Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	ANALOG ELECTRONICS
COURSE CODE	:	BEL 10203
PROGRAMME	:	BEV/ BEJ
EXAMINATION DATE	:	DECEMBER 2018/JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) State the definition of unbiased, forward-biased and reverse-biased a p-n junction.

(3 marks)

(b) The Shockley equation gives the relationship between the voltage across a semiconductor p-n junction diode and the current through it.

(i) By using a diagram, describe the current-voltage characteristics of a silicon diode.

(3 marks)

(ii) When a voltage of 0.7 V is applied, the current through a diode is 18.3 mA. Calculate saturation current (I_S) for that diode. Given that, emission coefficient (n) is 1 and thermal voltage (V_T) is 25 mV.

(2 marks)

(c) **Figure Q1(c)** shows an ideal diode circuit with $R_1 = 3\ k\Omega$, $R_2 = 3\ k\Omega$ and $R_3 = 6\ k\Omega$.

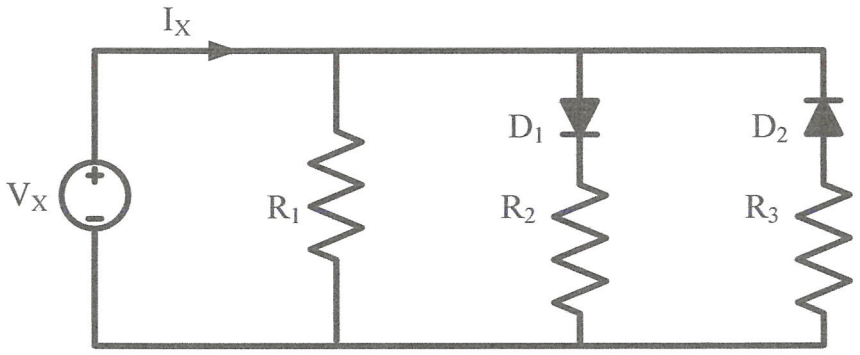

Figure Q1(c)

(i) Calculate the input current (I_X) by verifying for both condition where the diode is ON and OFF.

(3 marks)

(ii) Plot the I_X-V_X characteristics.

(2 marks)

(d) **Figure Q1(d)** shows an ideal diode with $R_1 = 10\ k\Omega$ and $R_2 = 20\ k\Omega$.

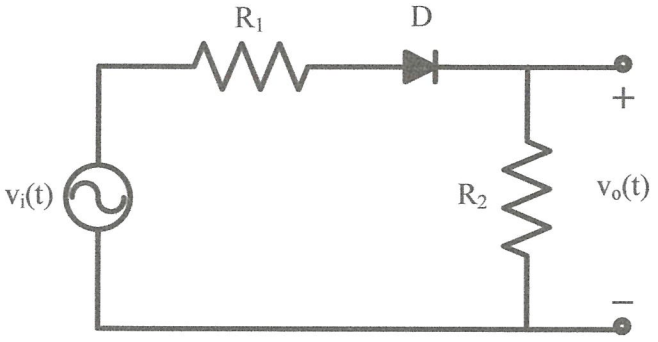

Figure Q1(d)

(i) Determine the range of input voltage (v_i) where the diode is ON and the range where the diode is OFF.

(3 marks)

(ii) Plot the output voltage $v_o(t)$ waveform if $v_i = 12 \sin 2\pi \cdot 50t$ V is applied at input voltage.

(2 marks)

(iii) State an advantage of the circuit shown in **Figure Q1(d)**.

(1 marks)

(e) **Figure Q1(e)** shows a block diagram of Circuit A which produces an output waveform $v_o(t)$ obtained from a given input waveform $v_i(t)$.

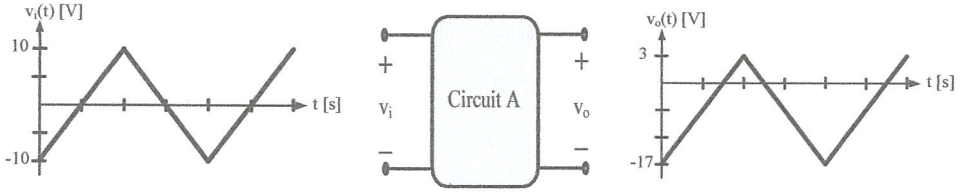

Figure Q1(e)

(i) By comparing both the input and output waveforms, analyze the operation of Circuit A.

(3 marks)

(ii) Draw the schematic of Circuit A.

(2 marks)

(iii) Indicate the name of Circuit A.

(1 marks)

Q2 (a) The biasing circuit shown in **Figure Q2(a)** has the values of $R_1 = 56\ k\Omega$, $R_2 = 12.2\ k\Omega$, $R_C = 2\ k\Omega$, $R_E = 0.4\ k\Omega$, $V_{CC} = 12\ V$ and $\beta = 100$.

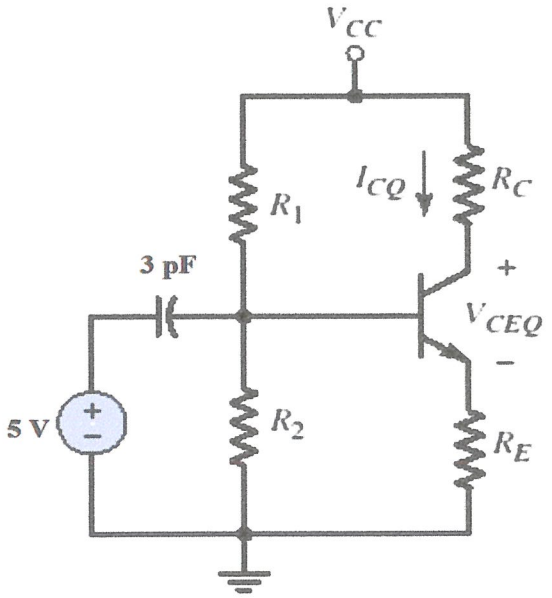

Figure Q2(a)

Using exact analysis,

(i) draw the Thevenin's equivalent of the circuit.

(3 marks)

(ii) estimate, V_E.

(5 marks)

(iii) determine I_{CQ} and V_{CEQ} for the circuit.

(3 marks)

(iv) predict the operation mode of this circuit.

(1 mark)

(b) The emitter-stabilized bias configuration shown in **Figure Q2(b)** has the specifications of V_{CC} = 24 V, V_E = 2.4 V, I_{CQ} = 0.5 I_{CSat}, I_{CSat} = 4.4 mA, V_{CEQ} = 10 V, $C_1 = C_2$ = 1 μF, C_E = 10 μF and β = 90.

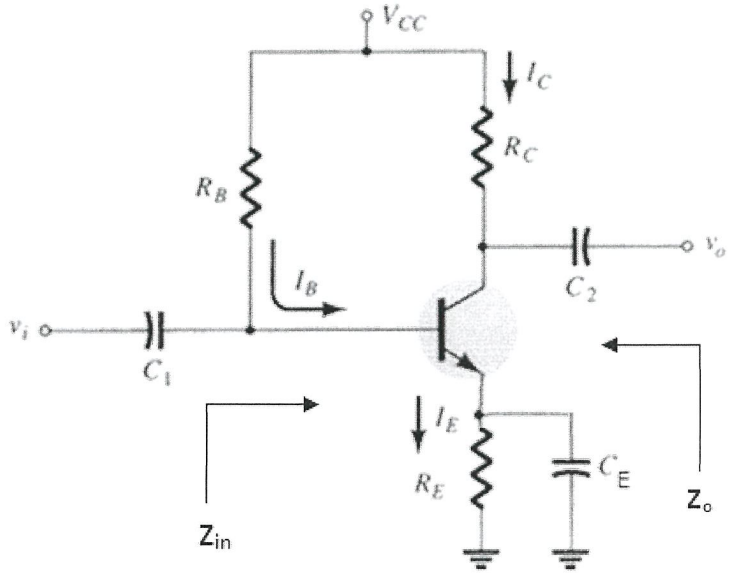

Figure Q2(b)

(i) Determine the values for R_C, R_E and R_B.

(6 marks)

(ii) If the amplifier in **Figure Q2(b)** is connected to a load of 1 kΩ and source resistance of 200 Ω, draw the resultant small-signal equivalent circuit (AC equivalent).

(3 marks)

(iii) By using the AC equivalent circuit obtained from Q2(b)(ii), calculate the values for input and output impedances.

(3 marks)

(iv) Determine the voltage gain (A_v).

(1 mark)

Q3 (a) Sketch and label clearly the transfer characteristics curve of a Depletion Mode Metal Oxide Semiconductor Field Effect Transistor (D-MOSFET) and Enhancement Mode Metal Oxide Semiconductor Field Effect Transistor (E-MOSFET). *(Hint: Use Shockley's equation).*

(4 marks)

(b) Determine **ONE (1)** parameter that differentiate between D-MOSFET and JFET.

(2 marks)

(c) **Figure Q3(c)(i)** shows an N-type D-MOSFET circuit while **Figure Q3(c)(ii)** shows the drain current plotted using Shockley equation. The given values for R_{G1} = 10 MΩ, R_{G2} = 1 MΩ, R_D = 1.8 kΩ, R_S = 750 Ω, V_{DD} = 20 V, I_{DSS} = 8 mA and $V_{GS}(off)$ = -6 V.

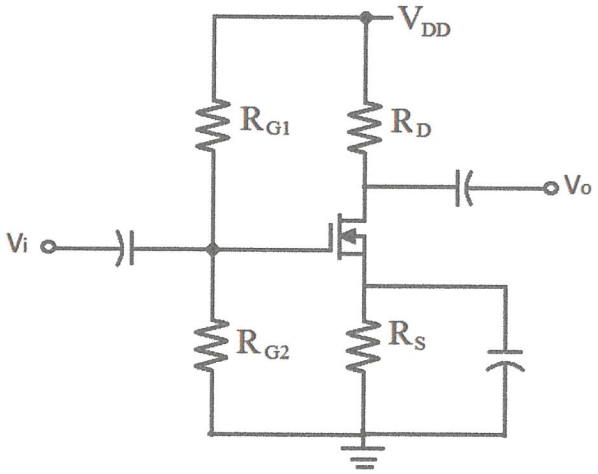

Figure Q3(c)(i)

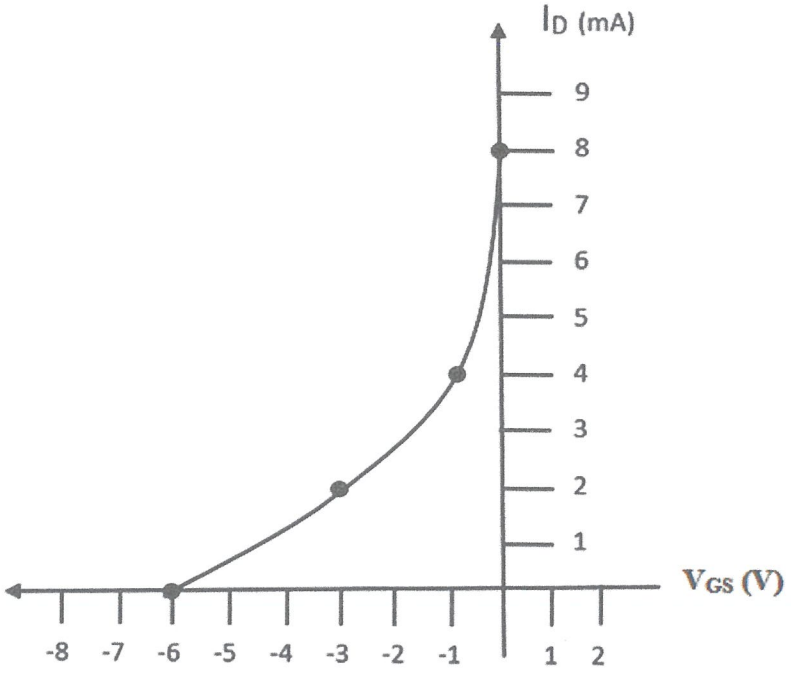

Figure Q3(c)(ii)

(i) Determine I_{DQ} and V_{GSQ} using graphical method.

(5 marks)

(ii) Determine the V_{DS}.

(2 marks)

(d) A common source FET amplifier circuit is shown in **Figure Q3(d)**. Given the values of $I_{DSS} = 9$ mA, $V_p = -4.5$ V, $g_m = 60$, and $r_d = 30$ kΩ.

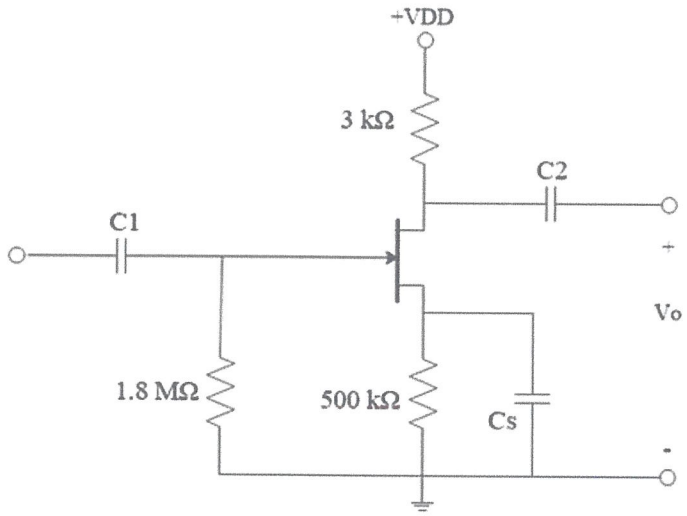

Figure Q3(d)

(i) Draw the AC equivalent circuit.

(4 marks)

(ii) Calculate the value of voltage gain, A_v.

(4 marks)

(iii) Determine the values of input impedance, Z_i and output impedance, Z_o .

(4 marks)

Q4 (a) Bode plot indicates the frequency response of an amplifier. It is a graph of amplifier gain versus the frequency.

(i) Sketch a bode plot of a bandpass filter complete with labels.

(5 marks)

(ii) Define a bandwidth and state the equation used.
(2 marks)

(iii) Define the roll-off gain.
(1 mark)

(iv) Differentiate between dB/decade and dB/octave.
(2 marks)

(b) Bipolar Junction Transistor (BJT)/ Field Effect Transistor (FET) amplifier reacts differently at low and high frequency resulting in different frequency response (bode plot).

(i) Explain why the above condition happen.
(2 marks)

(ii) By using a table, list the capacitors which are affected at low frequency and high frequency for both BJT and FET amplifier.
(6 marks)

(c) By using a suitable diagram, elaborate how does Class AB amplifier configuration can be used to eliminate crossover distortion.
(7 marks)

- END OF QUESTIONS -