UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE HOME)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	ELECTRONIC CIRCUIT ANALYSIS AND DESIGN
COURSE CODE	:	BEL 30403
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2020
DURATION	:	4 HOURS
INSTRUCTION	:	ANSWER ONLY **TWO QUESTIONS** IN PART A AND **ONE QUESTION** IN PART B. PLEASE UPLOAD YOUR ANSWER IN JUST 1 PDF FORM TO AUTHOR (UTHM LMS) WITHIN THE SPECIFIED TIME GIVEN. TAKE HOME EXAMINATION.

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

PART A: Answer ONLY TWO question from this part.

Q1 (a) **Figure Q1(a)** shows an audio amplifier using two Op-Amps. For this circuit:

(i) Determine the output voltages (V_{O1} and V_{O2}) for each Op-Amp in terms of V_{in} and the resistors in the circuit.

(4 marks)

(ii) Derive the expression for the voltage gain, $A_V = V_L/V_{in}$.

(4 marks)

(iii) Design the circuit to provide a gain of $A_V = 15$ so that the magnitudes of V_{O1} and V_{O2} are equal.

(4 marks)

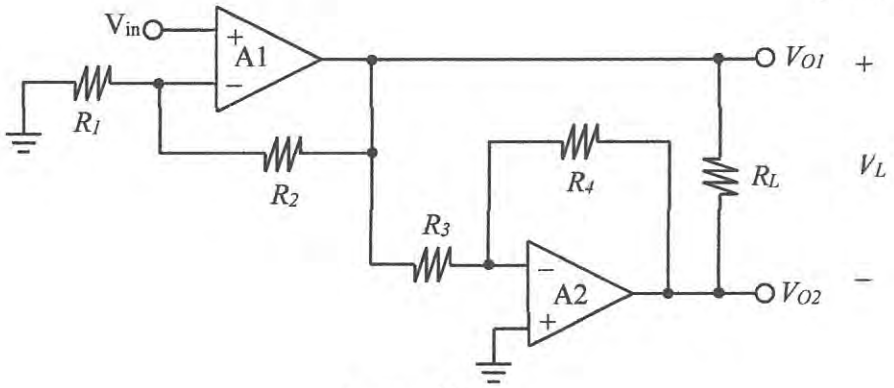

Figure Q1(a)

(b) **Figure Q1(b)** shows a Schmitt Trigger circuit. The circuit is powered by a ± 10V supply.

(i) Calculate the upper (V_{UTP}) and lower (V_{LTP}) threshold point voltages, and hysteresis voltage (V_H) for the circuit if $R_1 = 2$ kΩ and $R_2 = 12$ kΩ.

(6 marks)

(iii) Explain the advantage of this circuit and relate it to the hysteresis voltage.

(2 marks)

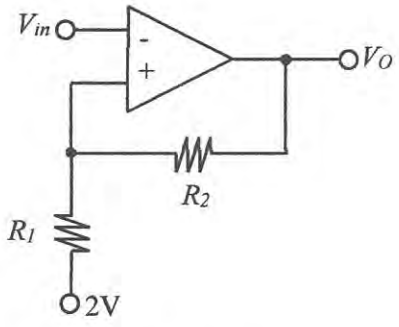

Figure Q1(b)

Q2 (a) Derive the gain transfer function, $H(s) = \frac{V_o(s)}{V_i(s)}$ of the circuit in **Figure Q2(a)**.

(8 marks)

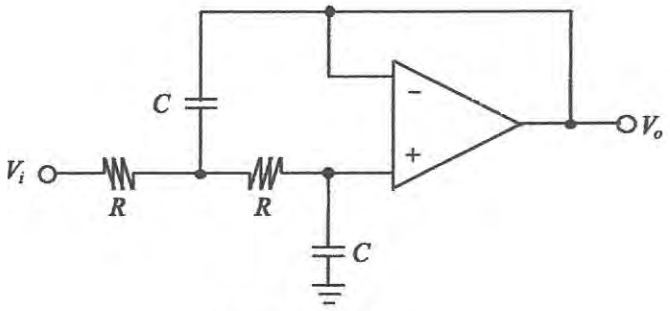

Figure Q2(a)

(b) A second-order band pass filter can be constructed by cascading a second-order high pass filter and a second-order low pass filter as shown in **Figure Q2(b)**. For this circuit;

(i) Determine the value for capacitors C_a and C_b in order to have a low cut-off frequency, f_{c1} of 500 Hz and high cut-off frequency, f_{c2} of 6000 Hz.

(2 marks)

(ii) Calculate the centre frequency, f_o and quality factor, Q of the circuit. Explain the value of quality factor (Q) obtained.

(6 marks)

(iii) Draw the frequency response of this filter.

(2 marks)

(iv) If the filter is the Butterworth type, obtain the value of R_F if the factors of polynominals $P_n(s)$ is:

$$s^2 + 1.414s + 1$$

(2 marks)

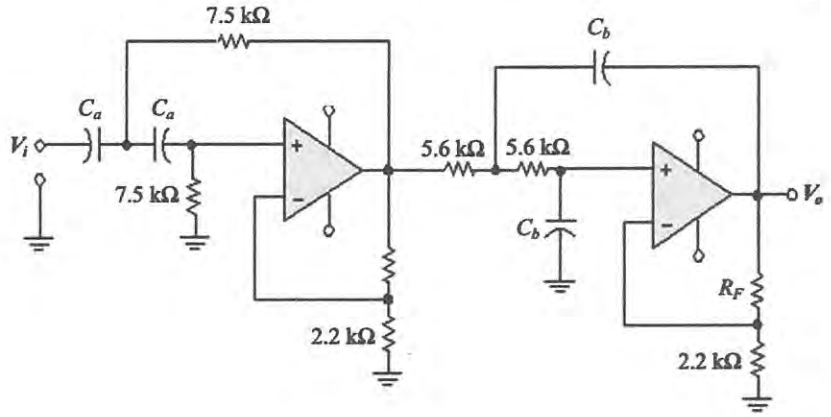

Figure Q2(b)

Q3 (a) An amplifier with an input impedance of 20 kΩ and output impedance of 13 kΩ has an open loop gain of 10000 and a low cut-off frequency at 13 kHz. The amplifier is connected to a feedback network as shown in **Figure Q3(a)** and the close loop gain is 100.

(i) Analyse the block diagram and determine the type of amplifier and feedback connection used.

(4 marks)

(ii) Explain the advantage of having this type of amplifier and feedback connection with respect to the input impedance.

(2 marks)

(iii) Calculate the value for feedback factor, closed-loop low cut-off frequency and closed loop input impedances.

(6 marks)

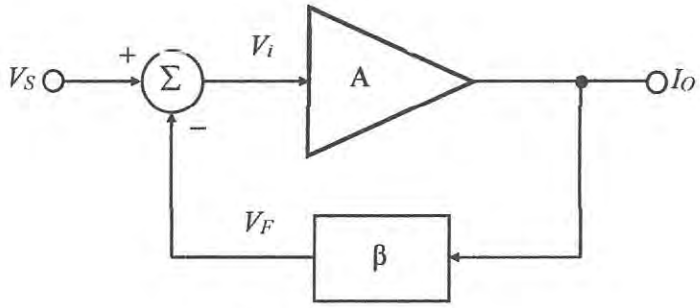

Figure Q3(a)

(b) **Figure Q3(b)** shows a transimpedance amplifier circuit with a voltage shunt feedback. Derive the equation for the feedback network (β) and the gain of the amplifier.

(8 marks)

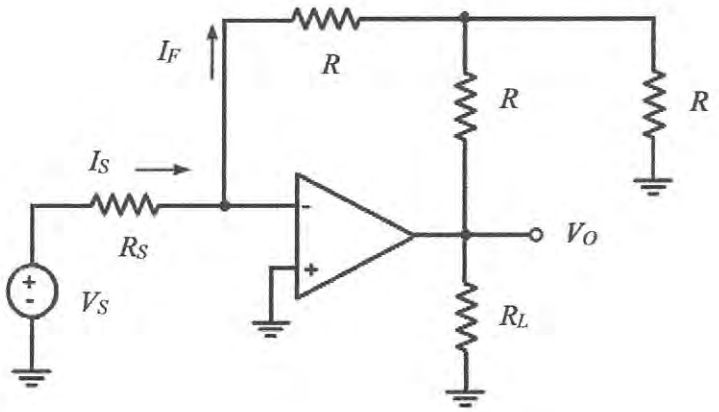

Figure Q3(b)

Q4 (a) An oscillation can take place for electronic circuit even when there is no external input signal is applied. Explain how this can be achieved.

(2 marks)

(b) A Unijunction (UJT) Oscillator and its *I-V* characteristic are shown in **Figure Q4(b)**. The UJT has an intrinsic stand-off ratio, $\eta = 0.55$.

(i) Determine the R_{B2} value.

(2 marks)

(ii) Calculate the time required for capacitor to discharge to V_v.

(2 marks)

(iii) Find the forward biased voltage across diode, V_D.

(2 marks)

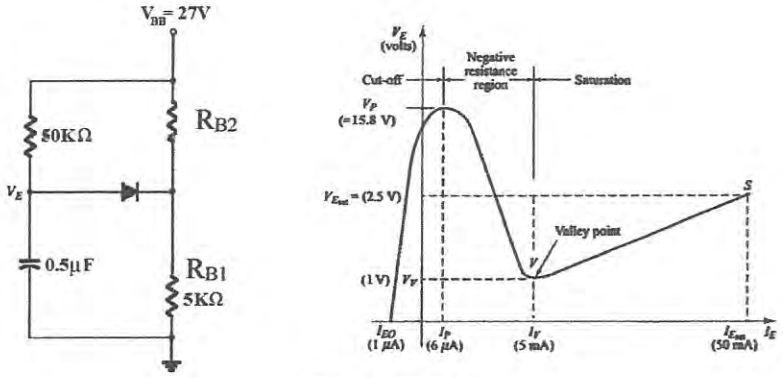

Figure Q4(b)

(c) The circuit shown in **Figure Q4(c)** is an oscillator. For this circuit:

(i) Derive the expression for the feedback network, $\beta = \frac{V_F}{V_O}$.

(8 marks)

(ii) Determine the frequency of oscillation.

(4 marks)

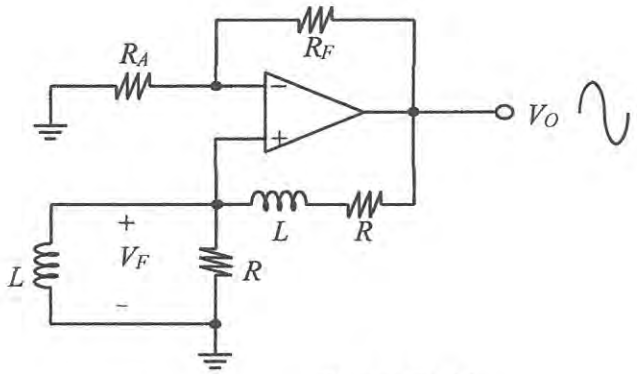

Figure Q4(c)

PART B: The following question MUST be answered.

Q5 (a) **Figure Q5(a)** shows a full wave bridge circuit with a capacitor filter. Given capacitor, $C = 2200\ \mu F$, forward diode voltage, $V_{diode} = 0.7$ V and DC current, $I_{dc} = 0.1$ V.

(i) Calculate the peak voltage at secondary winding, $V_{p(sec)}$, output average voltage, V_{dc} and peak-to-peak ripple voltage, $V_{r(p-p)}$

(6 marks)

(ii) Draw the output waveforms of V_{sec} and V_o.

(4 marks)

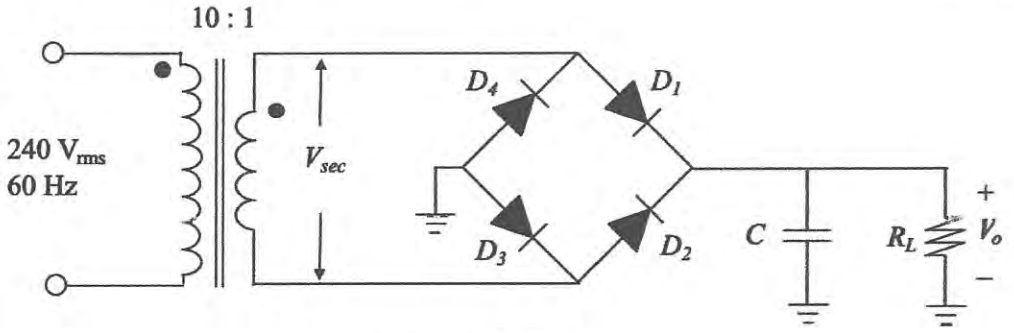

Figure Q5(a)

(b) An additional RC filter is connected to the circuit in **Figure Q5(a)**. Compare and conclude on the old and new ripple factor, r (%) if the value R and C are 100 Ω and 470 μF, respectively. Use $R_L = 200\ \Omega$.

(6 marks)

(c) For the circuit in **Figure Q5(c)**, calculate the approximate values of output voltage V_O, input current I_{R2}, load current I_L and collector current I_{SH}. Given: $R_2 = 10\Omega$, $V_Z = 6.8$V, $R_3 = 2.5$ kΩ, $R_4 = 7.5$ kΩ and $R_L = 50\ \Omega$.

(4 marks)

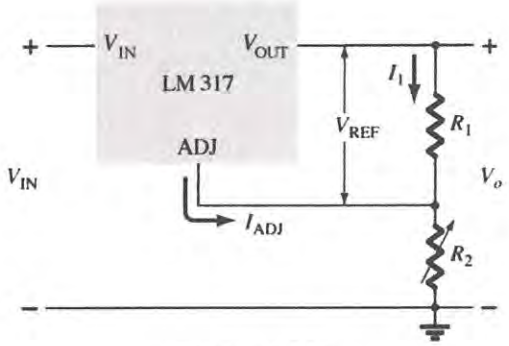

Figure Q5(c)

– END OF QUESTIONS –