UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE	:	ANALOG ELECTRONICS/ ELECTRONIC PRINCIPLES
COURSE CODE	:	BEL10203/ BEE 2113
PROGRAMME	:	BEB / BEC / BEH / BED / BEU / BEE
EXAMINATION DATE	:	APRIL / MAY 2011
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE** (5) QUESTIONS ONLY.

THIS PAPER CONSISTS OF TEN (10) PAGES

Q1 (a) Explain what is the doping process. With the help of diagrams, explain briefly the effect of adding a Boron atom and Antimony atom to a Silicon semiconductor.

(5 marks)

(b) A silicon diode is connected in dc series configuration as shown in **Figure Q1(b)**. Determine I, V_1, V_2, and V_O.

(8 marks)

(c) An output waveform in **Figure Q1(c)** is produced using a clipper circuit. Design a series clipper circuit to get the same result as shown. Use ideal diode model. Prove the answer by showing all your calculation during positive and negative half cycle.

(7 marks)

Q2 (a) Compare the characteristics of silicon diode, germanium diode and zener diode.

(3 marks)

(b) A simple bridge rectifier circuit is connected to a step down transformer with the turns ratio of N_p: 1. The following specifications meet the circuit design requirement:

Output current, I_{dc} = 0.1 A
Average voltage to the load = 15 V
Forward diode voltage , V_{diode} = 0.7 V
Mains supply = 110 V, 60 Hz

(i) Draw the schematic diagram of the circuit and determine the transformer turns ratio.

(6 marks)

(ii) Sketch and label the values of input voltage, V_{in} and output voltage, V_o of the rectifier.

(4 marks)

(iii) Calculate the Peak Inverse Voltage, PIV of each diode in the circuit.

(2 marks)

(c) The application of zener diode as a voltage controller is shown in **Figure Q2(c)**. Draw the voltage waveform across the system with respect to the given input voltage, V_i. Use silicon diode model in the analysis.

(5 marks)

Q3 (a) An npn transistor with α = 0.995 is biased in a circuit and is allowed a base current of 25 μA. Determine the collector current, I_C.

(2 marks)

(b) Design a common emitter stabilized bias amplifier with Unbypassed R_E for npn transistor having the following parameters:
$I_{CQ} = 0.5I_{Csat}$, $V_{CEQ} = 0.5V_{CC}$, $I_{Csat} = 8$ mA, $V_{CC} = 16$ V, and $\beta = 100$.

(i) Draw the circuit and determine the values of R_C, R_E, and R_B. State any assumption used.

(8 marks)

(ii) Draw the AC equivalent circuit. Assume $r_o = \infty$.

(2 marks)

(iii) Calculate the input impedance, Z_i and output impedance, Z_o.

(4 marks)

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

(4 marks)

Q4 (a) For the amplifier circuit in **Figure Q4(a)** has an operating point defined by $V_{GSQ} = -1.8$ V and $I_{DQ} = 5.4$ mA. Assume the value of y_{OS} is given as 20 μS.

(i) Sketch the AC equivalent circuit. Hence, determine the g_m and r_d.

(5 marks)

(ii) Calculate the input and output impedance.

(3 marks)

(iii) Find the midband voltage gain, $A_v = \frac{V_o}{V_{in}}$.

(2 marks)

(b) For the circuit in **Figure Q4(b)**, the transistors are identical and very well matched and $V_{BE} = 0.7$ V, $\beta = 200$:

(i) draw the AC equivalent for double ended operation and derive the equation for the differential gain, A_{Vd}.

(4 marks)

(ii) draw the AC equivalent circuit for common mode operation and derive the equation for the common mode gain, A_{VCM}.

(4 marks)

(iii) determine the common mode rejection ratio, CMRR in dB at V_{01}.

(2 marks)

Q5 A two stage audio voltage has been developed for use in a small portable public address (PA) system. The circuit is given in **Figure Q5** and the value of $r_d = r_o = \infty$,

(i) calculate the DC bias voltages and currents for each stage (I_{DQ}, V_{GSQ}, I_{CQ} and V_{CEQ}). Use graphical method to find I_{DQ} and V_{GSQ}.

(8 marks)

(ii) draw an AC equivalent circuit. Determine the input impedance, Z_i and the output impedance, Z_o.

(5 marks)

(iii) determine the gain of each stage, A_{V_1} and A_{V_2}. Hence, calculate the total voltage gain, A_{VT}.

(5 marks)

(iv) find the resulting output voltage, V_O.

(2marks)

Q6 For the network in **Figure Q6**, the parameters are given as follow:

$V_{BE} = 0.7V$	$C_{be} = 10$ pF	$C_{wi} = 5$ pF
$r_o = \infty$	$C_{bc} = 5$ pF	$C_{wo} = 8$ pF
	$C_{ce} = 8$ pF	

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

(6 marks)

(ii) Determine the low cut-off frequencies f_{LS}, f_{LC} and f_{LE}. Hence, identify the low cut-off frequency of the system.

(7 marks)

(iii) Determine the high cut-off frequencies f_{Hi} and f_{Ho}. Hence, identify the high cut-off frequency of the system.

(5 marks)

(iv) Sketch the full frequency response of the amplifier using results in part (ii) and (iii) (the combination of low cut-off frequency and high cut-off frequency)

(2 marks)

Q7 (a) Using a graph given in **Figure Q7(a)**, prove that the maximum efficiency of Class A amplifier with a resistive load is not more than 25%, which is not very efficient. Comment on the output waveform of the amplifier.

(8 marks)

(b) The circuit in **Figure Q7(b)** operates on a ±12 V supply. The impedance of the speaker is 80 Ω and the output of the speaker is 8 V_{peak}.

(i) Calculate its efficiency.

(6 marks)

(ii) The circuit in **Figure Q7(b)** will have crossover distortion in its output waveform. Draw the output waveform to illustrate crossover distortion and explain how this happen.

(3 marks)

(iii) Suggest how to overcome the crossover distortion. Modify the circuit in **Figure Q7(b)** so that crossover distortion could be eliminated. Draw the modified circuit.

(3 marks)

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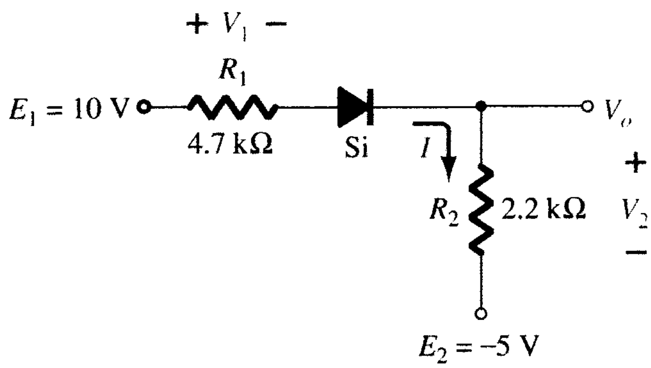

Figure Q1(b)

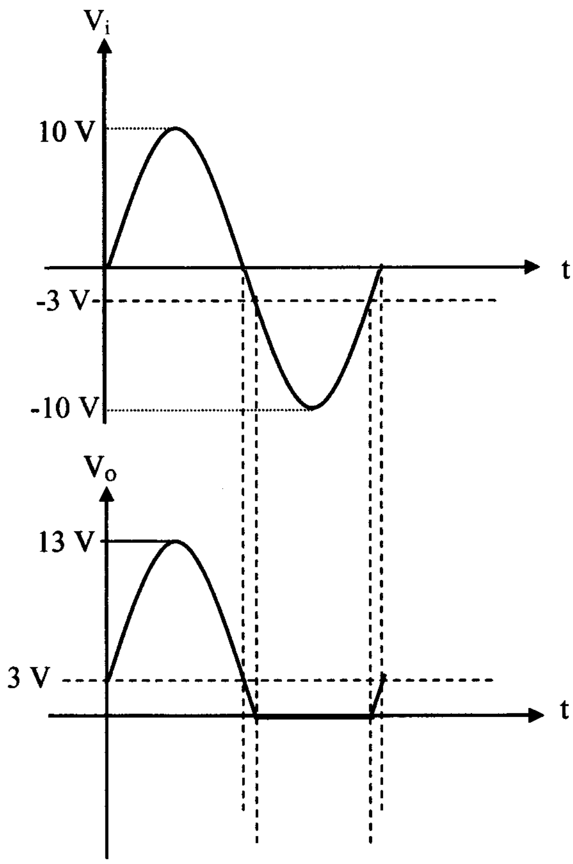

Figure Q1(c)

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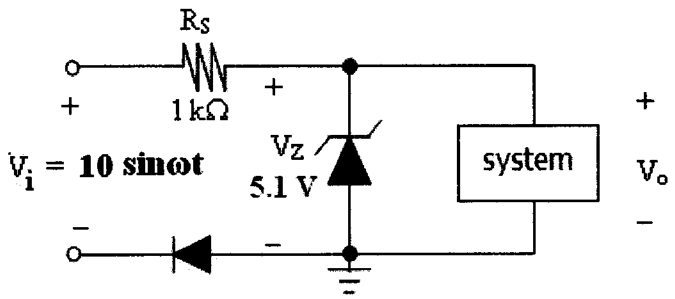

Figure Q2(c)

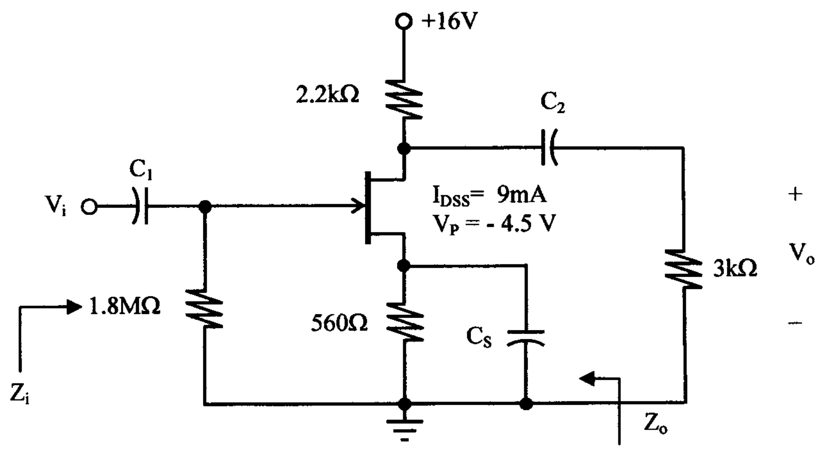

Figure Q4(a)

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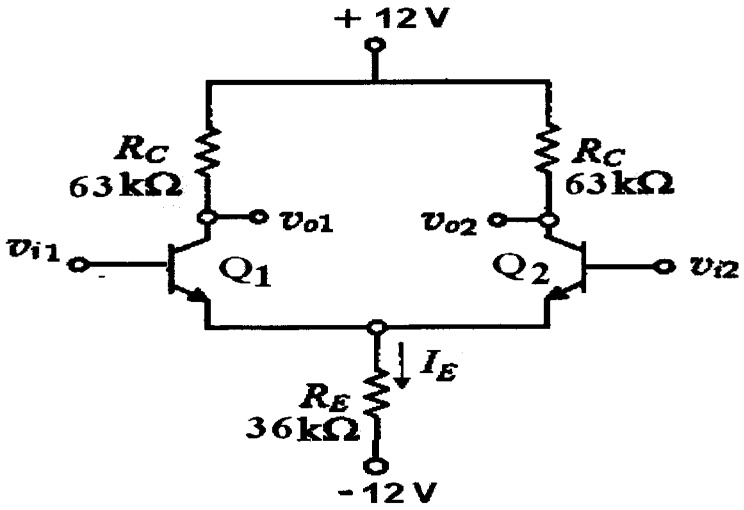

Figure Q4(b)

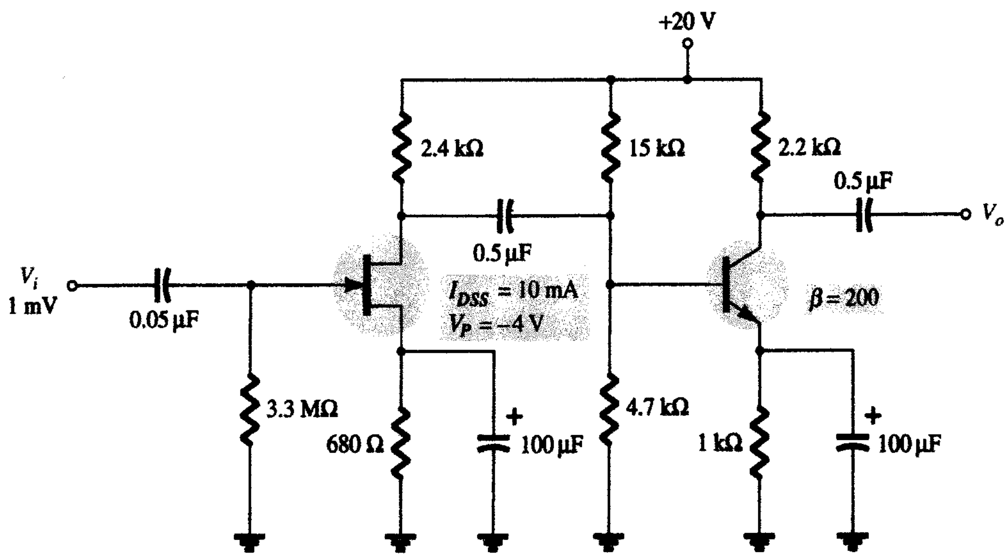

Figure Q5

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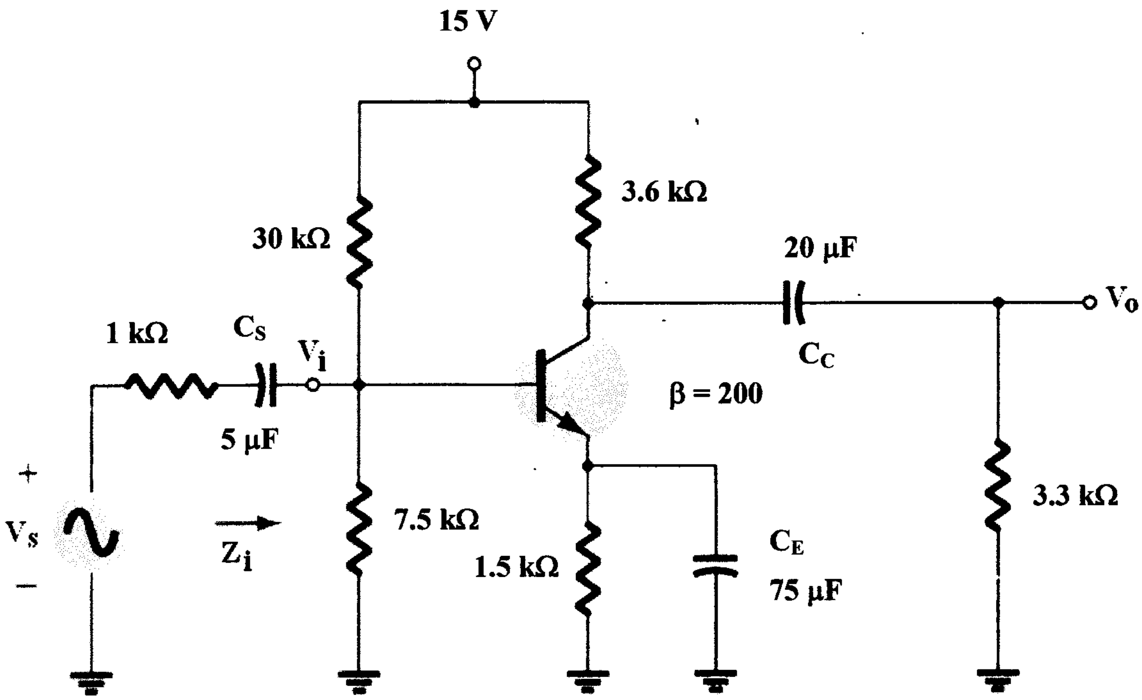

Figure Q6

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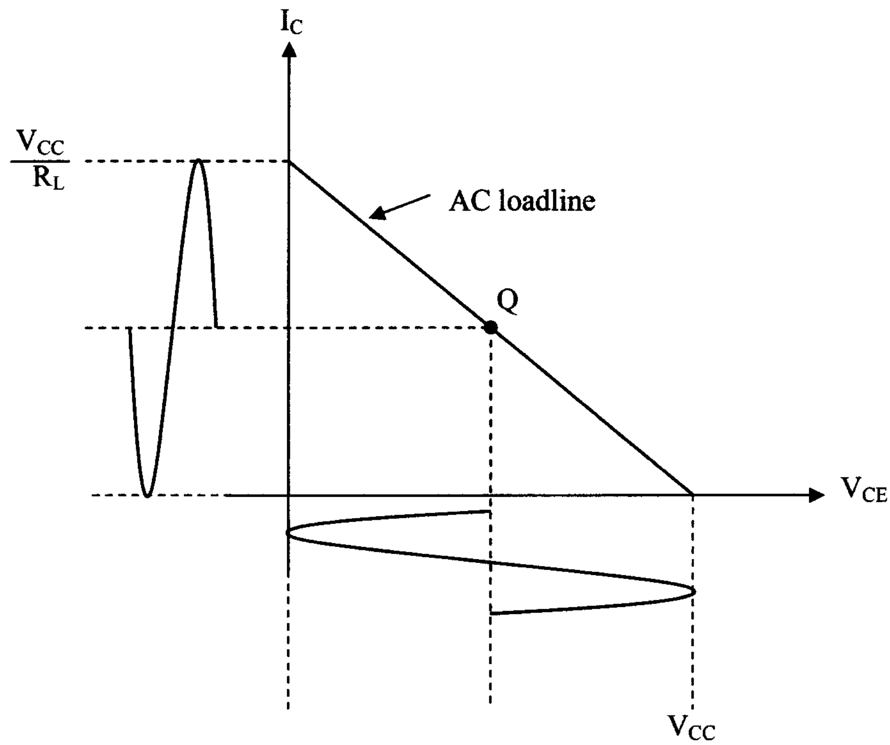

Figure Q7(a)

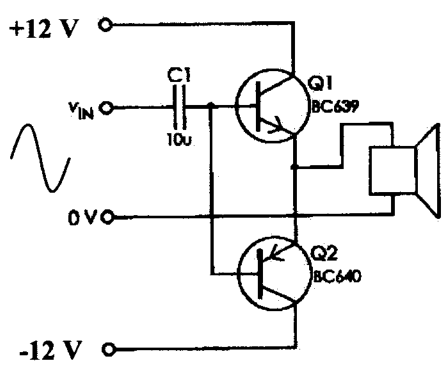

Figure Q7(b)