Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	ELECTRONIC CIRCUIT ANALYSIS AND DESIGN
COURSE CODE	:	BEL 30403
PROGRAMME	:	BACHELOR OF ELECTRONIC ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 As an apprentice in TOTO Electronic Sdn Bhd, Mr Obama is instructed to design two electronic circuits that involve the usage of operational amplifier.

(a) In the first task, he needs to design a circuit that
- able to amplify at least 10 times the input signal
- produces both input and output signals are in phase

(i) Show a possible circuit design to satisfy the pre-defined outcomes mentioned in **Q1(a)**.

(4 marks)

(ii) Prove that, using mathematical equation, the circuit design in **Q1(a)(i)** could achieve the first condition mentioned in **Q1(a)**.

(6 marks)

(b) In the second task, he shall design a circuit that produces an output
- which is less susceptible to a noisy input signal
- which changes whenever the input signal has surpassed over or dropped below the reference levels

Assume that the circuit will be supplied with a sinusoidal input signal of 5 $V_{p\text{-}p}$.

(i) Show a possible circuit design to satisfy the pre-defined outcomes mentioned in **Q1(b)**.

(4 marks)

(ii) Draw the input-output waveform to prove that the circuit design in **Q1(b)(i)** could achieve both conditions mentioned in **Q1(b)**.

(6 marks)

Q2 In October 2015, Janji Bulan Bintang Sdn Bhd has been awarded the 2.6GHz band spectrum by the Malaysian Communications and Multimedia Commission (MCMC) to enable them offering the 4G-Long Term Evolution (4G-LTE) broadband services. The awarded spectrum ranges from 2595 MHz to 2615 MHz and the broadband services will use Time Division Duplex communication.

(a) As a consultant of Janji Bulan Bintang Sdn Bhd, design an active filter that could ensure that the transmitted signal will reach the end user within the specified band spectrum. The frequency response shall be
- maximally flat response, and
- roll-off shall not more than 20 dB/decade.

Express the component values in **FOUR (4)** significant figures.

(12 marks)

(b) Verify that the filter design in **Q2(a)** meets the requirement of your client, Janji Bulan Bintang Sdn Bhd in which you need to show:

- quality factor of filter, and
- a complete frequency response.

(8 marks)

Q3 (a) **Figure Q3(a)** is a block diagram of a system with feedback network.

(i) Derive the closed-loop gain, A_f of the system.

(5 marks)

(ii) State the reasons why a system with a negative feedback is preferred although it produces much lower gain compared to a system without a negative feedback.

(2 marks)

(b) **Figure Q3(b)** shows an amplifier with a negative feedback network. Given Z_{of} = 100 kΩ, Z_o = 10 kΩ and A_f = 50.

(i) State the feedback topology and the amplifier type.

(2 marks)

(ii) Calculate the gain without feedback, A and the feedback factor, β.

(6 marks)

(iii) If the low cutoff frequency of the amplifier with feedback network (f_{Lf}) is 300 Hz, calculate the low cutoff frequency (f_L) if the amplifier does not have the feedback network.

(2 marks)

(iv) Sketch and label the values of the frequency response for both conditions, with and without feedback.

(3 marks)

Q4 (a) For the RC oscillator circuit shown in **Figure Q4(a)** derive the feedback network equation, β and determine the equation for frequency of oscillation.

(10 marks)

(b) Two 555 timers are connected together as shown in **Figure Q4(b)**.

(i) Draw and completely label the waveforms for V_{01}, V_{C1}, V_0 and V_{C3}. All the waveforms must be drawn parallel at the time-axis and clearly show the relationship between them.

(6 marks)

(ii) Calculate the duty cycle of the output waveform V_0.

(4 marks)

Q5 **Figure Q5(a)** is a full wave bridge circuit with a capacitor filter and the output waveform produced by the circuit is shown in **Figure Q5(b)**. Assume all the diodes in the circuit have a forward voltage of 0.7 V.

(a) Design the circuit by finding the value for the capacitor, C and the line voltage $V_{pri(rms)}$ to the circuit to produce the output as shown in **Figure Q5(b)**.

(9 marks)

(b) Calculate the ripple factor for the circuit in **Figure Q5(a)**.

(2 marks)

(c) An additional RC filter with a 100 µF capacitor is added to the circuit in **Figure Q5(a)** to produce a new output DC voltage of 10V.

(i) Modify the circuit to include the additional RC filter. Draw the new circuit and completely label the circuit. Determine the value for the resistor of the additional RC filter.

(5 marks)

(ii) Find the new ripple factor of the circuit and compare with the ripple in **Q5(b)**. Draw a conclusion from this comparison.

(4 marks)

– END OF QUESTIONS–

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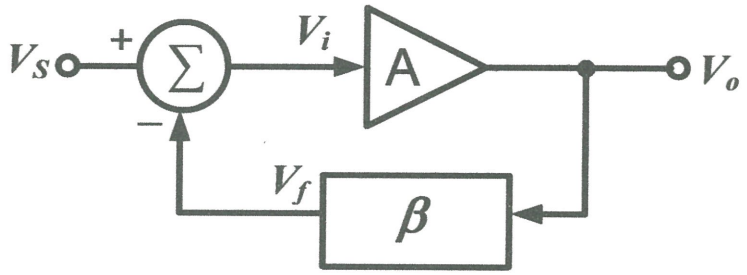

FIGURE Q3(a)

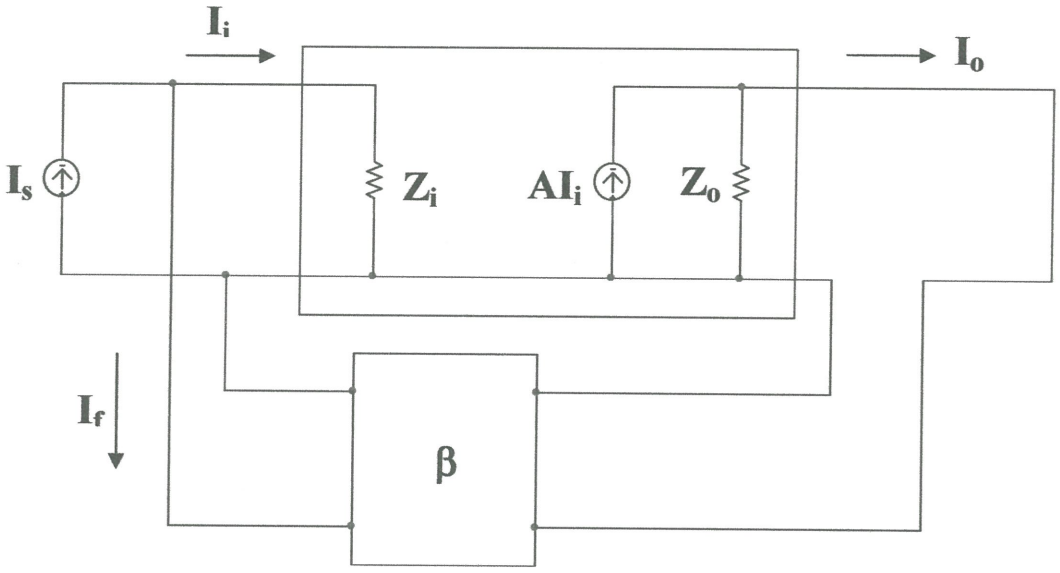

FIGURE Q3(b)

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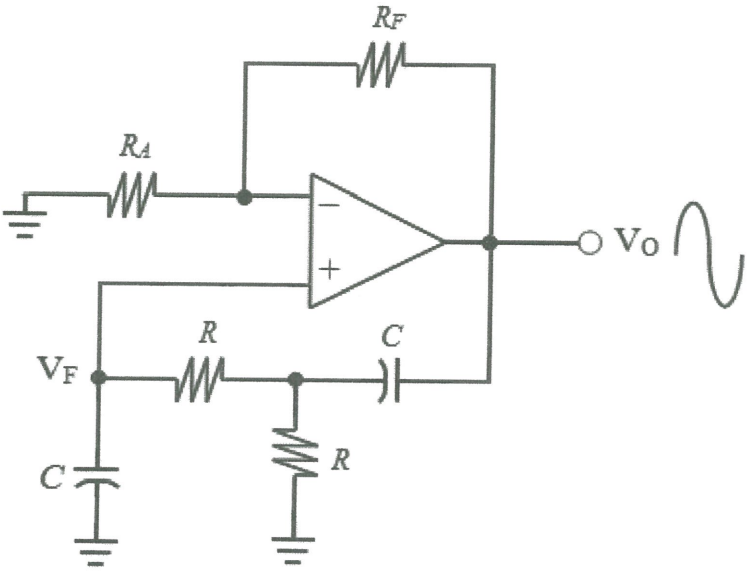

FIGURE Q4(a)

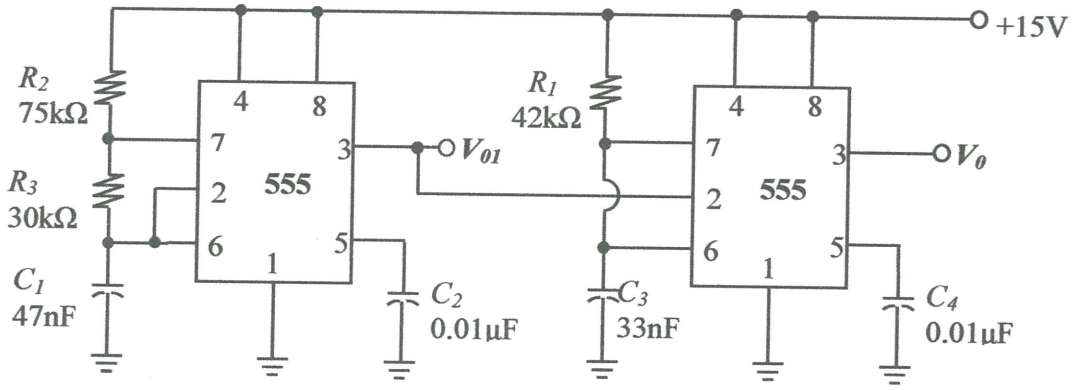

FIGURE Q4(b)

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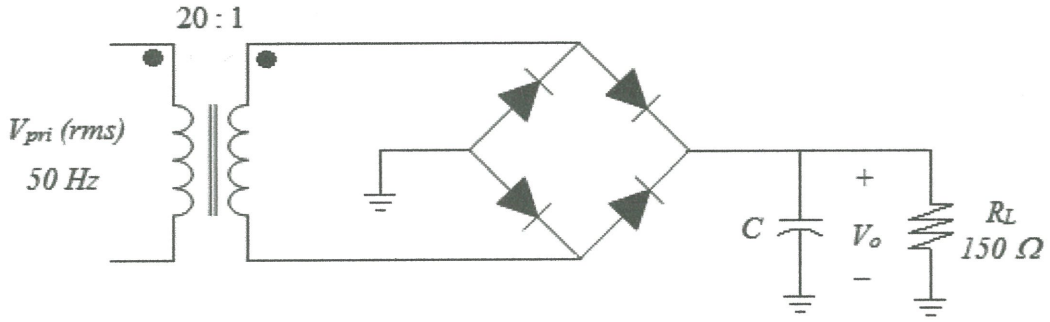

FIGURE Q5(a)

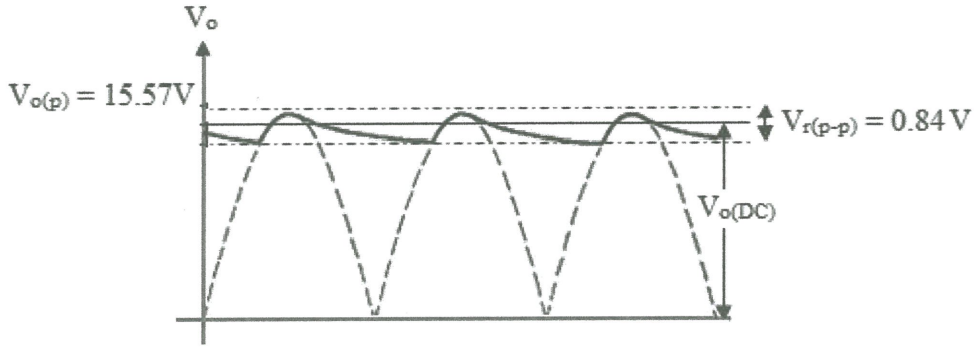

FIGURE Q5(b)