UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	ELECTRONIC PRINCIPLES II
COURSE CODE	:	BNR 27203
PROGRAMME CODE	:	BND/BNE/BNF
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWERS **ALL** QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open Book ☒ Closed Book 3. STUDENT ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

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

Q1 (a) Explain how an instrumentation amplifier is better than a differential amplifier. Describe why these advantages make the instrumentation amplifier preferable for precise signal processing tasks.

(3 marks)

(b) For the instrumentation amplifier as shown in **Figure Q1.1**, the values for R_1, R_2, R_3, and R_4 are fixed for a gain of 1 for the differential amplifier. Also, the values of R_f are 20kΩ.

(i) Determine the value of R_g assuming the voltage gain Acl is 500.

(4 marks)

(ii) If $V_1 = 10$ mV and $V_2 = 6$ mV, determine the voltage output V_o.

(4 marks)

(c) Consider a differentiator operational amplifier (op-amp) circuit as in **Figure Q1.2** with R = 10 kΩ, C = 0.22 μF and Vi(t) = 20 sin(ωt) mV at 500 Hz.

(i) Show that the output voltage, $Vo = -RC\ (dVi/dt)$

(6 marks)

(ii) Calculate the output voltage, Vo and draw both the input and output waveforms for one complete cycle.

(8 marks)

Q2 (a) For the operational amplifier circuit shown in the **Figure Q2.1**,

(i) Analyse the circuit and generate the expression of V_o in term of Vs, Rs_1, Rs_2, R_{f1}, R_{f2} and R_{f3}.

(12 marks)

(ii) Compute the output voltage, V_o if the value of Vs, Rs_1, Rs_2, R_{f1}, R_{f2} and R_{f3} are given by 5 V, 10 kΩ, 10 kΩ, 100 kΩ, 50 kΩ and 50 kΩ respectively.

(3 marks)

(b) Based on the op-amp circuit given in **Figure Q2.2,** examine the value of output voltage, V_2 and output current, I_o if $V_1 = 7$ V, $R_1 = 5$ kΩ, $R_2 = R_3 = R_4 = 3$ kΩ and $R_5 = 20$ kΩ.

(10 marks)

Q3 (a) The transistor in the power amplifier shown in **Figure Q3 (a)**, has the output characteristics shown in **Figure Q3 (b),** assume that the transformer has zero resistance.

(i) Construct the (ideal) dc and ac load lines necessary to achieve maximum output voltage swing. What quiescent values of collector and base current are necessary to realize the ac load line?

(10 marks)

(ii) What is the smallest value of $I_{C\ (max)}$ for which the transistor should be rated?

(5 marks)

(iii) What is the maximum peak-to-peak collector voltage, and what peak-to-peak base current is required to achieve it? Assume that the base current cannot go negative and that, to minimize distortion, the collector should not be driven below 2.5 V in the saturation region.

(5 marks)

(iv) Find the average power delivered to the load under the maximum signal conditions of Q3(iii).

(3 marks)

(v) Find the power dissipated in the transistor under no-signal conditions (standby).

(2 marks)

Q4 (a) Design a phase-shift oscillator that operates at 2 kHz frequency with capacitors value of 68 nF.

(7 marks)

(b) Sketch the input and output waveforms for a monostable mode of one-shot pulse using a 555-timer triggered by a 5kHz clock for $R_A = 4.7\ k\Omega$ and $C = 0.01\ \mu F$.

(6 marks)

(c) An astable oscillator circuit using 555-timer shown in **Figure Q4.** Calculate the value for R_A and R_B so that the oscillator has a frequency of 2.5 kHz at 60% of duty cycle.

(10 marks)

(d) List **TWO (2)** examples of RC Oscillators

(2 marks)

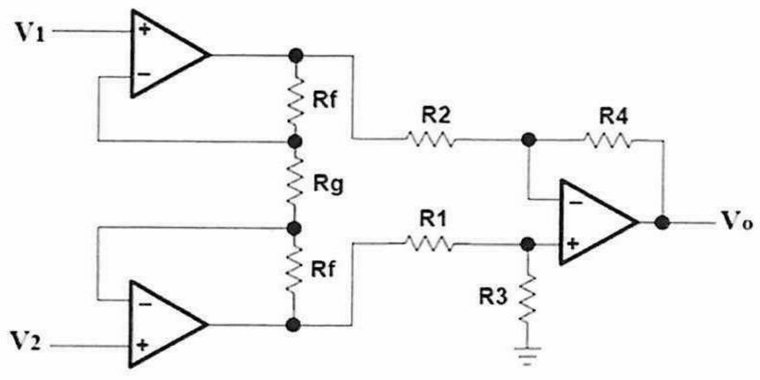

Figure Q1.1

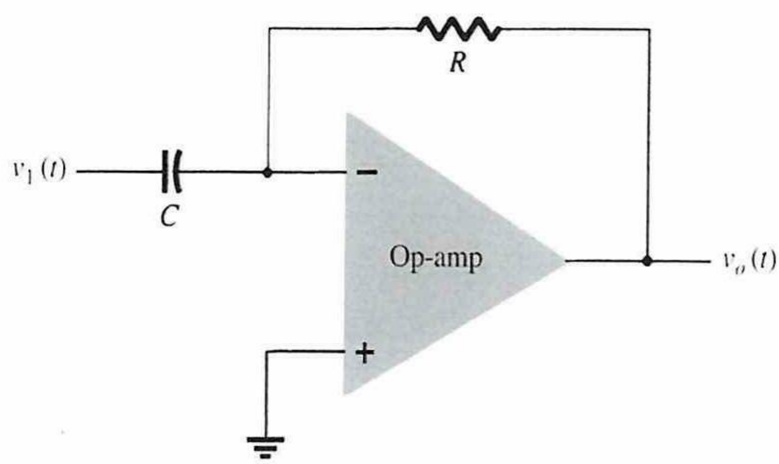

Figure Q1.2

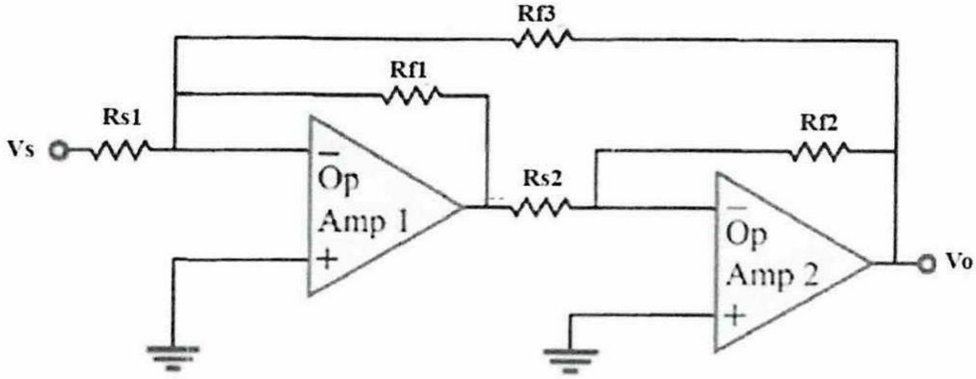

Figure Q2.1

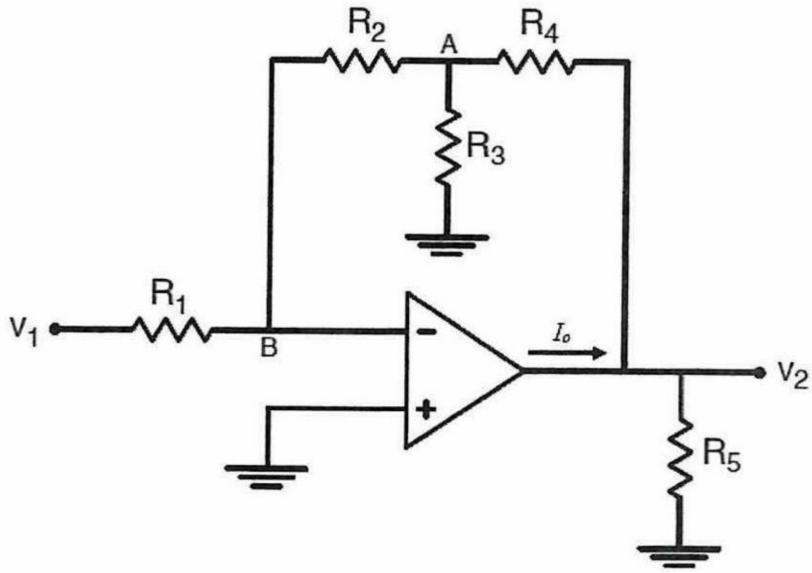

Figure Q2.2

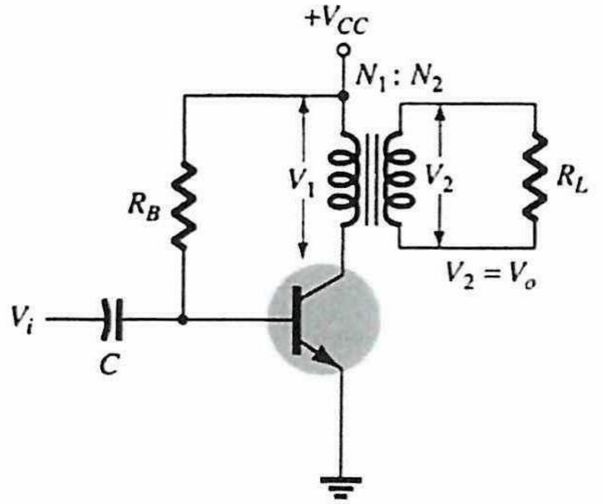

Figure Q3(a)

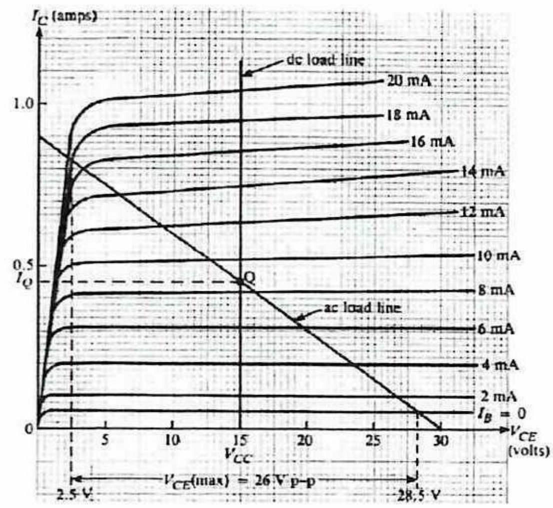

Figure Q3(b)

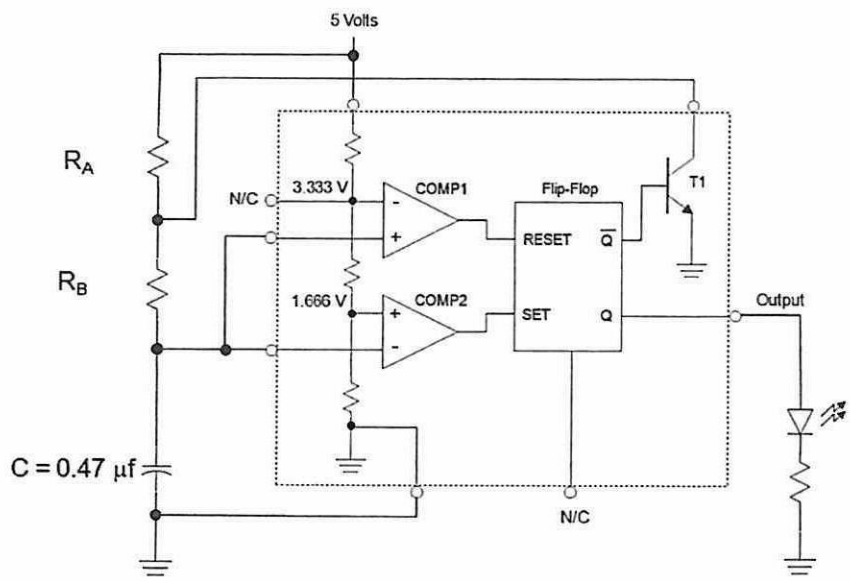

Figure Q4

END OF QUESTIONS

APPENDIX A

Power Amplifier; $P_i(dc) = V_{CC}I_{CC}$

where $I_{CC} = I_{CQ} + I_1$

and $I_1 = \dfrac{V_{CC}}{R_1 + R_2}$

Using rms signals:

$$P_0(ac) = V_L(rms)I_L(rms)$$

$$P_0(ac) = I_L^{\,2}(rms)R_L$$

$$P_0(ac) = \frac{V_L^{\,2}(rms)}{R_L}$$

Using peak signals:

$$P_0(ac) = \frac{V_L(p)I_L(p)}{2}$$

$$P_0(ac) = \frac{I_L^{\,2}(p)}{2}R_L$$

$$P_0(ac) = \frac{V_L^{\,2}(p)}{2R_L}$$

Using peak-to-peak signals:

$$P_0(ac) = \frac{V_L(pp)I_L(pp)}{8}$$

$$P_0(ac) = \frac{I_L^{\,2}(pp)}{8}R_L$$

APPENDIX A

The efficiency:

$$\eta = \frac{\text{average power delivered to load}}{\text{average power drawn from DC source}}$$

$$\%\eta = \frac{P_0(ac)}{P_i(dc)} \text{ x } 100\%$$

Power Dissipated by Output Transistors

$$P = P_i(dc) - P_o(ac)$$