UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	ELECTRONIC DEVICES AND APPLICATIONS
COURSE CODE	:	BEX21003
PROGRAMME	:	BEE
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Explain with the aid of a diagram the internal block diagram of an operational amplifier.

(5 marks)

(b) Operational amplifier is used to perform mathematical operation. **Figure Q1(b)(i)** shows one of the applications of operational-amplifier. The input waveforms of V_1 (CH1) and V_2 (CH2) are shown in **Figure Q1(b)(ii).**

(i) Determine the expression of output, V_o in terms of V_1 and V_2.

(6 marks)

(ii) Based on the answer in part **Q1(b)(i)**, name the operation performed by this circuit.

(1 mark)

(iii) Based on the inputs given, draw the output waveform generated from this circuit if the resistor, R is equal to 2 kΩ. Show all the steps involved.

(8 marks)

Q2 (a) The circuit in **Figure Q2(a)**, is an integrator circuit.

(i) Determine the rate of change of the output voltage in response to the input square wave, when output voltage is initially zero and the pulse width is 100 μs.

(6 marks)

(ii) Determine the output and draw the waveform.

(4 marks)

(b) Determine the output of a differentiator for the triangular wave input as shown in **Figure Q2(b).**

(10 marks)

Q3 (a) The circuit in **Figure Q3(a)** is a type of oscillator used to perform the switching function.

(i) Name the oscillator type and explain the operation of the circuit.

(8 marks)

(ii) Draw the output response of the integrator, V_o if the output of the comparator is a rectangular waveform.

(2 marks)

(b) The circuit in **Figure Q3(b)** is a basic FET Colpitts oscillator.

(i) Design a tank circuit for the oscillator which can be loaded to a point where Q (quality factor) is equal to 4 (the oscillator has frequency of 7.18 kHz, $C_1 = 0.1$ μF and $C_T = 0.091$ μF).

(8 marks)

(ii) Using the value of C_1, C_2 and L from the answer in part Q3(b)(i), calculate the new frequency produced by the oscillator if it is loaded to a point where $Q = 1$.

(2 marks)

Q4 (a) A 555 timer can be configured to run in the astable mode.

(i) Draw and label clearly the circuit for astable mode multivibrator using a 555 timer, resistors, R_1 and R_2, and capacitors C_{ext} and C_1.

(2 marks)

(ii) Design an astable multivibrator which has duty cycle of 60% and output frequency of 5 kHz using C_{ext} value of 0.022 μF and C_1 value of 0.01 μF.

(9 marks)

(iii) Explain how the astable multivibrator can be set to become a voltage-controlled oscillator (VCO) and how the output frequency is varied.

(4 marks)

(b) **Figure Q4(b)** is the phase-shift oscillator circuit. Determine the value of R_f necessary for the circuit to operate as an oscillator and calculate the frequency of oscillation. Given that $R_1 = R_2 = R_3 = 5$ kΩ and $C_1 = C_2 = R_3 = 0.01$ μF.

(5 marks)

Q5 (a) **Figure Q5(a)** is the shunt regulator using the combination of an op-amp and a bipolar junction transistor.

(i) Calculate the power rating that R_1 should have if the maximum input voltage, V_{in} is 12 V. Given that $R_1 = 20$ Ω, $R_2 = 1.2$ kΩ, $R_3 = 10$ kΩ and $R_4 = 10$ kΩ.

(5 marks)

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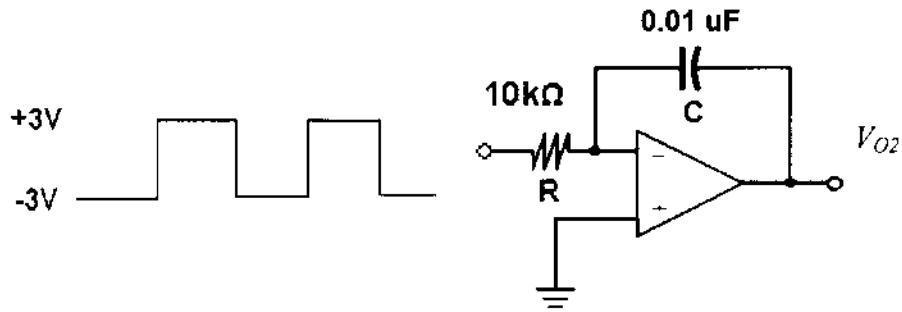

FIGURE Q2(a)

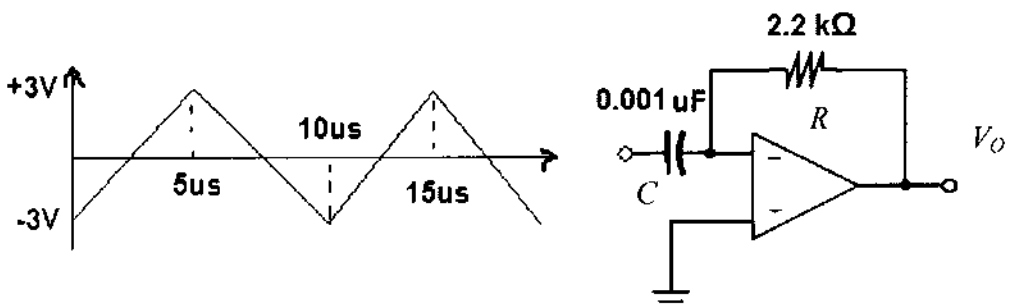

FIGURE Q2(b)

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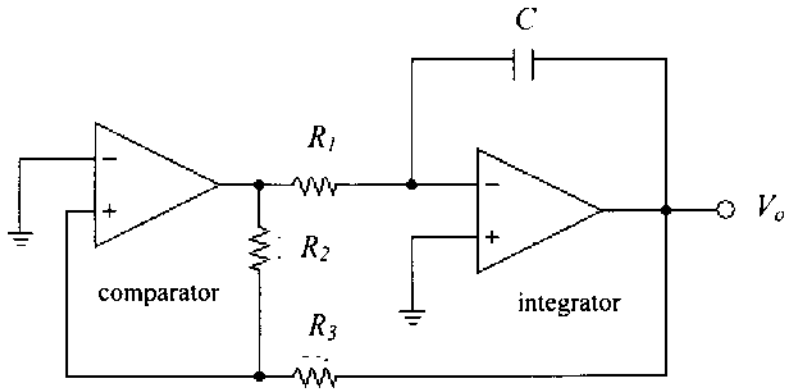

FIGURE Q3(a)

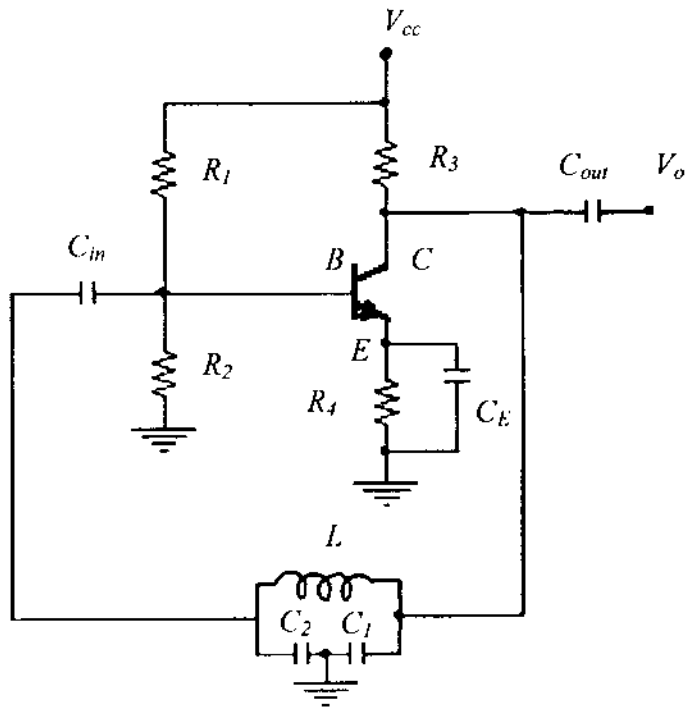

FIGURE Q3(b)

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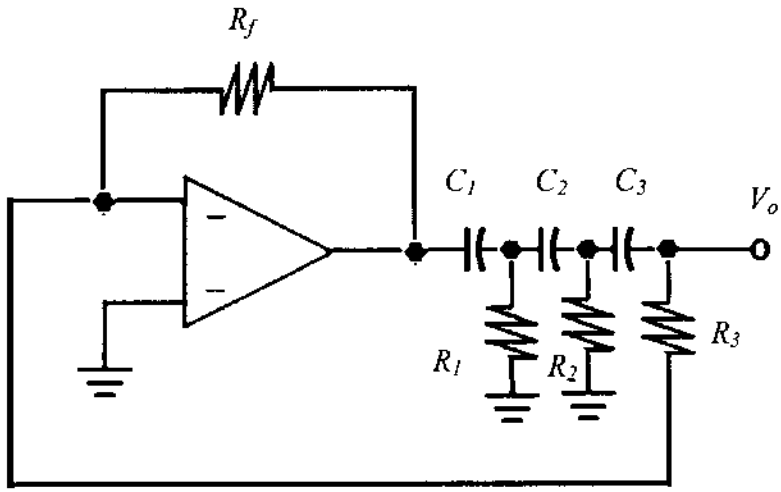

FIGURE Q4(b)

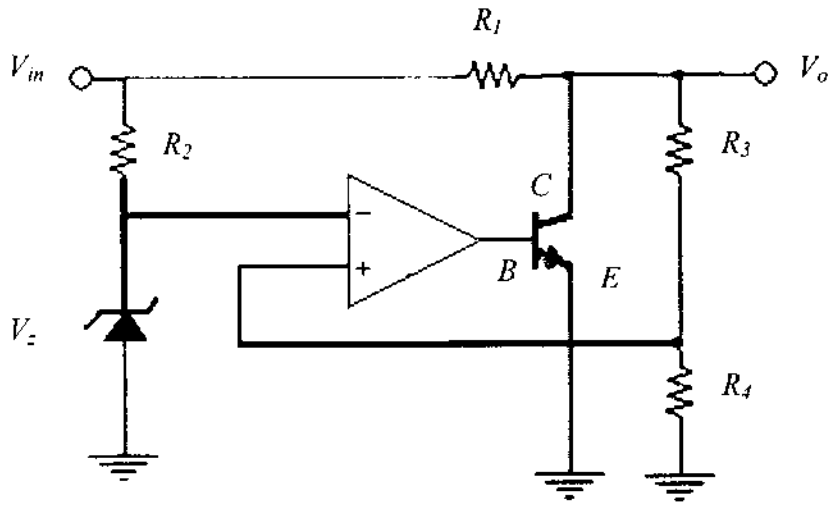

FIGURE Q5(a)