UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016

COURSE NAME	:	ELECTRONIC CIRCUIT ANALYSIS AND DESIGN
COURSE CODE	:	BEL 30403
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE / JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Define the function of the following component/device:

(i) Operational amplifier

(1 mark)

(ii) Comparator

(1 mark)

(b) **Figure Q1(b)** is a an instrumentation amplifier. Prove that $A_{cl} = A_1 A_2 = \frac{V_o}{V_2 - V_1} = 1 + \frac{2R}{R_x}$

(10 marks)

(c) A comparator circuit with an input of $10\sin \omega t$ is desired to provide the following output logic:

Output; $V_o \cong -V_{o\max}$ for $V_i > +7.5$
$V_o \cong +V_{o\max}$ for $V_i > -7.5$

(i) Design the circuit using the general purpose op-amp using ±15 V power supplies. Use feedback resistor of 10 kΩ.

(4 marks)

(ii) Sketch both the output and input signals to show the output logic.

(4 marks)

Q2 (a) Design a first-order high pass Butterworth filter with a cut-off frequency of 20 Hz and passband gain of 30 dB. Use feedback resistor of 100 kΩ.

(9 marks)

(b) Redesign the filter in **Figure Q2(a)** into a low pass filter with a cut-off frequency of 30 kHz and gain of 30 dB.

(6 marks)

(c) Draw and completely label the frequency response for both filters in **Figure Q2(a)** and **Figure Q2(b)**. Comment on the frequency response of both filters.

(5 marks)

Q3 (a) Explain **TWO (2)** differences between system with positive feedback and system with negative feedback.

(4 marks)

(b) **Figure Q3(b)** is a block diagram of an amplifier with a negative feedback network with the following: input impedance with feedback, Z_{if} =1 kΩ, output impedence with feedback, Z_{of} = 200 kΩ, output impedence without feedback, Z_o = 10 kΩ, gain with feedback, A_f = 20, ω_{Lf} = 10^3 rad/s and ω_{Hf} = 10^6 rad/s.

(i) State the disadvantage using negative feedback and discuss how the negative feedback can improve the frequency response of an amplifier.

(3 marks)

(ii) Determine the input impedance without feedback, Z_i, gain without feedback, A, feedback network, β, lower cut-off frequency without feedback, f_L and higher cut-off frequency without feedback, f_H.

(8 marks)

(iii) Sketch the frequency response for both conditions, with and without negative feedback. Compare the bandwidth values.

(5 marks)

Q4 (a) Design a free-running multivibrator circuit using 555 timer IC and 2 nF capacitor such that the output waveform will have a frequency of 20 kHz and PW:SW ratio 3:2. Use V_{cc} = 15 V. Sketch the circuit connections to the 555 timer IC and label clearly.

(10 marks)

(b) Sketch the capacitor and output voltage waveforms of the multivibrator in **Figure Q4(a)** for the first two cycles. Illustrate clearly the relationship between the two waveforms and completely label them. Determine the duty cycle (%) of the output waveform.

(10 marks)

Q5 (a) **Figure Q5(a)** shows the block diagram of a regulated DC power supply:

(i) explain the function of each stage;

(4 marks)

(ii) sketch and label the output waveform of each stage.

(4 marks)

(b) Using **Figure Q5(a)** as a reference as a complete regulated power supply using a bridge rectifier with a filter, an IC regulator and load of 100 Ω. Assume the following specifications:

AC line voltage = 240 V, 50 Hz
Regulated output voltage (V_{REG} or V_{CC}) = 12 V
V_{DC} = 16 V
Ripple voltage at filter output = 0.5 V (p-p)
Forward voltage drop of each diode = 0.7 V

(i) Construct and label the schematic diagram of the complete regulated power supply circuit.

(4 marks)

(ii) Design a complete regulated power supply by finding the transformer turns ratio and the value of the capacitor.

(7 marks)

(iii) State the type of IC regulator used.

(1 mark)

– END OF QUESTIONS –

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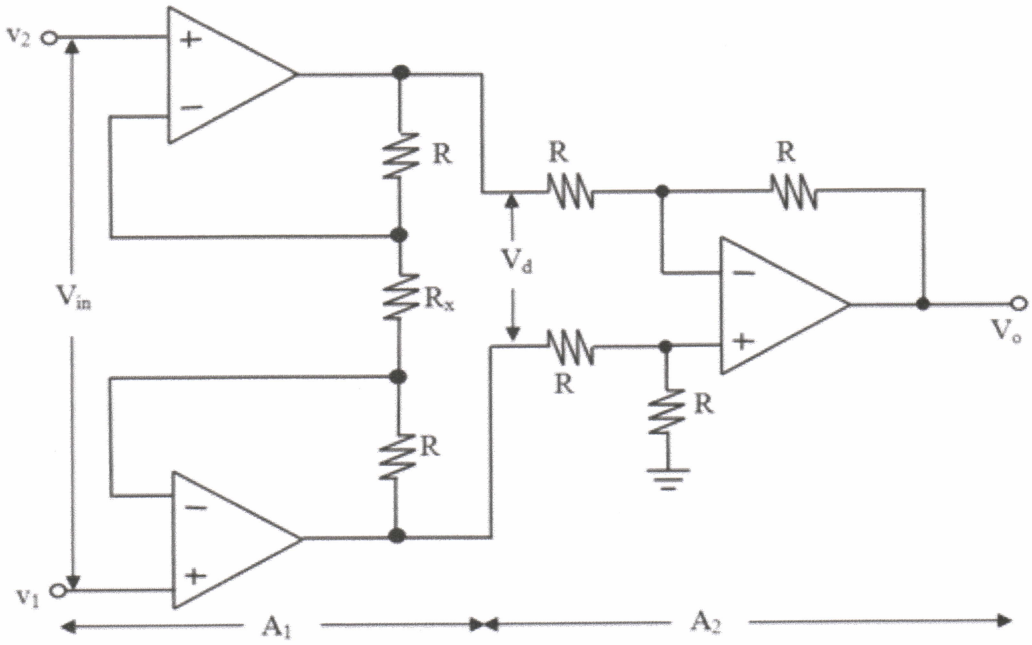

Figure Q1(b)

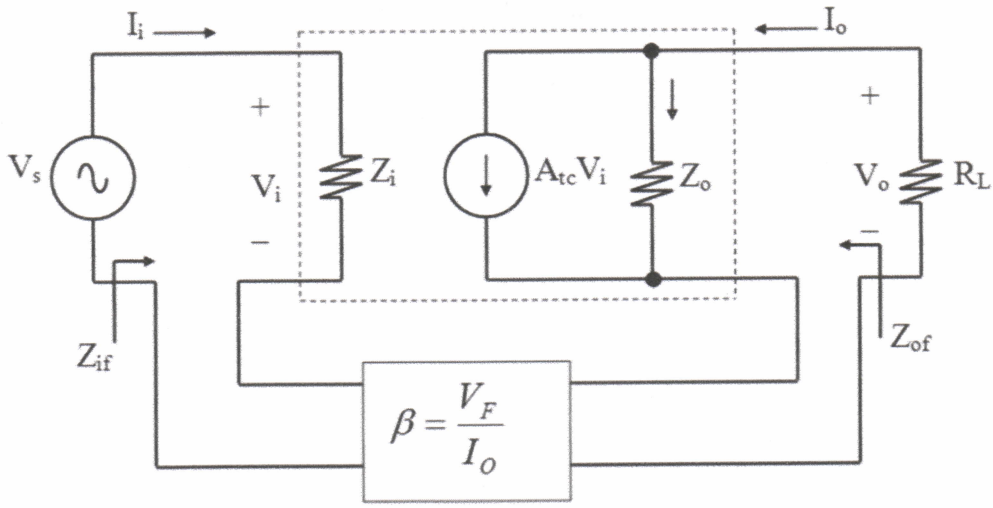

Figure Q3(b)

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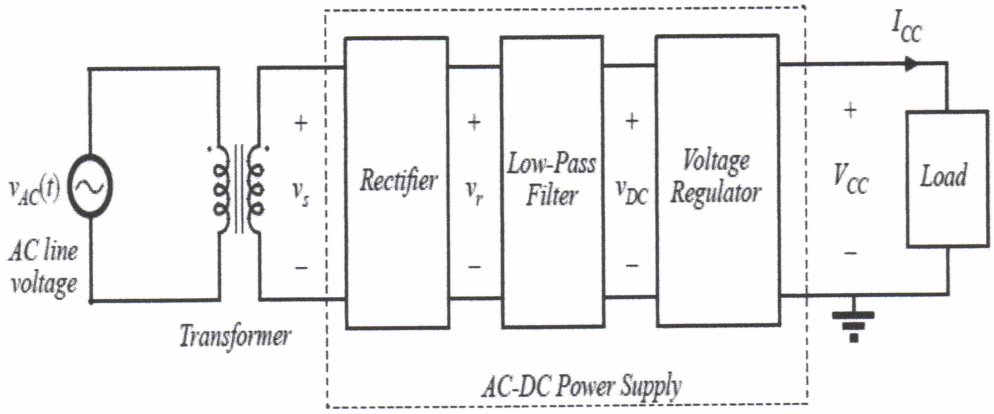

Figure Q5(a)