UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	ANALOG ELECTRONICS
COURSE CODE	:	BEJ 10503
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS.

TERBUKA

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1   (a)   Explain **TWO (2)** reasons a pure semiconductor behaves like an insulator at absolute zero temperature.

(4 marks)

   (b)   Zener diodes usually operate under reverse biased condition.

   (i)   Explain the operation of a zener diode.

(3 marks)

   (ii)   Sketch the voltage-current graph for the zener diode.

(3 marks)

Q2   (a)   A diode labelled as Si has characteristic I-V graphs shown in **Figure Q2(a)**. Obtain the operating point for the diode in the given circuit.
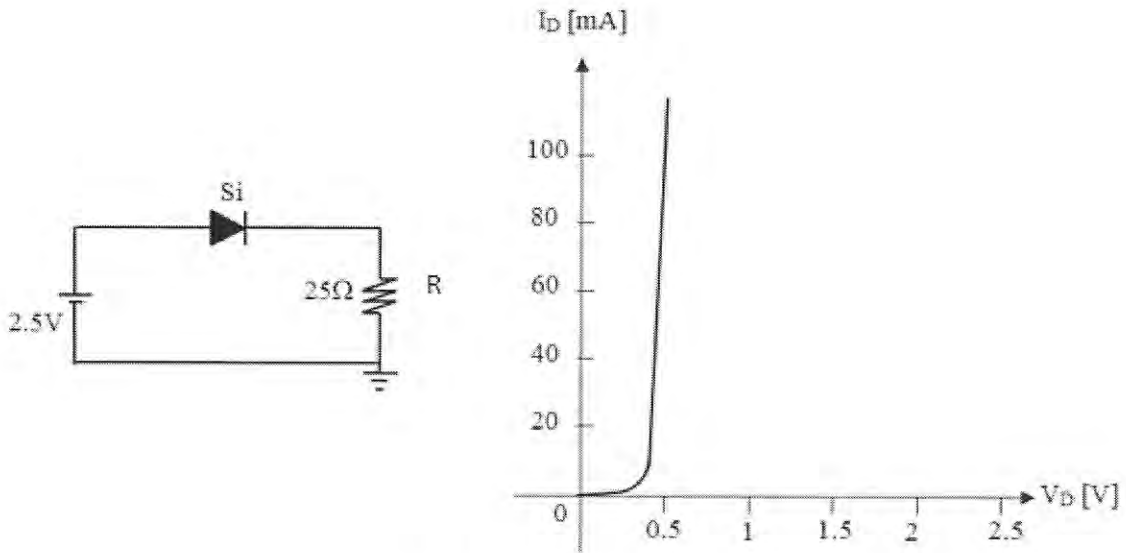
(5 marks)

Figure Q2 (a)

   (b)   Based on **Figure Q2(a)**, if the resistor, R is changed to 50 Ω, determine the new current and voltage across the diode. Describe the load line condition.

(5 marks)

2

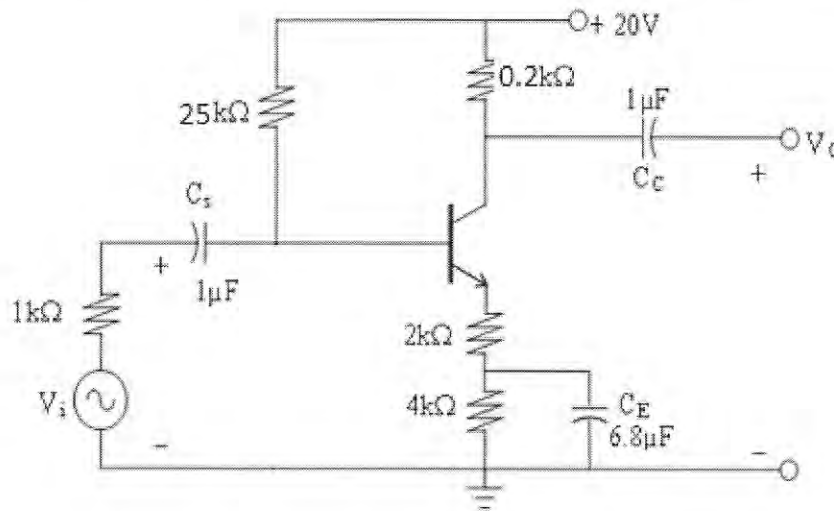**Q3**   (a)   **Figure Q3(a)** shows a BJT amplifier with $I_B = 26$ µA and $V_{BE} = 0.67$ V.

Figure Q3(a)

(i)   What is the function of the emitter resistor in the circuit as shown in **Figure Q3(a)**?

(2 marks)

(ii)   Calculate current, β, I_C, I_E and output voltage, V_{CE} for the circuit using exact analysis.

(8 marks)

(iii) Draw the midband AC equivalent circuit using r_e model.

(6 marks)

(iv)   Determine the input impedance, Z_i, output impedance, Z_o, voltage gain, A_V, and current gain, A_i, based on the obtained answer in part **Q3(a)(ii)**.

(12 marks)

(b)   What is the advantage of r_e model?

(2 marks)

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Q4   (a)   Sketch the transfer characteristics curve of JFET, D-MOSFET and E-MOSFET. Then, formulate the drain current, I_D for each curve.

(9 marks)

(b)   **Figure Q4(b)** shows the JFET self-bias configuration. Determine $V_{GSQ}, I_{DQ}, Z_i, Z_o$, and A_V for the circuit. Given $I_{DSS} = 9$ mA, $Vp = -4.5$ V, $rd = \infty$, and $g_m = 2.4$ mS. Show all your calculations with support of sketching diagrams. (Hint: transfer curve and ac analysis)
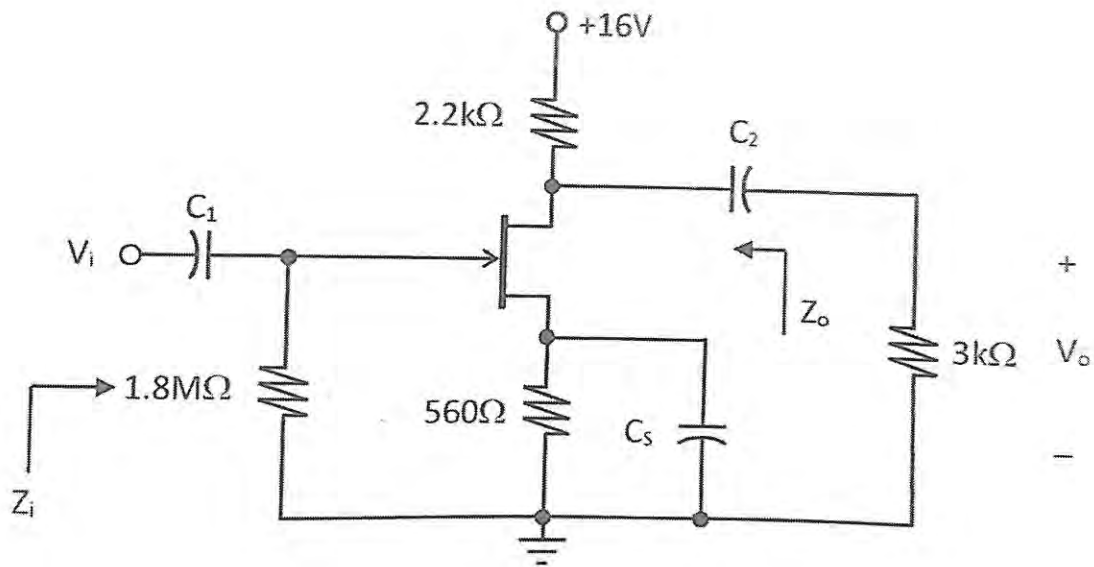
(21 marks)

Figure Q4(b)

Q5 (a) **Figure Q5(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 $A_v = -72.91$;

14 V

$C_{W_i} = 5 \ pF \quad C_{bc} = 12 \ pF$
$C_{W_o} = 8 \ pF \quad C_{bc} = 40 \ pF$
$C_{ce} = 8 \ pF$

5.6 kΩ

68 kΩ

0.47 μF

V_o

V_i

0.47 μF

$\beta = 120$

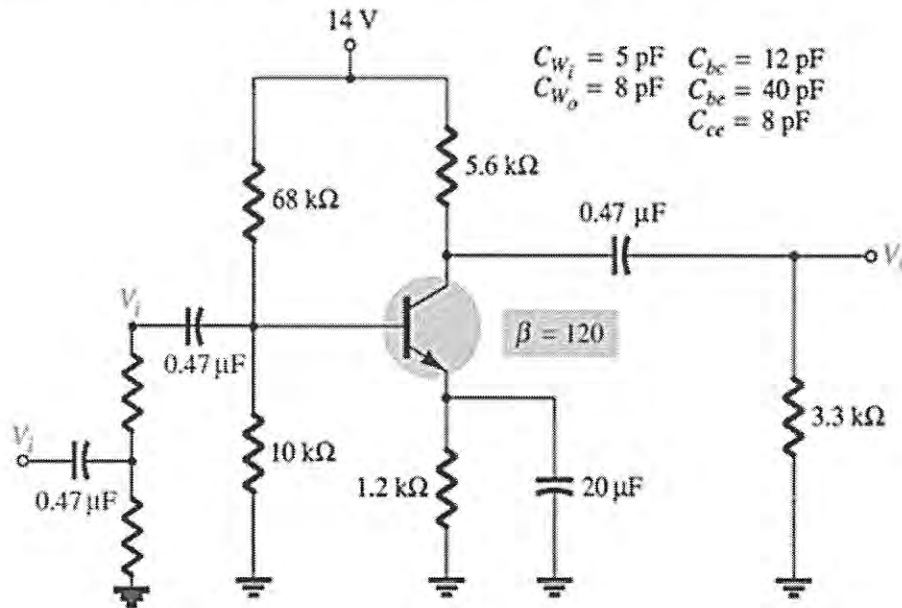3.3 kΩ

V_i

0.47 μF

10 kΩ

1.2 kΩ

20 μF

Figure Q5(a)

(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)

Q6 (a) A class B amplifier with a power supply of $V_{CC} = 30$ V is used to deliver a 25 V peak signal to a 15 Ω speaker.

(i) Propose a circuit diagram for the amplifier.

(1 mark)

(ii) Determine the input power, P_{in}, output power, P_{out}, and circuit efficiency, η for the amplifier.

(5 marks)

(iii) Evaluate the circuit performance in terms of its efficiency as a class B amplifier based on the value obtained in **Q6(a)(ii)**.

(1 mark)

(b)   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}.

(3 marks)

-END OF QUESTIONS –

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