Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	ANALOG ELECTRONICS
COURSE CODE	:	BEJ 10503 / BEV 10503
PROGRAMME CODE	:	BEJ / BEV
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	1.	ANSWER ALL QUESTIONS
	2.	THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.**
	3.	STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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Q1 (a) (i) In your own words, define the intrinsic semiconductor and acceptor atoms.
(2 marks)

(ii) Differentiate between p-type semiconductors and n-type semiconductors.
(4 marks)

(iii) Show how to forward-biased a diode and draw the direction of the current flow.
(2 marks)

(b) The input voltage, $V_i(t) = 5\sin(\omega t)$ V, is applied to the circuit shown in **Figure Q1(b)**. Assume the diodes are ideal.

(i) Calculate the output voltage, $V_o(t)$ during positive and negative cycles. Show all steps clearly.
(9 marks)

(ii) Sketch the output voltage, $V_o(t)$ with respect to the input voltage, $V_i(t)$.
(4 marks)

(c) For the circuit shown in **Figure Q1(c)**, assume that the diode is ideal and $V_{DC} = 2$ V.

(i) Calculate the output voltage V_o and the capacitor voltage, V_c for the input shown.
(8 marks)

(ii) Sketch and label the output voltage, V_o waveform.
(2 marks)

Q2 A common emitter voltage divider bias amplifier circuit is depicted in **Figure Q2**. Given that $\beta = 150$, $V_{CC} = 20$ V, $V_{BE} = 0.7$ V, $R_1 = 15$ kΩ, $R_2 = 5$ kΩ, $R_C = 3$ kΩ and $R_E = 1.5$ kΩ.

(a) By using approximate analysis, determine the operating points I_{BQ}, I_{CQ}, I_{EQ}, V_{CEQ}, V_B, and r_e. Show all the calculations.
(13 marks)

(b) Sketch and label clearly the AC equivalent circuit of **Figure Q2** using r_e model. Assume that $r_o = \infty$.
(3 marks)

(c) Based on **Q2(b)**, calculate the input impedance, Z_i, output impedance, Z_o and voltage gain, A_v.
(9 marks)

(d) Determine the current gain, A_i if $r_o = 50$ kΩ.
(4 marks)

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Q3 A self-bias circuit configuration of a depletion n-channel MOSFET is shown in **Figure Q3**.

(a) Find the operating points of the transistor, I_{DQ} and V_{GSQ} using a graphical method. (Draw the transfer characteristics and the network equation on the same graph paper).

(11 marks)

(b) Obtain V_{DSQ}.

(3 marks)

(c) Calculate the transconductance, g_m.

(2 marks)

(d) Sketch the AC small-signal equivalent circuit of **Figure Q3** with bypass source resistance, R_s.

(3 marks)

(e) Assuming the admittance equivalent circuit parameter y_{os} = 20 μS, calculate the input impedance, Z_i, output impedance, Z_o and voltage gain, A_v.

(8 marks)

Q4 (a) Draw a basic Class B push-pull amplifier that uses two dc power supplies of ±16 V and a load resistor of 20 Ω.

(2 marks)

(b) If the output signal in **Q4(a)** has a peak value of 12 V, determine:

(i) The efficiency.

(5 marks)

(ii) The dissipated power.

(2 marks)

(c) The output waveform in the Class B amplifier in **Q4(a)** will have crossover distortion. Illustrate and explain the crossover distortion and suggest a method to minimize or eliminate it.

(4 marks)

- END OF QUESTIONS –

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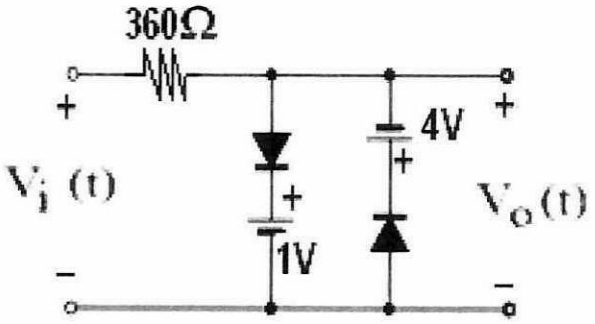

Figure Q1(b)

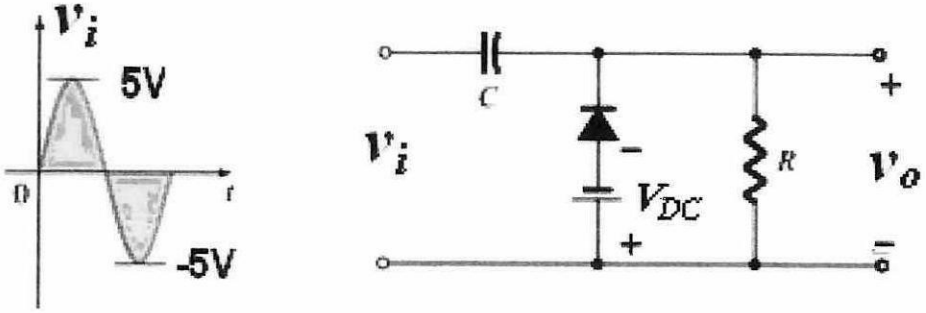

Figure Q1(c)

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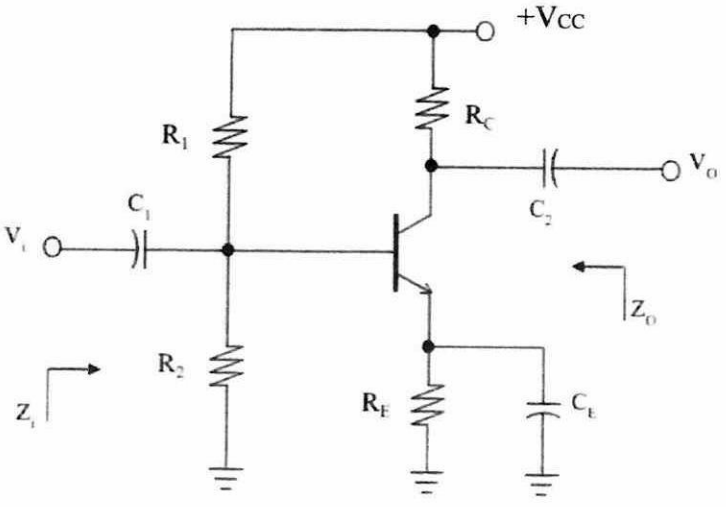

Figure Q2

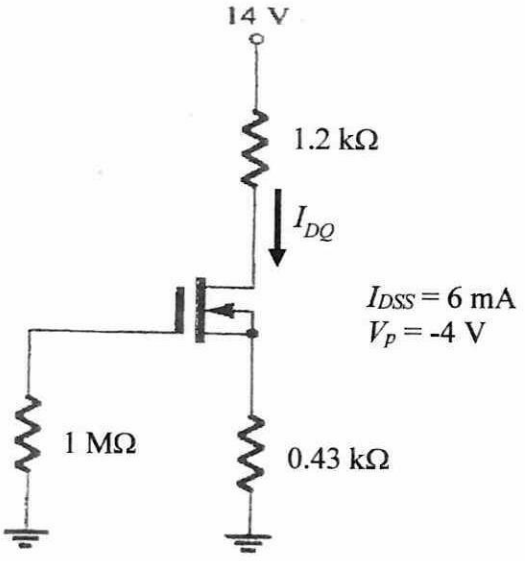

Figure Q3

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