CONFIDENTIAL

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	: ELECTRONIC CIRCUIT THEORY
COURSE CODE	: BEF 12603
PROGRAMME	: BEV
EXAMINATION DATE	: JUNE 2014
DURATION	: 3 HOURS
INSTRUCTION	: A) ANSWER **ALL FOUR (4)** QUESTIONS. B) ANSWER **ONE (1)** QUESTION.

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

CONFIDENTIAL

SECTION A

Q1 (a) Figure **Q1(a)** shows an I-V characteristics of a pn junction diode. Construct a piece wise linear (PWL) model of this pn junction diode.

(3 marks)

(b) Diodes D_1 and D_2 of the circuit shown in Figure **Q1(b)** are having the same I-V characteristics as the one indicated in Figure **Q1(a)**. Using the PWL diode model obtained in Q1(a),

(i) Calculate the currents I_1 and I_2, and the voltage, V_o if V_s is 5 V

(8 marks)

(ii) Calculate the currents I_1 and I_2, and the voltage, V_o is V_s is –5 V.

(4 marks)

(c) If the I-V characteristics of diodes D_1 and D_2 are similar to those of ideal pn junction diodes, calculate the new values of I_1, I_2 and V_o when V_s is 5 V.

(5 marks)

Q2 (For **Q2**, the voltage transfer characteristic curve, the input signal and output signal must be drawn on a **graph paper**).
The zener diode, Z_D in the regulator circuit shown in Figure **Q2** has the PWL parameters as follow:

$V_F = 0$ V; $R_F = 0\ \Omega$
$V_{ZK} = 6$ V; $R_Z = 0\ \Omega$

(a) Modify the circuit in Figure **Q2** to include PWL model that represents the zener diode, Z_D as indicated above.

(2 marks)

(b) Analyse the circuit of Figure **Q2** to determine the transition voltages and fill-in the values in Table **Q2**. Plot the graph of the voltage transfer characteristic (V_o versus V_s for this circuit from V_s = -10 V to 10 V and label the transition voltages).

(10 marks)

(c) If the input signal, $V_s = 10 \sin (100\ \pi\ t)$ V, draw the input waveform, V_s and output waveform, V_o for one complete cycle.

(8 marks)

Q3 (a) Explain three operation modes available for bipolar junction transistor (BJT) and the conditions required to operate in these modes.

(3 marks)

(b) Circuit in Figure **Q3** is used to control the lighting of a LED. When the input signal, V_i is at 5 V, LED is lit; else it will be turned off. Assume that the LED requires 5 mA current for full brightness and drops about 1.8 V. The controller circuit using a BJT transistor type which β is specified to be in the range of 50 to 150.

(i) Compute the value of R_C. Calculate the voltage across R_C when the LED is lit. Also calculate the voltage across R_C when the LED is OFF.

(7 marks)

(ii) Propose the value of R_B to guarantee the circuit remains in the saturation mode.

(6 marks)

(iii) Explain how your answer in **Q2(i)** and **Q2(ii)** fulfil its operation in controlling the LED's lighting.

(4 marks)

Q4 (a) With the aid of a diagram, describe the importance of quiescent points to be in the middle of the DC load line for BJT transistor amplifier circuit.

(4 marks)

(b) The amplifier circuit shown in Figure **Q4** is used to amplify the audio signals. The three capacitors have infinite capacitances.

(i) Draw the small-signal equivalent circuit of the amplifier circuit.

(6 marks)

(iii) Calculate the voltage gain, A_V, the current gain, A_i and the overall gain, A_{VT}.

(10 marks)

SECTION B

Q5 (a) State the assumption(s) made in modelling the ideal operational amplifiers in terms of its gain and voltage(s).

(4 marks)

(b) Circuit in Figure **Q5** is an operational amplifier used to perform a type of mathematical operation.

(i) Derive the expression of the output voltage, Z in terms of inputs A, B and C.

(6 marks)

(ii) Determine the output voltage, Z for the following scenarios:

Case 1 – the values of A, B and C are 2 V, -3 V and 4 V respectively.
Case 2 – the values of A, B and C are 3 V, 3 V and 5 V respectively.

(7 marks)

(iii) If the feedback resistor is doubled of the present value, deduce the new expression of the output, Z in terms of inputs A, B and C.

(3 marks)

Q6 (a) State the assumption(s) made in modelling the ideal operational amplifiers in terms of its impedance values.

(4 marks)

(b) Circuit in Figure **Q6** is an operational amplifier used to perform a type of mathematical operation.

(i) Derive the expression of the output voltage, $v_o(t)$ in terms of input signal, $v_i(t)$.

(5 marks)

(ii) If the input signal, $v_i(t) = 10 \sin(100\pi t)$ V, draw both the input waveform, $v_i(t)$ and output waveform, $v_o(t)$ for one complete cycle. Label the diagram clearly.

(8 marks)

(iii) Explain the effect on the output signal, $v_o(t)$ as the frequency, ω of input signal, $v_i(t)$ is varied.

(3 marks)

Q7 (a) State two (2) advantages of using negative feedback in the amplifier circuit design.

(4 marks)

(b) Figure **Q7** shows a series-shunt feedback network. The open-loop gain, A of this amplifier is 1×10^4 and the resistor $R_S = 1\ \text{k}\Omega$.

(i) Derive the expression of the feedback factor, β

(4 marks)

(ii) Calculate the ratio of R_1/R_2 to obtain the closed-loop voltage gain, A_f of 5. Leave your answer in 3 decimal points

(5 marks)

(iii) If $v_s = 1$ V, find the voltages v_o , v_f and v_i

(4 marks)

(iv) If the open loop gain decreases by 20%, deduce the corresponding decrease in the closed-loop voltage gain.

(3 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2013/2014 PROGRAMME: BEV
COURSE NAME: ELECTRONIC CIRCUIT THEORY COURSE CODE: BEF 12603

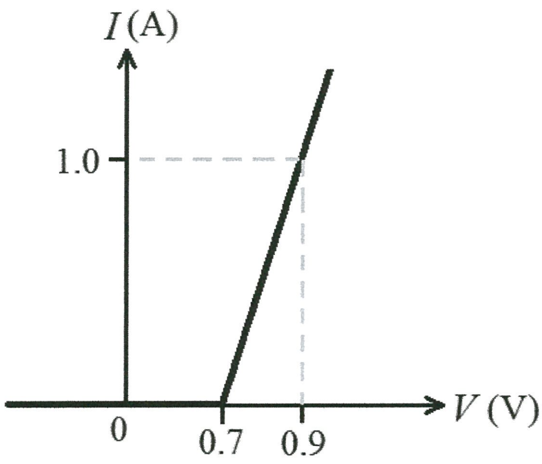

FIGURE Q1(a)

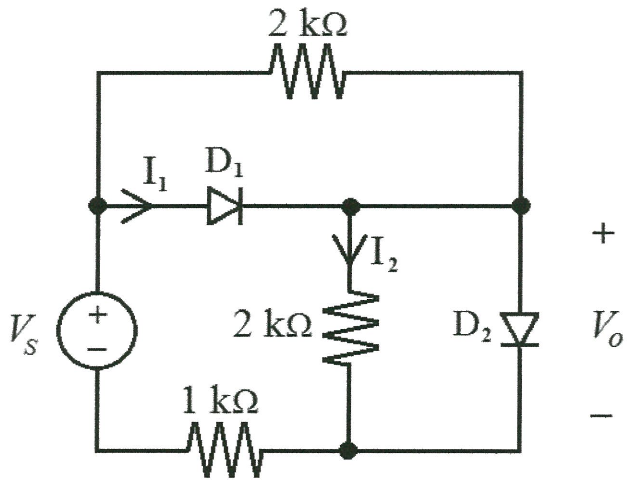

FIGURE Q1(b)

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2013/2014 PROGRAMME: BEV
COURSE NAME: ELECTRONIC CIRCUIT THEORY COURSE CODE: BEF 12603

TABLE Q2

V_s (V)	-10	0	2	5	7.5	10
V_o (V)						

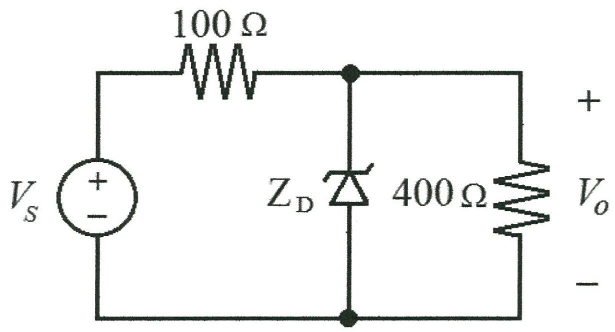

FIGURE Q2

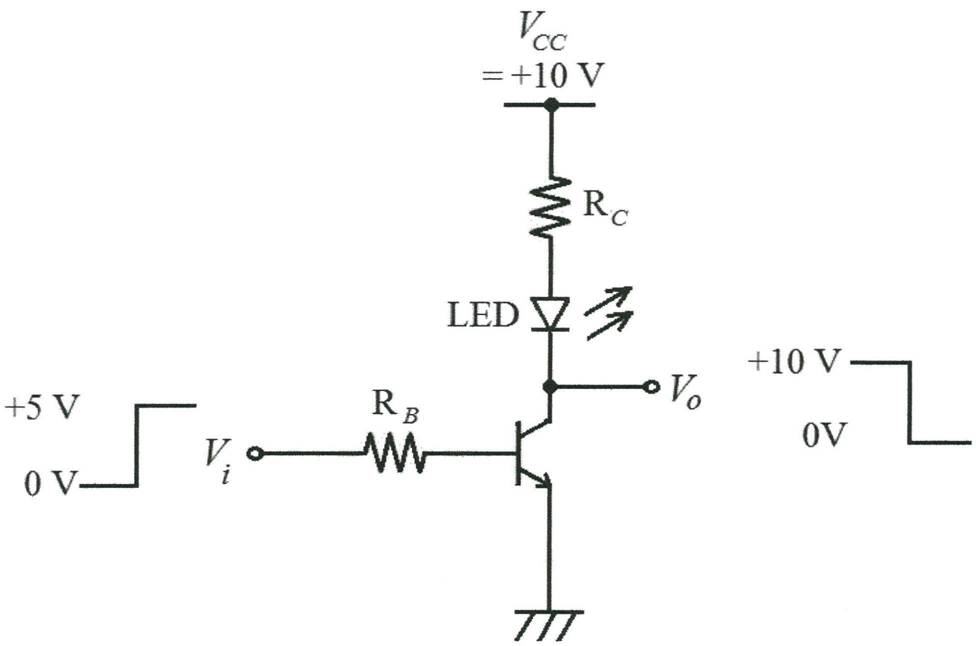

FIGURE Q3

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2013/2014 PROGRAMME: BEV
COURSE NAME: ELECTRONIC CIRCUIT THEORY COURSE CODE: BEF 12603

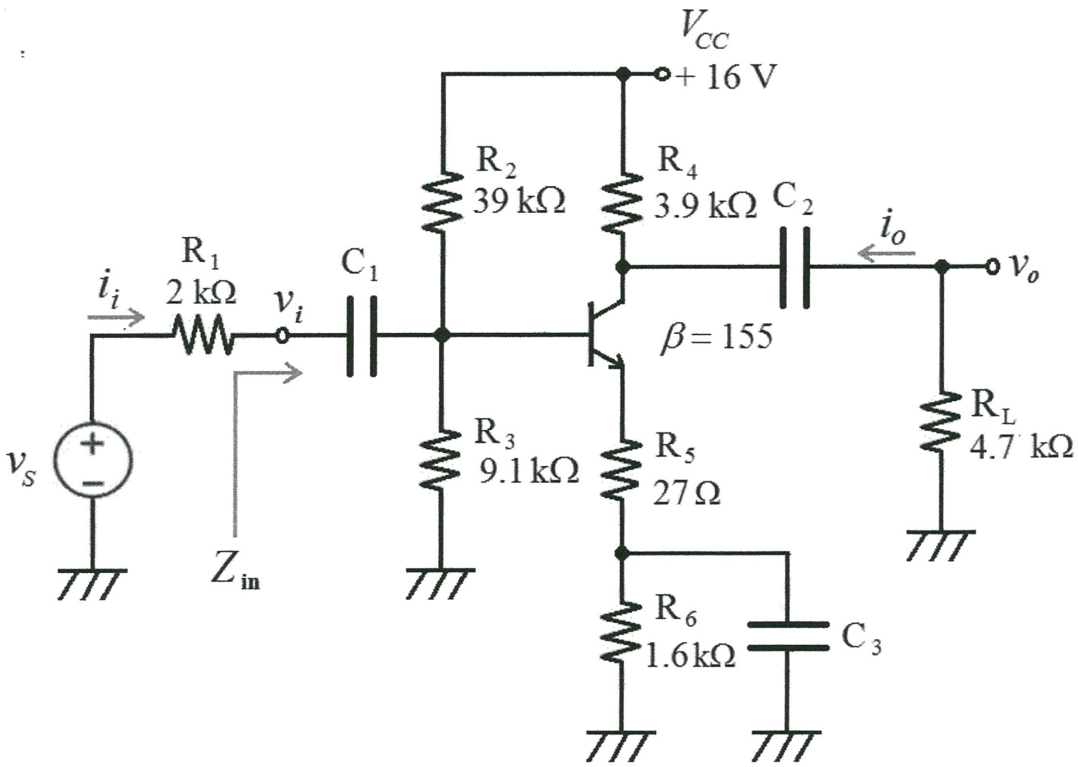

FIGURE Q4

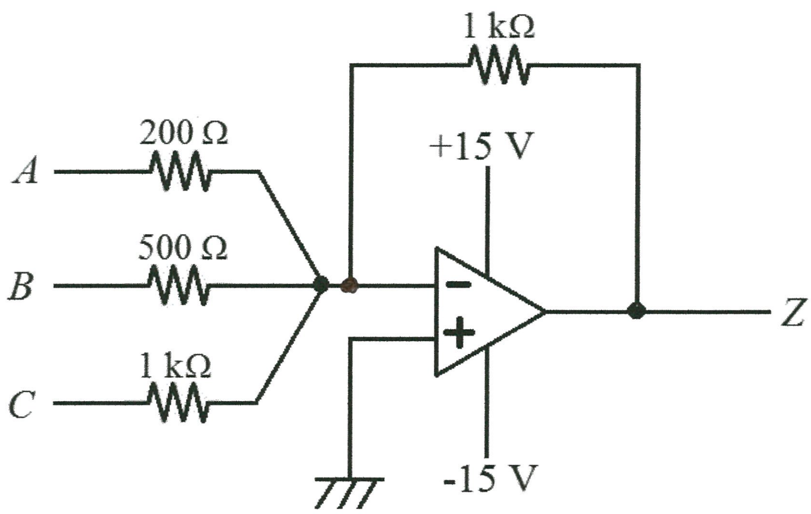

FIGURE Q5

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2013/2014 PROGRAMME: BEV
COURSE NAME: ELECTRONIC CIRCUIT THEORY COURSE CODE: BEF 12603

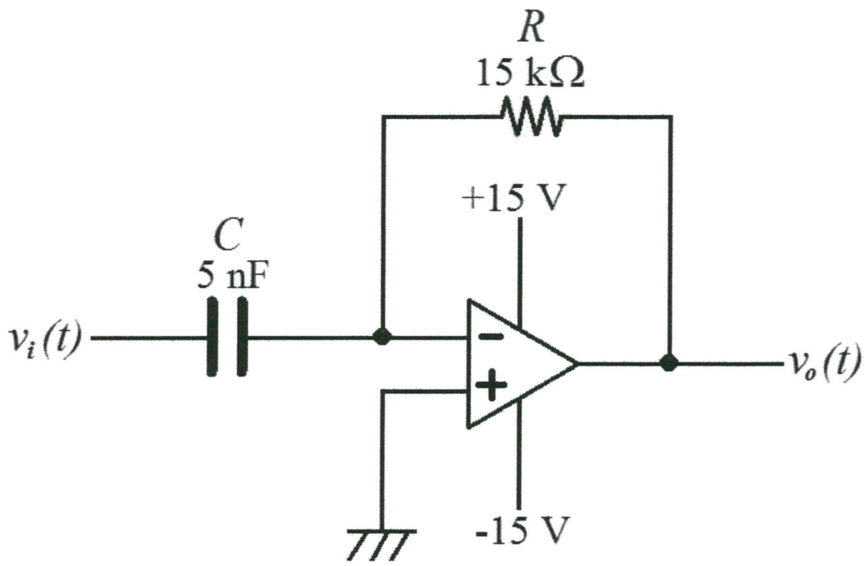

FIGURE Q6

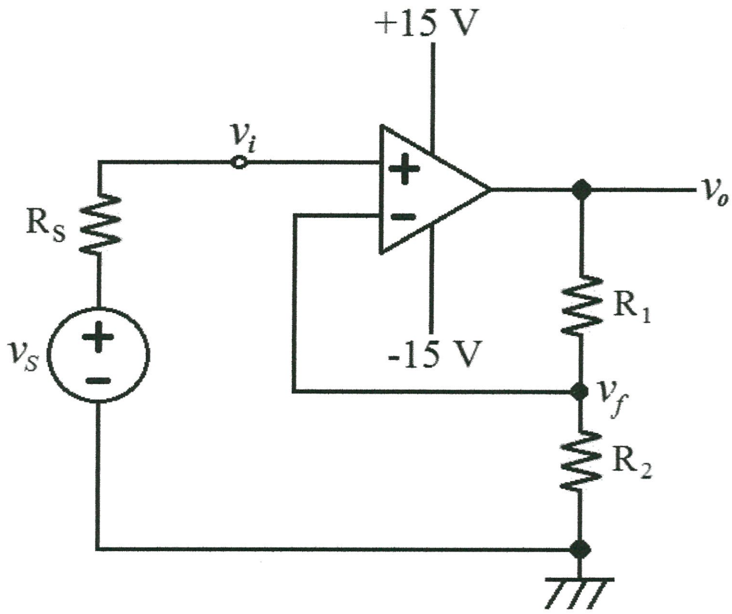

FIGURE Q7

FINAL EXAMINATION

SEMESTER/SESSION: SEM II/2013/2014 PROGRAMME: BEV
COURSE NAME: ELECTRONIC CIRCUIT THEORY COURSE CODE: BEF 12603

FORMULA

Bipolar Junction Transistor (BJT)

$$\beta = \frac{I_C}{I_B}$$

$$\alpha = \frac{I_C}{I_E}$$

$$r_e = \frac{26\,mV}{I_E}$$

$$\left.\begin{array}{l} Z_{in} = R'_B || \beta(r_e + R_E) \\ Z_{out} = R_C \end{array}\right\} \text{For common-emitter amplifier}$$

Amplifier Gain:

Voltage gain, $A_v = \frac{v_o}{v_i}$

Current gain, $A_i = \frac{i_o}{i_i}$

Power gain, $A_p = \frac{p_o}{p_i}$

Voltage gain with feedback, $A_{vf} = \frac{A_o}{1+A_o\beta}$