Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2023/2024

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| COURSE NAME | : | ANALOG ELECTRONICS |
| COURSE CODE | : | BEJ10503 |
| PROGRAMME CODE | : | BEJ |
| EXAMINATION DATE | : | JULY 2024 |
| DURATION | : | 3 HOURS |
| INSTRUCTIONS | : | 1. ANSWER ALL QUESTIONS<br>2. THIS FINAL EXAMINATION IS CONDUCTED VIA<br>☐ Open book<br>☒ Closed book<br>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

**Q1** A common emitter voltage divider bias amplifier circuit is depicted in **Figure Q1.1**. Given $\beta = 100$, $R_1 = 15\ k\Omega$, $R_2 = 6\ k\Omega$, $R_C = 2\ k\Omega$, $R_E = 1.5\ k\Omega$ and $r_o = \infty$. shows a BJT amplifier circuit with $\beta = 75$ and $V_{BE} = 0.7$ V.

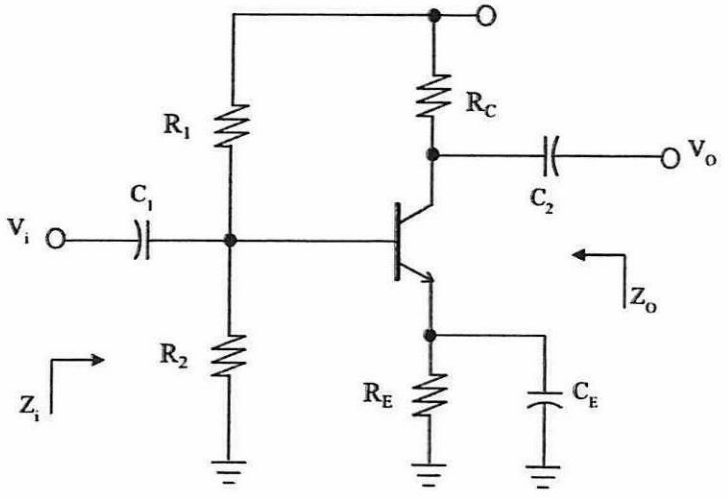


**Figure Q1.1** BJT amplifier circuit

(a) Analyze the circuit and determine Q-point current and voltage, ($I_{BQ}$, $I_{CQ}$ and output voltage, $V_{CEQ}$) using exact analysis.

(15 marks)

(b) From the results obtained in **Q1(a)**, find the $r_e$ value.

(1 mark)

(c) Sketch the small signal AC equivalent circuit using $r_e$ model for the circuit in **Figure Q1.1**.

(3 marks)

(d) Determine the input impedance, $Z_i$ and output impedance, $Z_o$ for the small signal AC equivalent circuit in part **Q1(b)**.

(2 marks)

(e) Calculate the voltage gain, $A_v$ and the current gain, $A_i$.

(4 marks)

**Q2** Based on the FET amplifier circuit shown in **Figure Q2.1**;

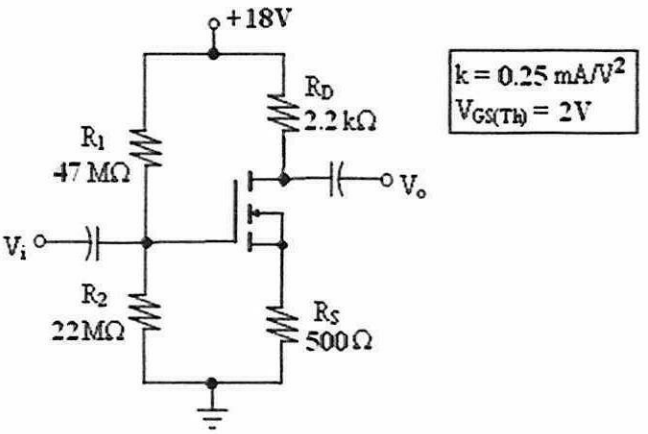


**Figure Q2.1** FET amplifier circuit

(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 **Q2(b)**.

(2 marks)

(d) if the amplifier has an applied load resistance, $R_L$ of 10 kΩ and a source resistance, $R_{sig}$ of 1 kΩ, sketch the AC small-signal equivalent circuit of the FET amplifier circuit.

(3 marks)

(e) assuming the transistor AC output resistance ro = ∞ (infinity), calculate the input impedance, Zi, output impedance, Zo and voltage gain, Av.

(11 marks)

**Q3** **Figure Q3.1** shows a common emitter amplifier network. Given the $\beta = 100$, $ro = \infty\ \Omega$, junction capacitances, $C_{be} = 35$ pF, $C_{bc} = 4$ pF, $C_{ce} = 1$ pF, and wiring capacitances, $C_{wi} = 5$ pF, $C_{wo} = 8$ pF. Based on this figure;

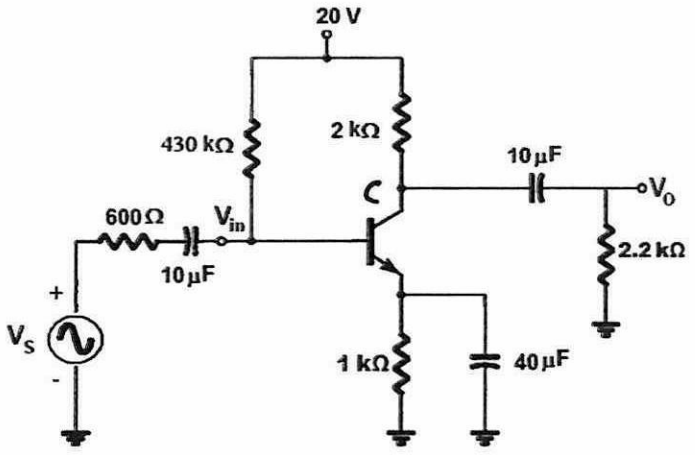


**Figure Q3.1** Common emitter amplifier

(a) conduct a DC analysis and determine the $I_B$, $I_C$, $V_{CE}$ and $r_e$.

(6 marks)

(b) draw the low frequency ac equivalent model.

(3 marks)

(c) calculate the lower cutoff frequencies $f_{LS}$, and $f_{LC}$ due to coupling capacitors.

(6 marks)

(d) draw the high frequency ac equivalent model.

(3 marks)

(e) calculate the high input and high output cut-off frequencies, $f_{Hi}$ and $f_{HO}$, respectively. Show all calculations.

(7 marks)

**Q4** There are different ways to describe amplifiers. For instance, they can be described by their class of operation, inter-stage coupling, or frequency range.

(a) Explain the signal cycle and efficiency of the Class A and Class B amplifiers.

(5 marks)

(b) Determine the input power, output power and circuit efficiency of a class B amplifier providing a 25 V peak signal to a 15 Ω load and a power supply of Vcc = 30 V. Sketch the circuit diagram for the amplifier.

(8 marks)

(c) Analyze the circuit performance in terms of its efficiency as a class B amplifier based on the value obtained in **Q4(b)**.

(2 marks)

(d) 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 -**