Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	ELECTRONIC DEVICES AND CIRCUITS II / ELECTRONIC DEVICES AND CIRCUITS
COURSE CODE	:	BNR 25903 / BNR 22303
PROGRAMME CODE	:	BNE
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Explain the significance of zero output impedance and infinite input impedance of an ideal op-amp.

(2 marks)

(b) From amplifier circuit in **Figure Q1(b)**:

(i) Calculate all voltage drops with polarity markings.

(2 marks)

(ii) Calculate all currents and show the current direction.

(2 marks)

(iii) Calculate the overall voltage gain, A_V as a ratio and as in decibel unit.

(2 marks)

(c) **Figure Q1(c)** shows an inverting op-amp with additional of output resistor, R_3. The circuit parameters are $R_1 = 5$ kΩ, $R_2 = 25$ kΩ, $R_3 = 12.5$ kΩ and $R_L = 5$ kΩ.

(i) Derive the expression for V_{out} in terms of the input voltage, V_{in}

(1 marks)

(ii) Derive the expression for I_3 in terms of the input voltage, V_{in}.

(3 marks)

(iii) Explain the situation of I_3 if R_3 is doubled for example 25 kΩ.

(1 marks)

(d) Show the connection of an LM124 quad op-amp as a three-stage amplifier with gains of +15, -22, and -30. Use a 420 kΩ feedback resistor for all stages. Calculate the output voltage results for an input of V_{in} = 80 μV. Refer **Appendix A** for pin configuration.

(7 marks)

Q2 (a) With the aid of diagram, explain the crossover distortion situation that usually occur in class B amplifier. Suggest a components to be added in order to reduce the crossover distortion.

(5 marks)

(b) Sketch the collector current waveform when amplifier operating as class A, class B, class C and class AB.

(4 marks)

(c) If the input voltage to the power amplifier of **Figure Q2(c)** is 8 V_{rms}, calculate:

(i) Power input, P_i (dc).

(2 marks)

(ii) Power output, P_o (ac).

(2 marks)

(iii) Efficiency, % η.

(2 marks)

(iv) Power dissipated by both power output transistors.

(2 marks)

(d) A 2N3055 power transistor dissipates 20 W during operation. The amplifier circuit is designed to operate over an ambient temperature range of 0°C to 80°C. The worse case condition exists when the ambient temperature is 80°C. The temperature case to heat sink thermal resistance is 0.5 °C/W and the heat sink is rated for a thermal resistance of 3 °C /W. Calculate the case temperature of the transistor for worst case operating conditions.

(3 marks)

Q3 (a) Describe the operation of the circuit in **Figure Q3(a)**.

(4 marks)

(b) Digital-to-analog conversion can be achieved using a number of different methods. One popular scheme uses a network of resistors called a ladder network. Sketch a ladder network using 01101 input and 15 kΩ resistors.

(5 marks)

(c) Draw the circuit of a one-shot using a 555 timer to provide one time period of 20 μs. If R_A = 7.5 kΩ, determine the value of capacitor, C.

(5 marks)

(d) **Figure Q3(d)** shows the PLL connected to work as a FM demodulator.

(i) Calculate the center frequency of the circuit.

(1 marks)

(ii) Find the value of capacitor, C_1 in the circuit to obtain a center frequency of 100 kHz.

(2 marks)

(iii) Find the lock range for R_1 = 4.7 kΩ and C_1 = 0.001 μF.

(3 marks)

Q4 (a) With the aid of diagram, describe the principles of oscillator operation in electronic systems.

(4 marks)

(b) State **TWO (2)** types of sine wave oscillator. Define **TWO (2)** examples for each of oscillator.

(4 marks)

(c) For the circuit shown in **Figure Q4(c)**,

(i) Find t_H and t_L for the output, V_O.

(3 marks)

(ii) Determine the duty cycle.

(1 marks)

(iii) Clearly draw and label the waveforms of V_C and V_O.

(3 marks)

(d) Design a phase-shift oscillator for a frequency of 800 Hz. The capacitors are to be 10 nF.

(5 marks)

Q5 (a) With the aid of diagram, show the relation between V_o, V_{in}, V_{ut} and V_{lt} of Scmitth trigger.

(4 marks)

(b) **Figure Q5(b)** shows the circuit of a Schmitt Trigger and its transfer characteristic respectively. Based on these figures, determine V_{REF} and R_2.

(5 marks)

(c) Transfer function for two type of active filter are:

$$H(s) = \frac{28.3 x 10^8}{2s^2 + (5.684 x 10^4)s + (8.08 x 10^8)}$$

$$H(s) = \frac{6.25s^2}{2.5s^2 + (2.222 x 10^4)s + (9.875 x 10^7)}$$

(i) State type of filter for each transfer function.

(2 marks)

(ii) Find the cut-off frequency for each filter.

(3 marks)

(d) Design a second order low pass Butterworth filter with cut-off frequency of 1 kHz. Select $C = 0.0047$ μF. Draw the frequency response of the circuit.

(6 marks)

\- **END OF QUESTIONS** -

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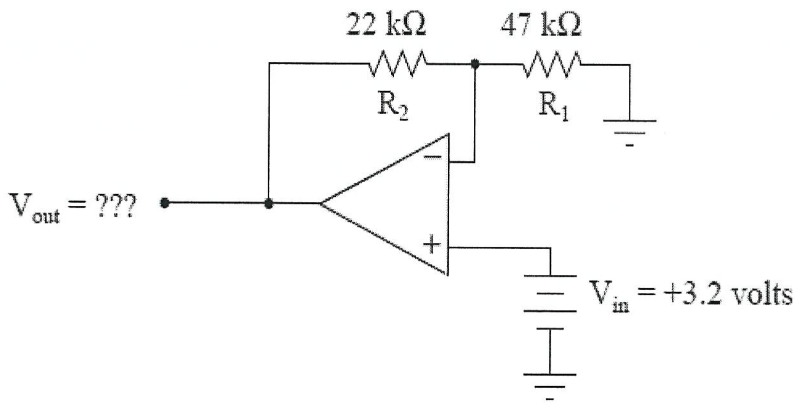

Figure Q1(b)

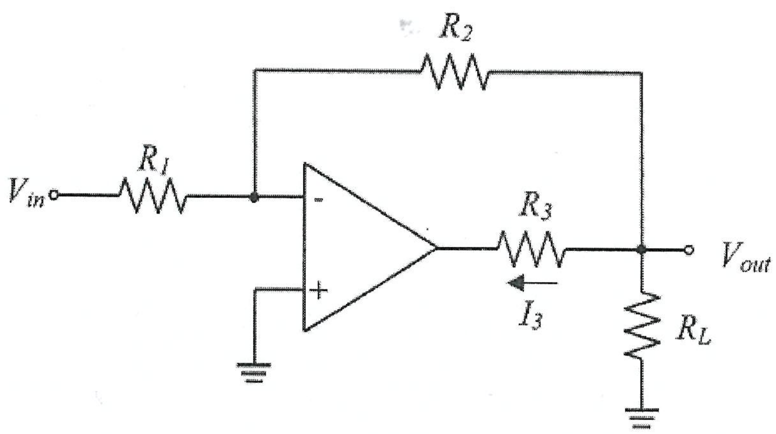

Figure Q1(c)

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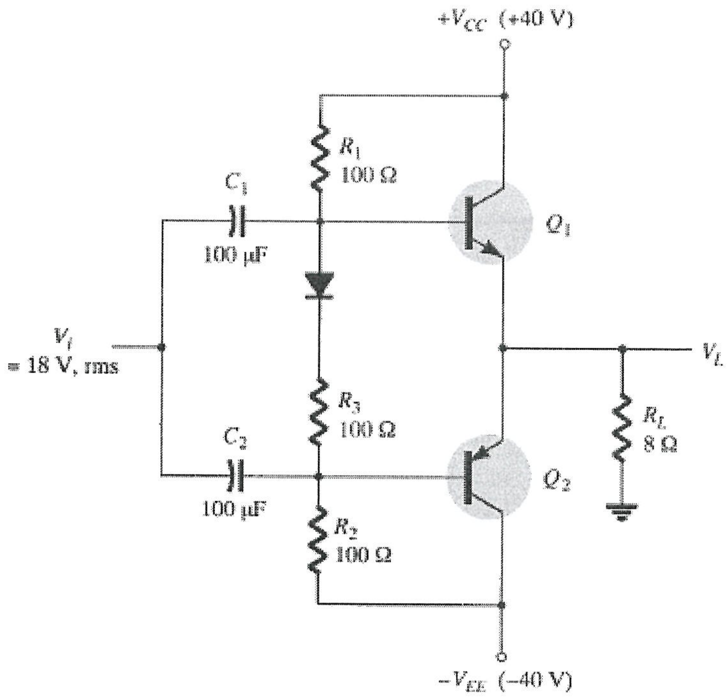

Figure Q2(c)

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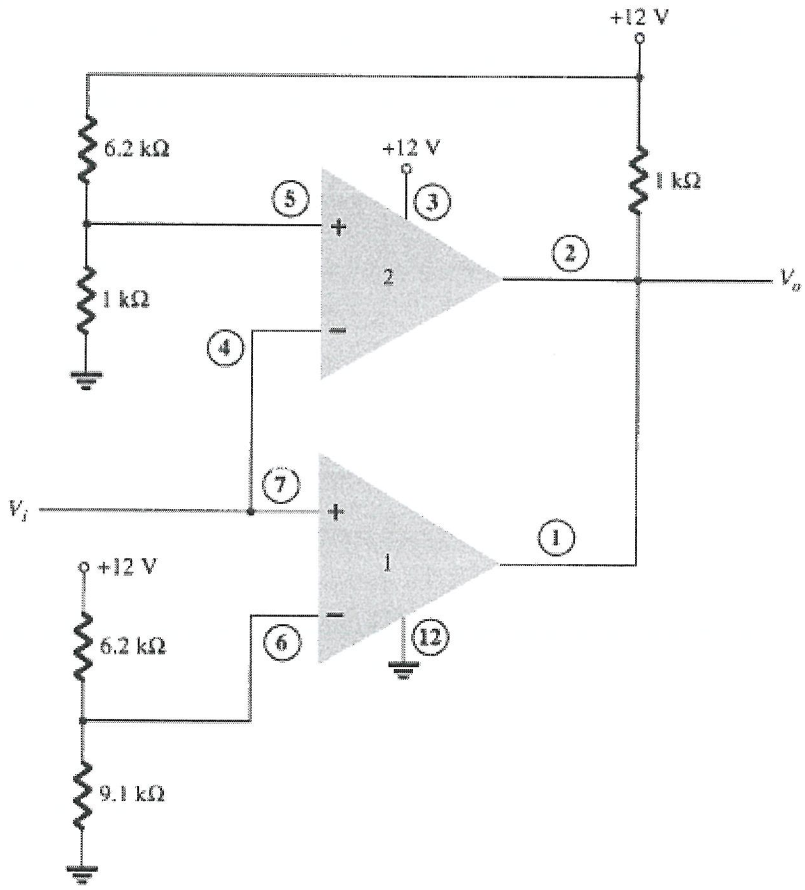

Figure Q3(a)

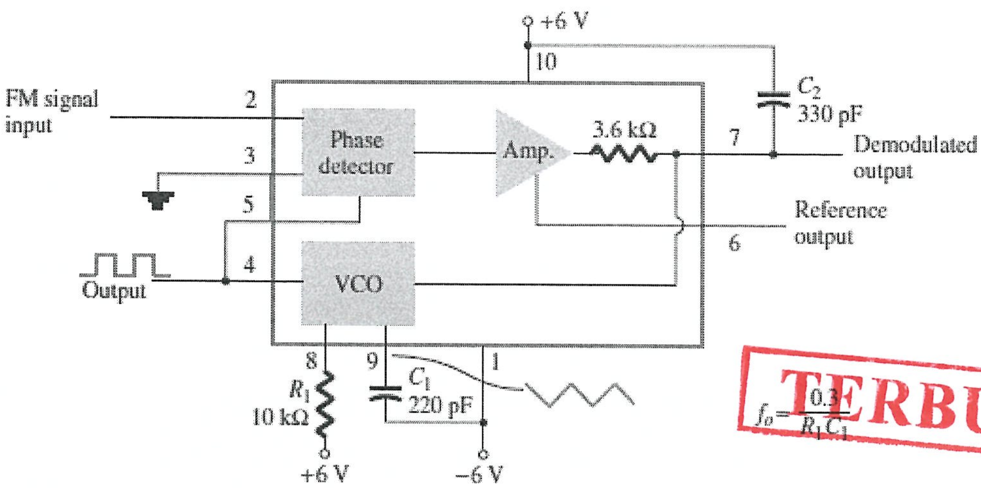

Figure Q3(d)

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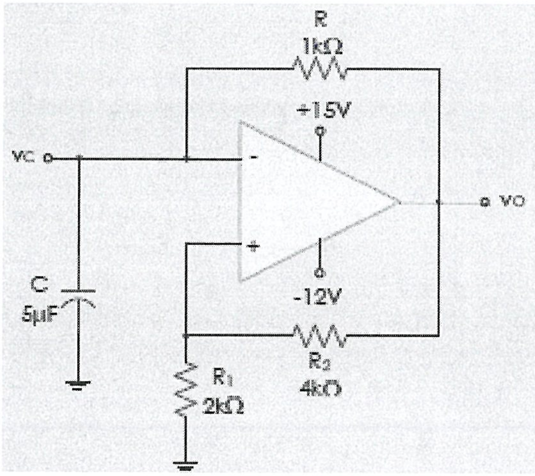

Figure Q4(c)

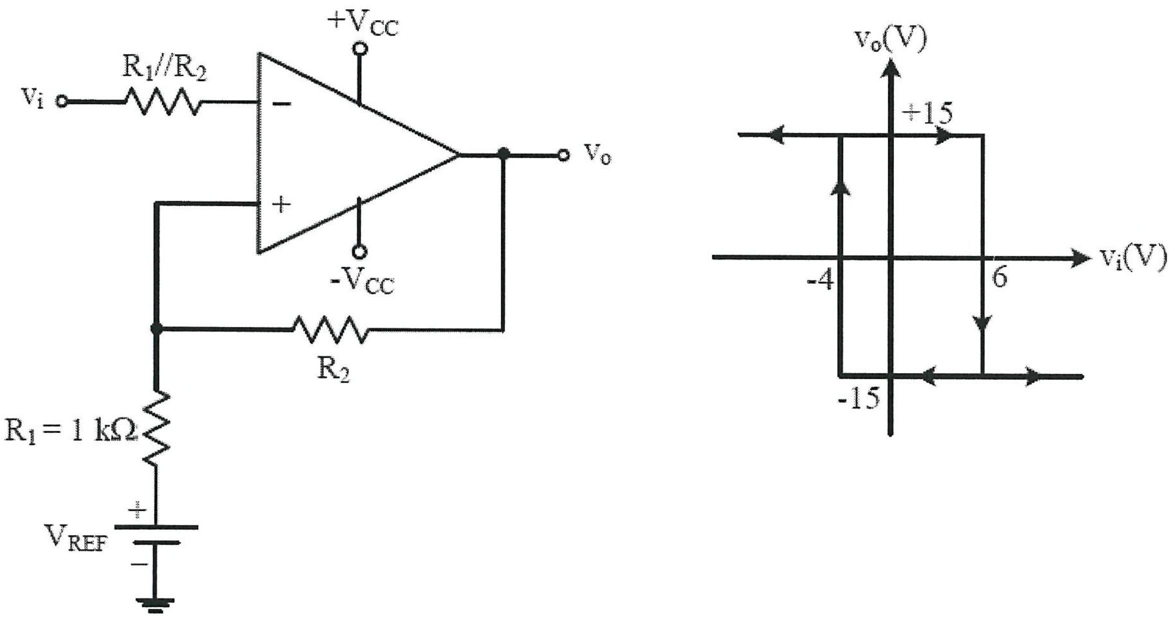

Figure Q5(b)

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APPENDIX A

Philips Semiconductors — Product specification

Low power quad op amps

LM124/224/324/324A/ SA534/LM2902

DESCRIPTION

The LM124/SA534/LM2902 series consists of four independent, high-gain, internally frequency-compensated operational amplifiers designed specifically to operate from a single power supply over a wide range of voltages.

UNIQUE FEATURES

In the linear mode, the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

The unity gain crossover frequency and the input bias current are temperature-compensated.

FEATURES

- Internally frequency-compensated for unity gain
- Large DC voltage gain: 100dB
- Wide bandwidth (unity gain): 1MHz (temperature-compensated)
- Wide power supply range Single supply: $3V_{DC}$ to $30V_{DC}$ or dual supplies: $\pm1.5V_{DC}$ to $\pm15V_{DC}$
- Very low supply current drain: essentially independent of supply voltage (1mW/op amp at $+5V_{DC}$)
- Low input biasing current: $45nA_{DC}$ (temperature-compensated)
- Low input offset voltage: $2mV_{DC}$ and offset current: $5nA_{DC}$
- Differential input voltage range equal to the power supply voltage
- Large output voltage: $0V_{DC}$ to V_{CC}-$1.5V_{DC}$ swing

PIN CONFIGURATION

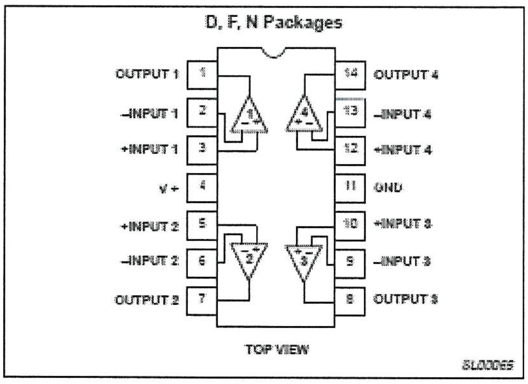

Figure 1. Pin Configuration

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