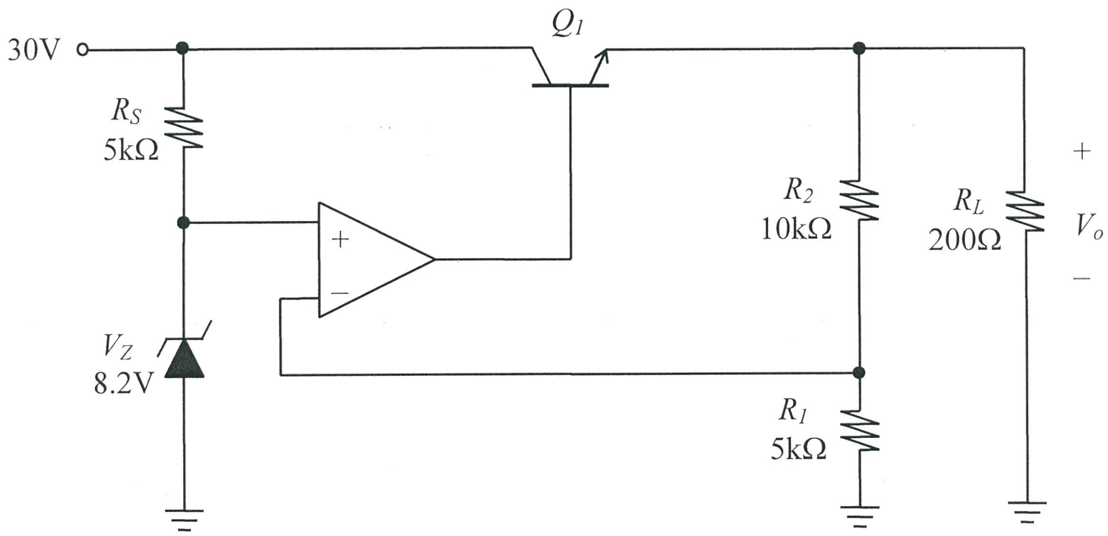

FIGURE Q5