# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2016/2017

| | | |
|---|---|---|
| COURSE NAME | : | ELECTRONIC PRINCIPLES |
| COURSE CODE | : | BNR20503 |
| PROGRAMME CODE | : | 2BND / BNF |
| EXAMINATION DATE | : | DECEMBER 2016 / JANUARY 2017 |
| DURATION | : | 2 HOURS 30 MINUTES |
| INSTRUCTION | : | ANSWERS **FOUR (4)** QUESTIONS ONLY |



THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

**Q1** (a) Briefly define the following terms with the aid of diagram for both forward bias and reverse bias connection. :

(i) Ideal diode model

(3 marks)

(ii) Practical diode model

(3 marks)

(b) Sketch $V_O$ for the network in **Figure Q1 (b)**. Determine the dc voltage available. Assume all the diodes are ideal. Show all calculations.

(6 marks)

(c) Draw and completely label the output waveform, $V_O$ for the circuit shown in **Figure Q1(c)**. Assume all the diodes are silicon. Show all your steps in obtaining the waveforms.

(5 marks)

(d) **Figure Q1 (d)** shows the Zener diode circuit. Given, $P_{ZM}$ (maximum power) = 40 mW. Assume the Zener diode is ideal. Determine:

(i) the output voltage, $V_o$

(2 marks)

(ii) voltage drop across load, $V_{RL}$

(2 marks)

(iii) zener current, $I_z$

(2marks)

(iv) power dissipated by the zener diode, $P_z$

(2 marks)

**Q2** (a) A bipolar junction transistor (BJT) needs to be biased for it to operate.

(i) How must the transistor junctions be biased for proper amplifier operation?

(2 marks)

(ii) Describe the three modes of operation of a BJT.

(6 marks)

(b) The emitter-stabilized bias configuration of **Figure Q2 (b)** has the following specifications:

$I_{CQ} = \frac{1}{2} I_{C\,(sat)}$, $I_{C\,(sat)} = 3.6$ mA, $V_E = 2.65$ V, $V_{CC} = 20$ V and $\beta = 50$.

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

(8 marks)

(ii) Draw the small-signal equivalent (AC equivalent) circuit for the circuit in **Figure Q2 (b)**.

(3 marks)

(iii) Calculate the values for input impedance ($Z_i$), output impedance ($Z_o$) and voltage gain ($A_v$).

(6 marks)

**Q3** (a) Draw clearly the transfer characteristics curve of a JFET, D-MOSFET and an E-MOSFET. Describe the differences between them.

(9 marks)

(b) **Figure Q3 (b) (i)** shows a voltage divider bias FET circuit. Find the required values for $R_S$ and $R_D$ if the FET transfer characteristics curve with the defined Q-point is as shown in **Figure Q3 (b) (ii)** and the following values are given:
$V_{DD}$ = 16 V, $R_1$ = 2.1 MΩ and $R_2$ = 270 kΩ, $V_{DS}$ = 7 V.

(8 marks)

(c) Find the input impedance ($Z_i$), output impedance ($Z_o$) and the output voltage of the amplifier in **Q3 (b)** if the input signal $V_i$ = 2 mV (peak) and the ac output impedance $r_d = \infty$.

(8 marks)

**Q4** For the network of **Figure Q4**, given $k$ = 0.6 mA/V$^2$, and $V_{GS\,(th)}$ = 4V.

(a) Determine the $I_{DQ}$, $V_{GSQ}$, $V_{DS}$, $V_G$, $V_D$ and $V_S$.

(14 marks)

(b) Draw the AC equivalent circuit. Determine the input impedance, $Z_i$ and the output impedance, $Z_o$.

(7 marks)

(c) Find the mid-band frequency voltage gain, $A_v = V_o/V_i$.

(4 marks)

**Q5** For the network of **Figure Q5**:

(a) Determine the ac resistance, $r_e$. Assume $V_{BE} = 0.7V$.
(5 marks)

(b) Draw the AC equivalent circuit and determine the input impedance, $Z_i$.
(4 marks)

(c) Find the mid-band frequency voltage gain $A_v = V_o/V_i$.
(2 marks)

(d) Find the voltage gain $A_{vs} = V_o/V_s$.
(2 marks)

(e) Determine the low cut-off frequencies, $f_{Ls}$, $f_{LC}$ and $f_{LE}$.
(6 marks)

(f) Determine the high cut-off frequencies, $f_{Hi}$ and $f_{Ho}$.
(6 marks)

**Q6** (a) For the Darlington pair circuit in **Figure Q6 (a)**, given $\beta_D = 6000$ and $V_{BE} = 1.6$ V.

(i) Calculate the dc bias voltage, $V_{E2}$ and emitter current, $I_{E2}$.
(6 marks)

(ii) Determine the output voltage.
(4 marks)

(b) **Figure Q6 (b)** shows a differential amplifier with constant current source. Assuming that all transistors have $V_{BE} = 0.7V$, determine:

(i) The current ***I***.
(4 marks)

(ii) The common mode gain
(4 marks)

(iii) The differential gain
(4 marks)

(iv) The common-mode rejection ratio (CMRR) in *dB*.
(3 marks)



- END OF QUESTION -

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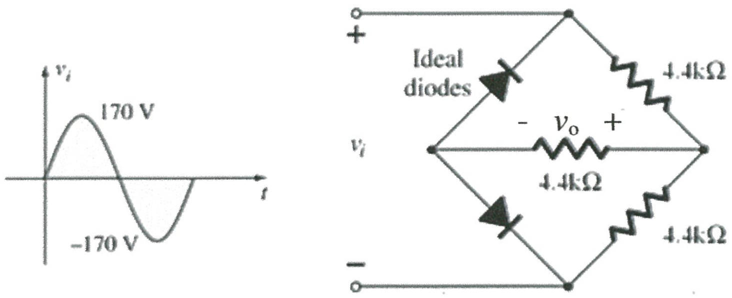


**FIGURE Q1 (b)**

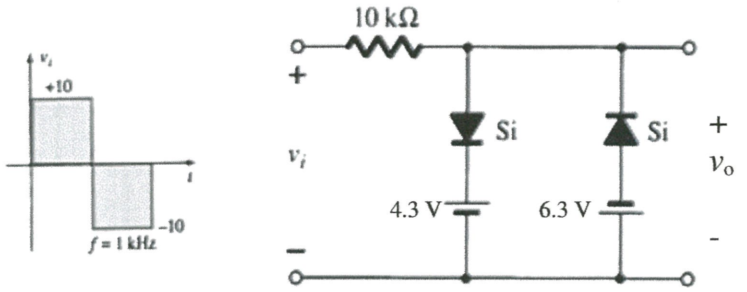


**FIGURE Q1 (c)**

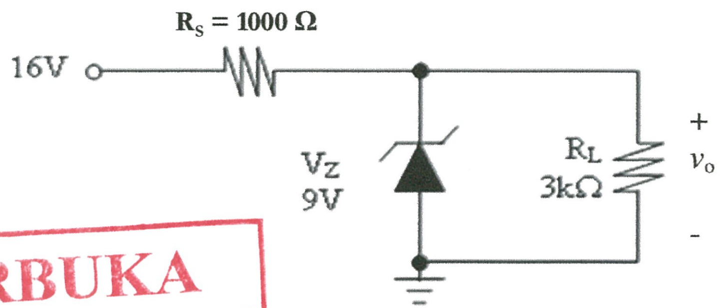




**FIGURE Q1 (d)**

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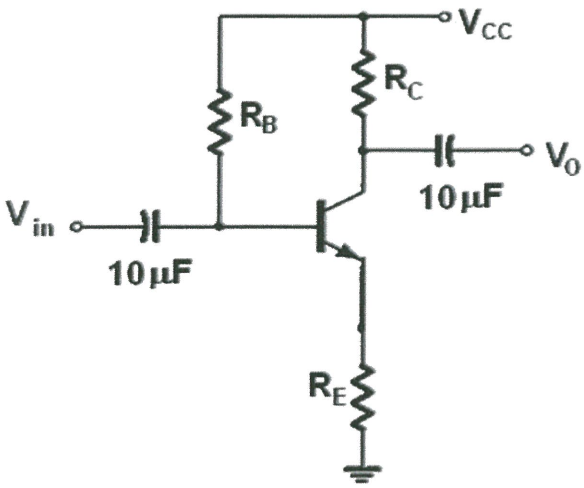


**FIGURE Q2(c)**

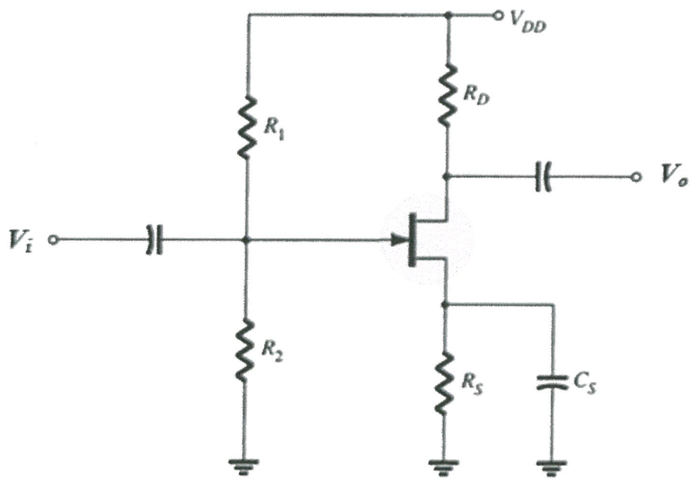


**FIGURE Q3(b)(i)**

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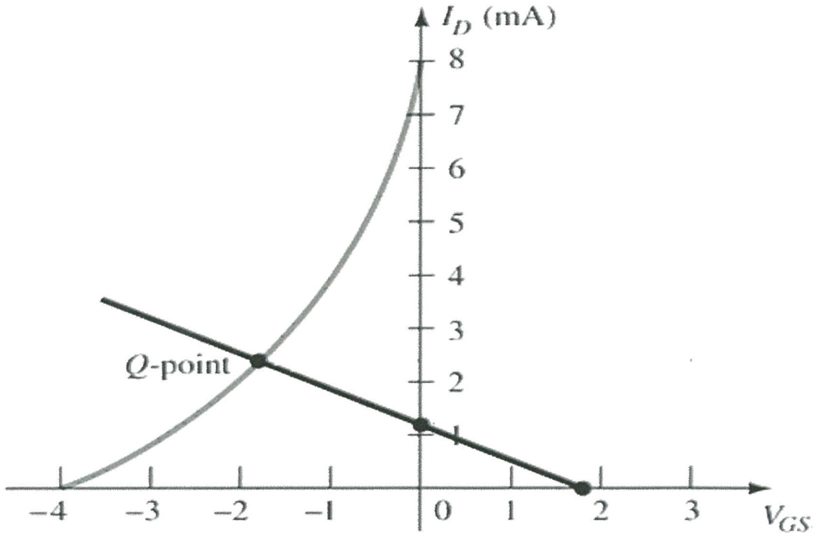


**FIGURE Q3 (b)(ii)**

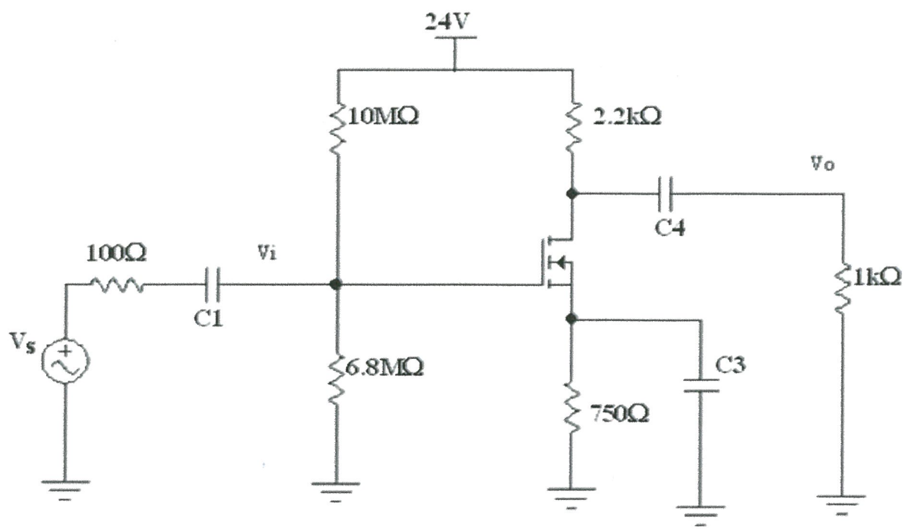




**FIGURE Q4**

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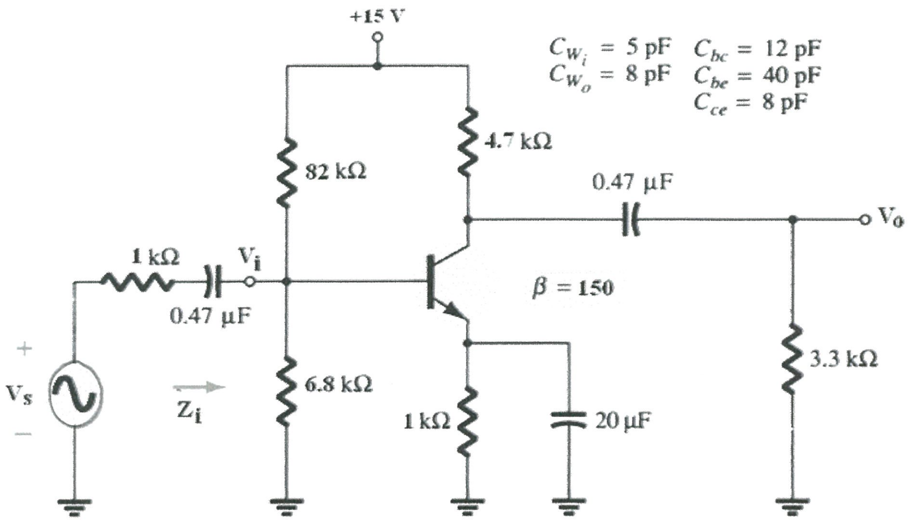


**FIGURE Q5**

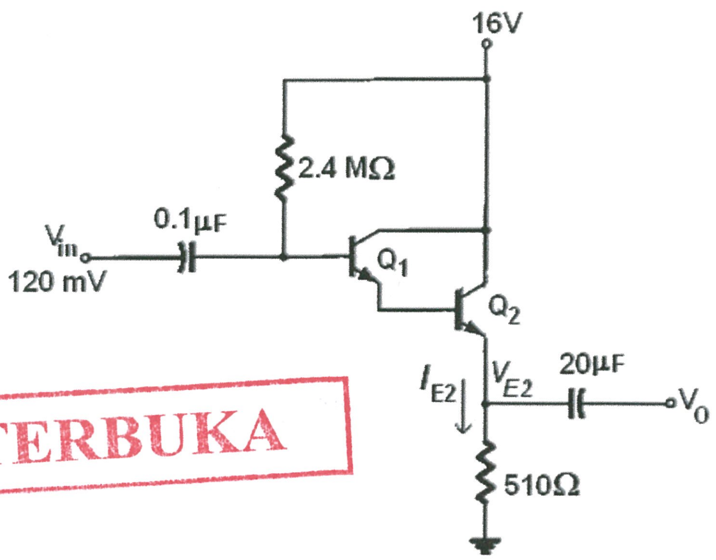


**FIGURE Q6 (a)**

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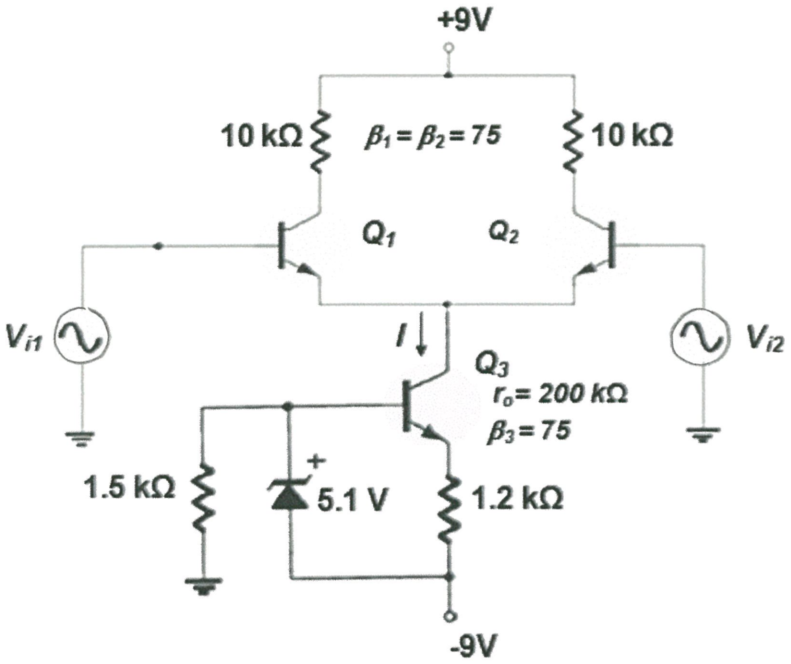


**FIGURE Q6 (b)**

**List of formula:**

$$k = \frac{I_{D(on)}}{(V_{GS(on)} - V_{GS(th)})^2}$$

$$R'_s = R_s \| R_1 \| R_2$$

$$g_m = 2k\left(V_{GS_Q} - V_{GS(th)}\right)$$

$$R_e = R_E \| \left(\frac{R'_s}{\beta} + r_e\right)$$

$$g_m = \frac{2I_{DSS}}{|V_P|}\left(1 - \frac{V_{GS}}{V_P}\right)$$