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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014**

**COURSE NAME : ELECTRONIC CIRCUITS
ANALYSIS AND DESIGN**

COURSE CODE : BEL 30403

PROGRAMME : BEJ

EXAMINATION DATE : JUNE 2014

DURATION : 3 HOURS

INSTRUCTION : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

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- Q1 (a)** The circuit in Figure **Q1(a)** is a non-inverting linear combination circuit. Prove that the output voltage V_o is given by:

$$V_o = \frac{(R_3 + R_4)}{R_3(R_1 + R_2)}(R_2V_1 + R_1V_2)$$

(6 marks)

- (b)** The first op-amp (A_1) in Figure **Q1(b)** is acting as an oscillator. The output of this op-amp is used as the input for the second op-amp (A_2). Both op-amps use a positive feedback concept.

- (i)** Briefly explain the function of the two feedback loop that connected to positive and negative input of op amp A_1 . State the name of this oscillator.

(4 marks)

- (ii)** Determine the value for resistors R_1 and R_2 so that the waveform of V_{o1} has a frequency of 1 kHz.

(4 marks)

- (iii)** Draw and completely label both output waveforms of V_{o1} and V_{o2} . Clearly show the relationship between these two waveforms.

(6 marks)

- Q2 (a)** The circuit in Figure **Q2 (a)** is used in sensor conditioning circuits. It is a filter circuit as well as an integrator.

- (i)** Determine the cutoff frequency and gain in dB of this filter.

(4 marks)

- (ii)** Draw and label clearly the frequency response of this filter. Comment on the frequency response.

(4 marks)

- (iii)** Describe when will this circuit acts as an integrator.

(3 marks)

- (b)** An amplifier system without feedback has specifications as follows:

Open loop gain, $A = 100$,
 Input impedance, $Z_i = 50 \text{ k}\Omega$,
 Output impedance, $Z_o = 2.5 \text{ k}\Omega$,
 Feedback factor = 0.1

Determine the closed-loop gain (A_{ff}), input impedance (Z_{if}) and output impedance (Z_{of}) for the amplifier with:

- (i) voltage shunt feedback (3 marks)
- (ii) current series feedback (3 marks)
- (iii) current shunt feedback (3 marks)

Q3 Refer to the timer circuit shown in Figure **Q3 (a)**. Given $R_A = 22 \text{ k}\Omega$, $R_B = 47 \text{ k}\Omega$ and $C = 100 \text{ nF}$.

- (a) Find the length of time when the LED is on and when the LED is off. (3 marks)
- (b) Determine the oscillation frequency and duty cycle of the output waveform. (4 marks)
- (c) If the timer output pin from the Figure **Q3 (a)** is connected to the circuit shown in Figure **Q3 (c)**,
 - (i) draw the output waveform of the timer for the first two cycles. (3 marks)
 - (ii) determine the output waveform of the op-amp (V_{o2}). Assume initially V_{o2} is zero. The op-amp has the saturation voltage at $\pm 10 \text{ V}$. Illustrate and label clearly the relationship between the timer output waveform and V_{o2} . (10 marks)

Q4 Design a simple DC power supply consisting of a centre-tapped transformer (12V-0-12V), a two-diode rectifier and a capacitor as filter with the following specifications:

Output current, $I_{o(max)} = 0.1 \text{ A}$
 Ripple voltage, $V_{r(p-p)} = 0.5 \text{ V}$
 Forward diode voltage, $V_{diode} = 0.7 \text{ V}$
 Mains supply = 240 V, 50 Hz

- (a) Draw and label the DC power supply circuit. (4 marks)

- (b) Sketch the output waveform and label (with values) the output voltage, V_{dc} and ripple voltage, V_r .
(5 marks)
- (c) If an adjustable output voltage regulator as shown in Figure Q4 (c) is connected to the output of the DC power supply circuit from part Q4 (a), determine:
- (i) the required transformer turns ratio
(4 marks)
- (ii) the filter capacitor value
(3 marks)
- (iii) the output range of this simple power supply. The value of R_2 can be varied from 0 to 1 k Ω . Assume that $I_{adj} = 7$ mA and $R_1 = 10$ k Ω .
(4 marks)
- Q5.** (a) Describe **TWO** (2) differences between a linear regulator and a switching regulator.
(4 marks)
- (b) Figure Q5 (b) is a zener follower regulator. From the figure, calculate:
- (i) the output voltage, V_o and current across the load, I_L .
(5 marks)
- (ii) the transistor power dissipation, P_Q .
(5 marks)
- (c) Figure Q5 (c) is a LC feedback oscillator. Determine the value of the components (L and R_F) for it to oscillate at 50 kHz.
(6 marks)

- END OF QUESTION-

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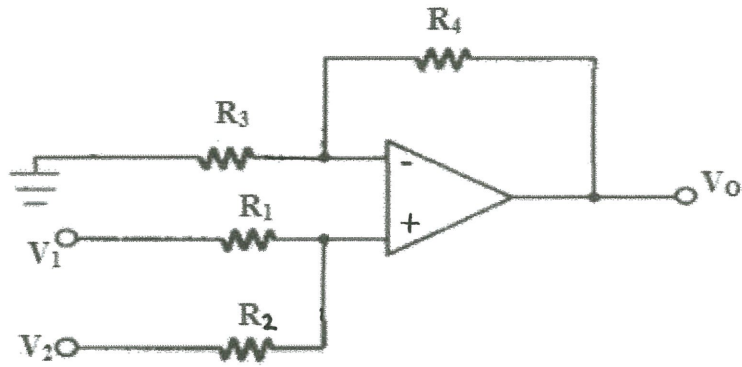


FIGURE Q1 (a)

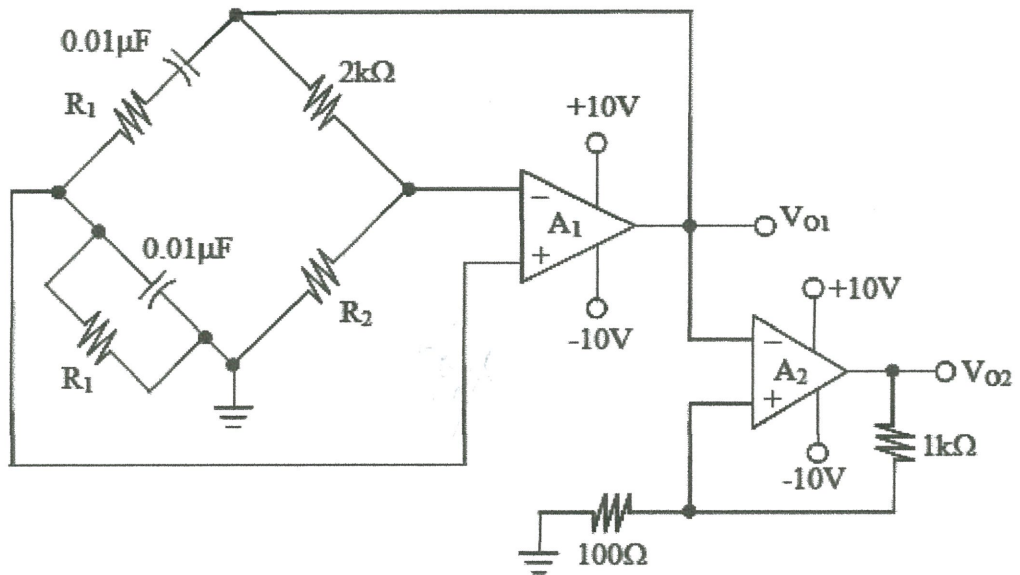


FIGURE Q1 (b)

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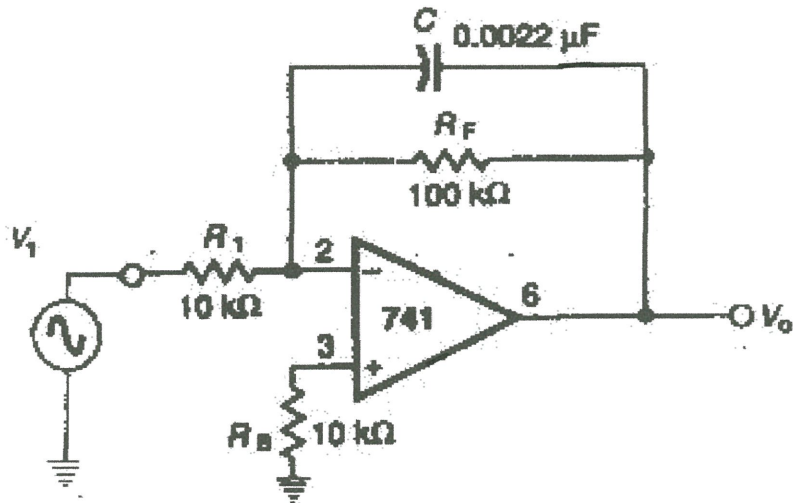


FIGURE Q2 (a)

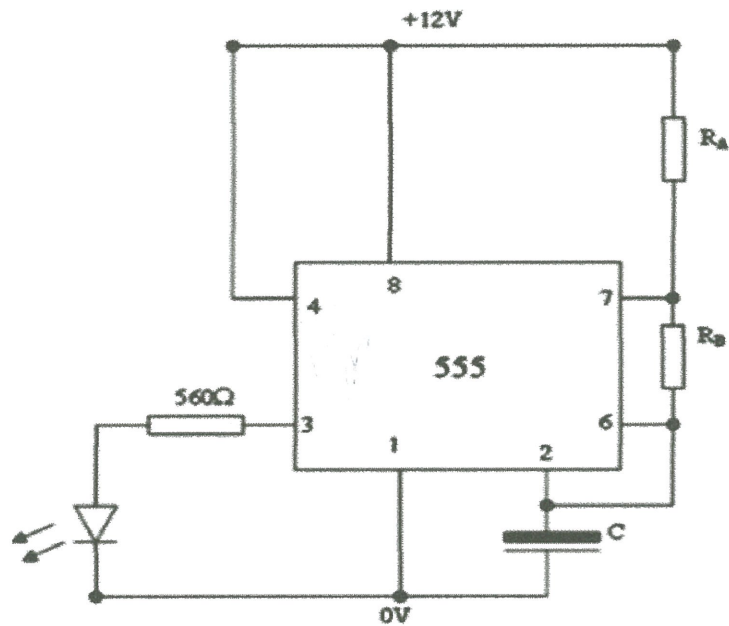


FIGURE Q3 (a)

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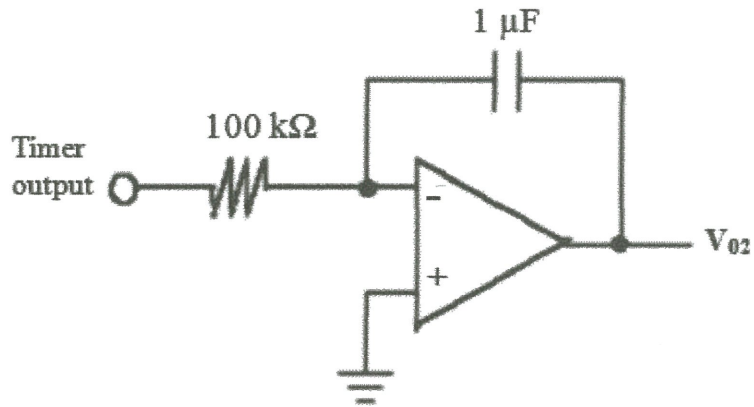


FIGURE Q3 (c)

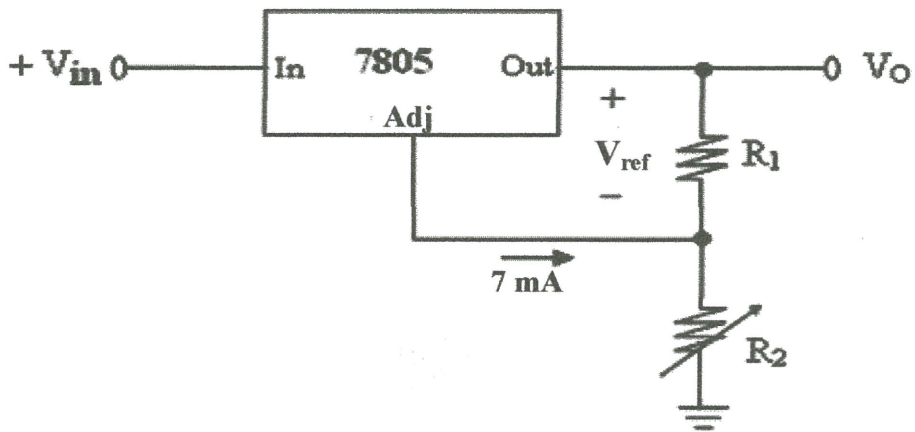


FIGURE Q4 (c)

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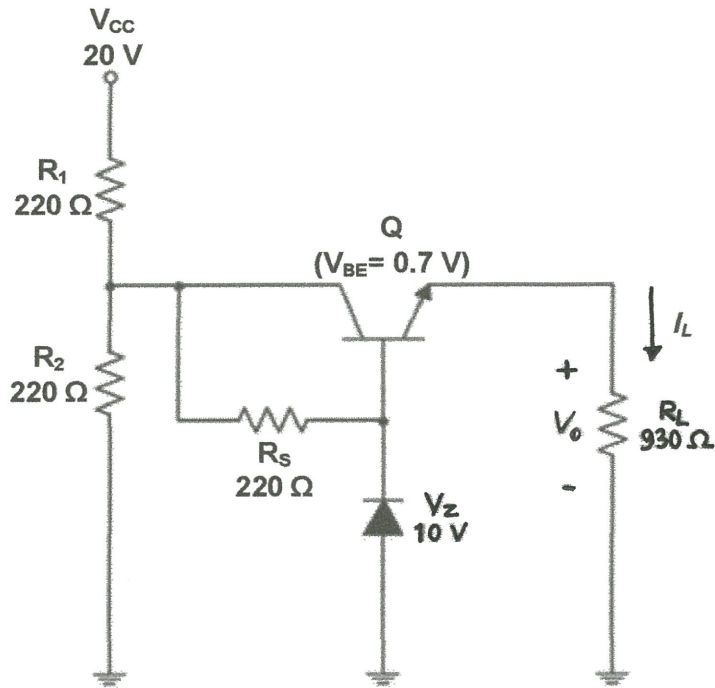


FIGURE Q5 (b)

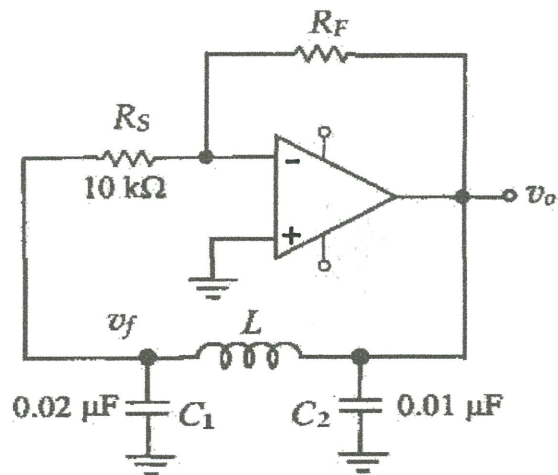


FIGURE Q5 (c)