



UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION SEMESTER I SESSION 2022/2023

- COURSE NAME : ANALOG ELECTRONICS
- COURSE CODE : BEJ10503
- PROGRAMME CODE : BEJ
- EXAMINATION DATE : FEBRUARY 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 SEVEN (7) PAGES

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- Q1** (a) Explain **TWO (2)** reasons a pure semiconductor behaves like an insulator (not a conductor) at absolute zero temperature. (2 marks)
- (b) Zener diodes usually operate under reverse biased condition. Explain the operation of a zener diode. (3 marks)
- (c) The Zener regulator circuit in **Figure Q1(c)** has the following values: $R_L = 0.22 \text{ k}\Omega$, Zener voltage, $V_Z = 8 \text{ V}$ and the maximum power rating of the Zener diode is 400 mW. In order to maintain this regulator circuit with load voltage, V_L at 8 V and not exceed the maximum power rating of the Zener diode; determine the:
- (i) minimum input voltage, $V_{i \text{ min}}$. (4 marks)
- (ii) maximum input voltage, $V_{i \text{ max}}$. (6 marks)
- Q2** (a) Determine the values for R_C , R_B , and R_E for the emitter-stabilized bias circuit in **Figure Q2(a)** that has the following specifications:
 $\beta = 100$, $I_{CQ} = \frac{1}{2}I_{C\text{sat}}$, $I_{C\text{sat}} = 8 \text{ mA}$, $V_{CEQ} = 12 \text{ V}$. Assume $V_E = 0.1V_{CC}$ and $V_{BE} = 0.7 \text{ V}$. (10 marks)
- (b) For the circuit in **Figure Q2(b)**, assume $\beta = 200$, $V_{BE} = 0.7 \text{ V}$ and $r_o = \infty$.
- (i) Determine the operating currents, I_{BQ} , I_{EQ} and V_{CEQ} . (6 marks)
- (ii) Using the r_e model, draw the AC equivalent circuit with consideration of the additional parameters for this amplifier as follows:
 $R_S = 1 \text{ k}\Omega$, C_B or $C_{in} = 10 \text{ }\mu\text{F}$, C_C or $C_{out} = 10 \text{ }\mu\text{F}$ and $C_E = 100 \text{ }\mu\text{F}$. (3 marks)
- (iii) Hence, determine the input impedance, Z_i and output impedance, Z_o . (5 marks)
- (iv) Calculate voltage gain, A_v and current gain, A_i . (6 marks)

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Q3 Based on the FET amplifier circuit shown in **Figure Q3**,

- (a) name the transistor and its configuration. (2 marks)
- (b) plot the transfer characteristics of the transistor. (12 marks)
- (c) Determine the operating point, V_{GSQ} and I_{DQ} of the amplifier from the graph obtained in **Q3(b)**. (2 marks)
- (d) If the amplifier has an applied load resistance, R_L of $10\text{ k}\Omega$ and a source resistance, R_{sig} of $1\text{ k}\Omega$, sketch the AC small-signal equivalent circuit of the FET amplifier circuit. (3 marks)
- (e) Assuming the transistor AC output resistance $r_o = \infty$ (infinity), calculate the input impedance, Z_i , output impedance, Z_o and voltage gain, A_v . (11 marks)

Q4 (a) **Figure Q4(a)** is a BJT amplifier circuit which has an infinite value of AC collector resistance, r_o (or r_C) with $r_e=28.48\ \Omega$ and $A_v=-72.91$;

- (i) Determine the high cut-off frequencies, f_{Hi} and f_{Ho} . (8 marks)
- (ii) The internal capacitors influenced the high frequency response. In your opinion, how to minimize the effect of internal capacitors? (2 marks)
- (b) A class B amplifier with power supplies of $V_{CC} = 30\text{ V}$ is used to deliver a 25 V peak signal to a $15\ \Omega$ speaker.
- (i) Sketch a circuit diagram for the amplifier. (2 marks)
- (ii) Determine the input power, P_{in} , output power, P_{out} , and circuit efficiency, η for the amplifier. (6 marks)
- (iii) Analyze the circuit performance in terms of its efficiency as a class B amplifier based on the value obtained in **Q4(b)(ii)**. (2 mark)

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- (c) Crossover distortion is seen as a problem arising from a class B push-pull amplifier. Analyse the crossover distortion problem that arises in the class B push-pull amplifier by using an appropriate illustration of V_{in} and V_{out} .

(5 marks)

- END OF QUESTIONS -

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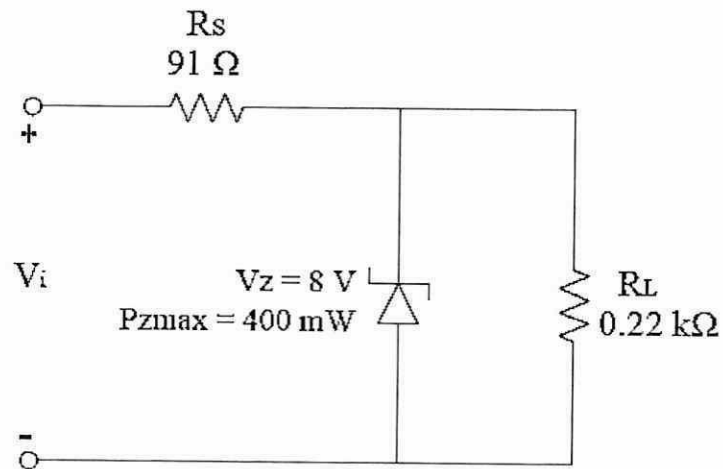


Figure Q1(c)

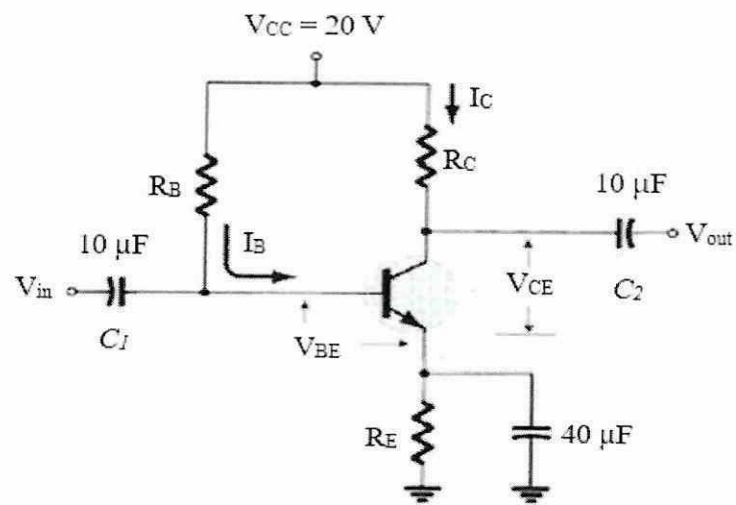


Figure Q2(a)

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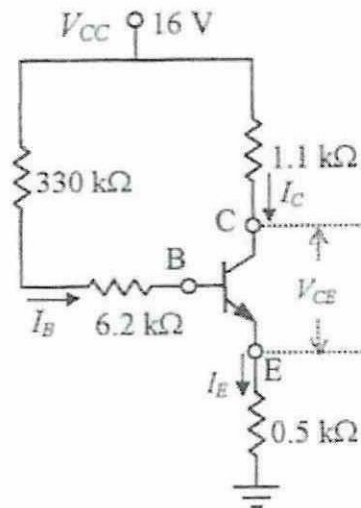


Figure Q2(b)

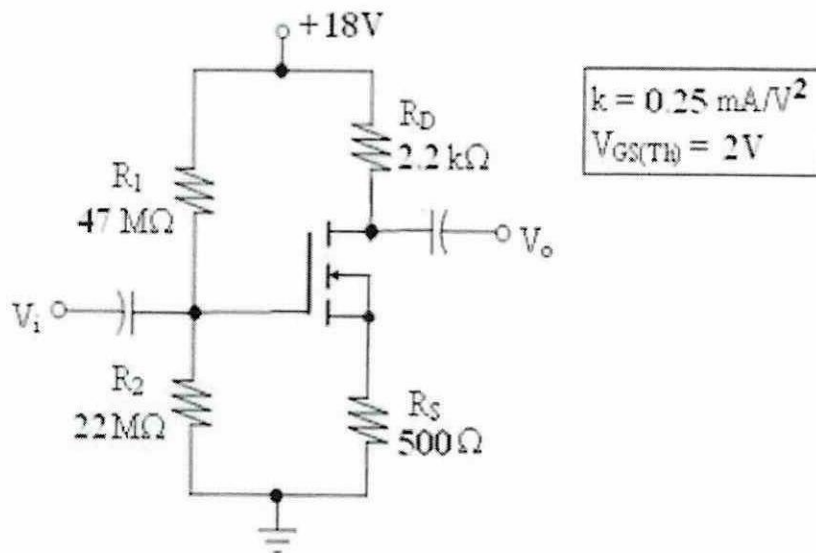


Figure Q3

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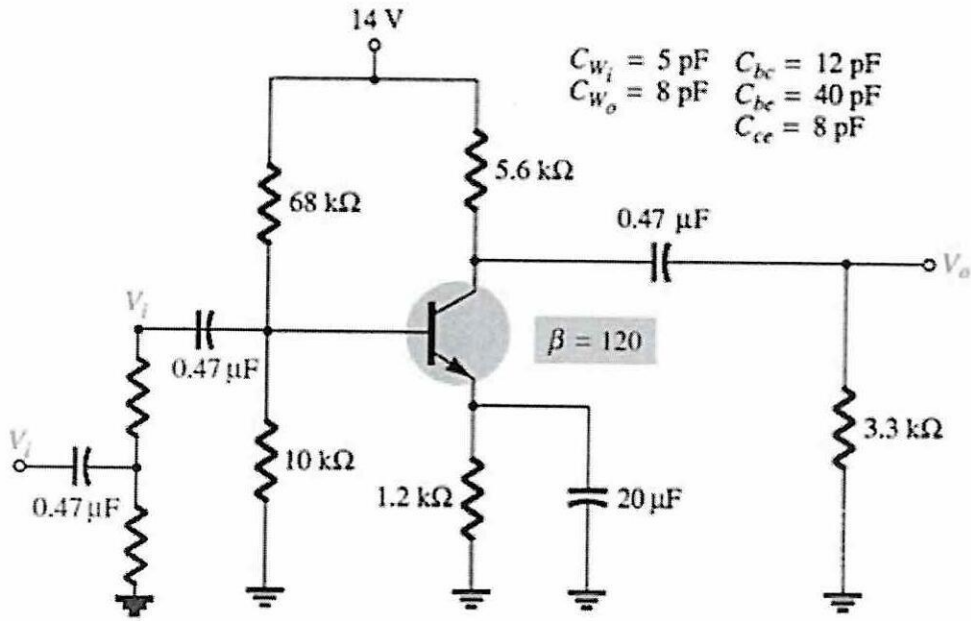


Figure Q4(a)

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