INTI
International College Penang
LAUREATE INTERNATIONAL UNIVERSITIES'

FINAL
Examination Paper

(COVER PAGE)

Session	:	**January 2018**
Programmes	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**EEE1106: Analogue Electronics**
Date of Examination	:	6 March 2018 (Tuesday)
Time	:	11:00am – 1:00pm
Duration	:	2 Hours Reading Time Nil
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

IMPORTANT NOTE : THIS PAPER SHOULD NOT BE TAKEN OUT OF THE EXAMINATION HALL BY THE STUDENTS.

Materials Permitted :

Scientific Calculator (Model fx570 Series)

Materials Provided :

Nil

Examiner(s)	:	**Chan Tse Wei**
Moderator	:	Assoc. Prof. Dr. Khoo Bee Ee

This paper consists of 7 printed pages, including the cover page.

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEEI)
EEE1106: ANALOGUE ELECTRONICS
FINAL EXAMINATIONS: JANUARY 2018 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks. The marks allocated to each sub-question are shown in square brackets at the right-hand margin. Present your answers neatly and clearly. The assessor reserves the rights to ignore your answers if they are ambiguous.

Question 1

a. Figure-Q1(a) shows a AC equivalent capacitor-coupled amplifier circuit built around a voltage amplifier. Tests conducted on the voltage amplifier revealed the following characteristics:

R_{in} = input resistance of the voltage amplifier = $560\ k\Omega$

A = voltage gain of the voltage amplifier = 120

R_{out} = output resistance of the voltage amplifier = $18\ \Omega$

Quantitatively show that the overall voltage gain of the capacitor-coupled amplifier circuit, V_{out}/V_{ac} is given by,

$$\frac{V_{out}}{V_{ac}} = -\frac{3.79\omega^2}{(1 + j0.00138\omega)(1 + j26.32\omega)}$$

where ω is the input frequency in rad/s. [10]

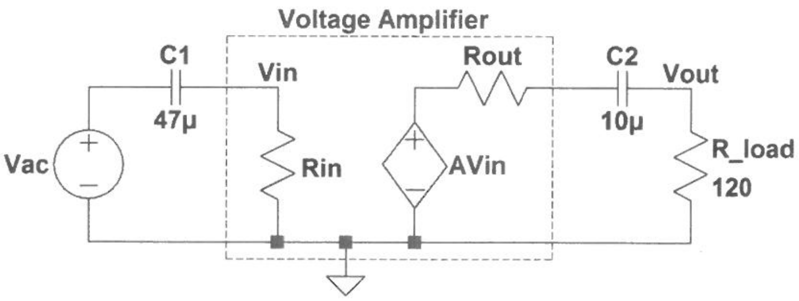

Figure-Q1(a)

b. Figure-Q1(b) shows a non-inverting summer circuit. Determine the output voltage value if $V_1 = 1.5\ V$, $V_2 = -2\ V$ and $V_3 = 4\ V$. [10]

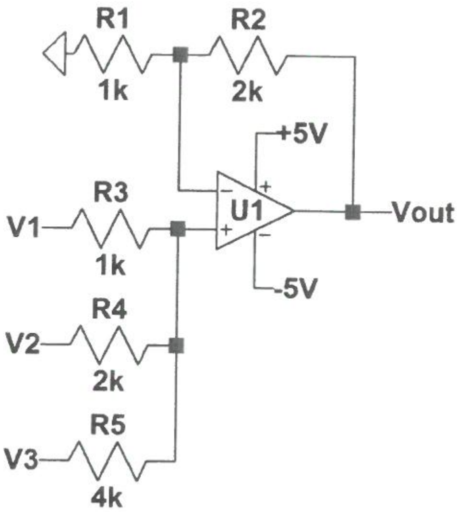

Figure-Q1(b)

C. Figure-Q1(c) shows the block diagram of a feedback harmonic oscillator. A_v is the voltage gain of the amplifier block and β is the feedback transfer function of the frequency determining circuit.

Explain the reason for this oscillator failing to operate. [5]

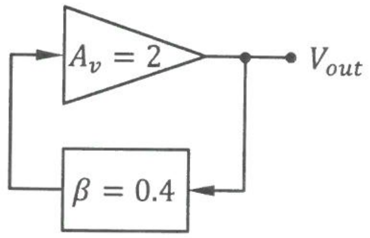

Figure-Q1(c)

Question 2

a. Figure-Q2(a) shows a basic class-B power amplifier. Explain its principle of operation. [5]

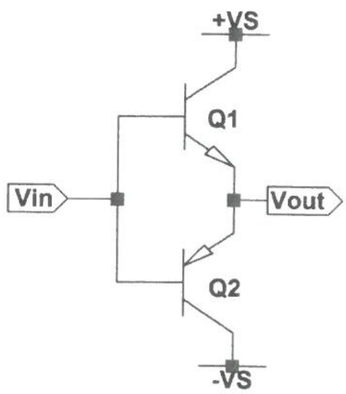

Figure-Q2(a)

b. Quantitatively show that the circuit in Figure-Q2(b) implements a second order low pass filter. [10]

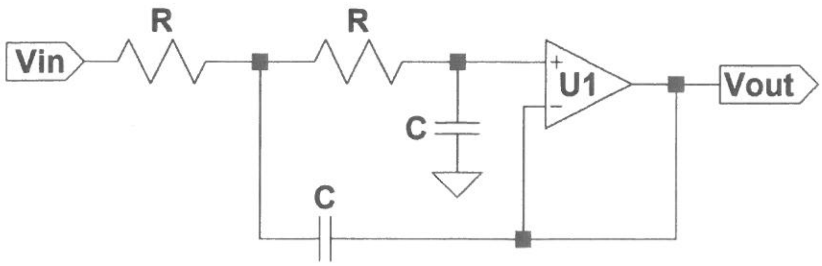

Figure-Q2(b)

c. Figure-Q2(c) shows a relaxation oscillator circuit which produces a triangular wave at its output terminal. Assume that the two op-amp has ideal characteristics, calculate the peak-to-peak value of V_{out} and its oscillating frequency. [10]

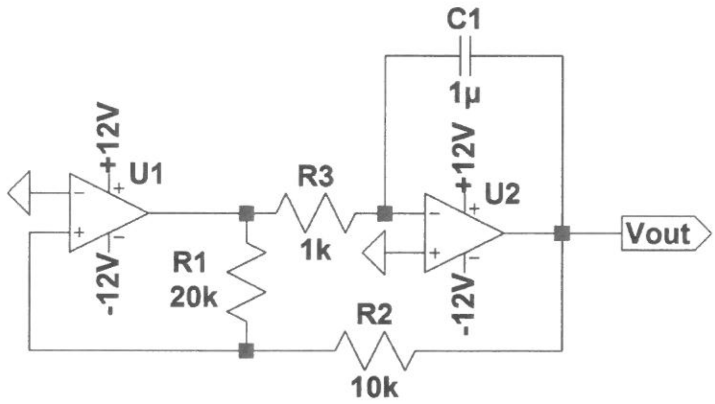

Figure-Q2(c)

Question 3

a. Figure-Q3(a) shows a basic class-A power amplifier circuit. Assume that transistor Q is ideal, and negligible current is flowing through resistor R_B, quantitatively show that the maximum power conversion efficiency of this amplifier circuit is merely 25%. [10]

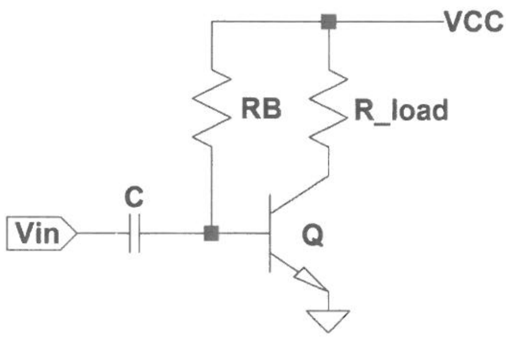

Figure-Q3(a)

b. Explain the technique to implement a band pass filter using high pass and low pass filters. [5]

c. Figure-Q3(c) shows a harmonic oscillator circuit. R_T is a thermistor which reduces its resistance when its current increases, while R_3 is a variable resistor. Quantitatively show that when output oscillation is sustained,

$$\frac{R_T}{R_1} = \frac{R_2}{R_3 + R_4} + \frac{C_2}{C_1}$$

[10]

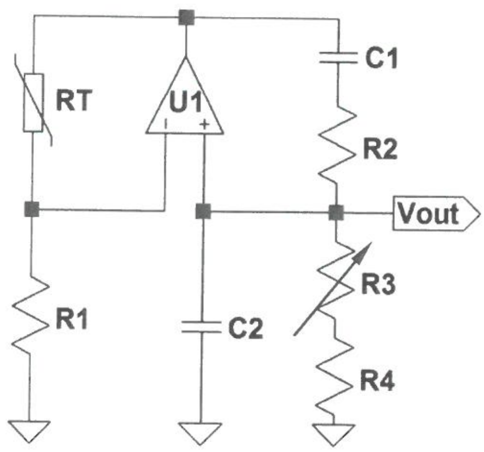

Figure-Q3(c)

Question 4

a. Explain op-amp slew rate limitation. [5]

b. Figure-Q4(b) shows a class AB power amplifier circuit. Diodes D_1 and D_2 are compensating diodes and they match well with the emitter diodes of transistors Q_1 and Q_2. Each diode has 0.7 V barrier voltage.

Calculate the amplifier's power conversion efficiency if V_{in} is a sinusoidal wave with 2 V peak amplitude at the amplifier's mid-band frequency. [10]

c. Figure-Q4(c) shows an audio amplifier circuit. Transistor J_1 has $I_{DSS} = 6\ mA$ and $V_{GS_{off}} = -6\ V$. Calculate the mid-band voltage gain of the amplifier. [10]

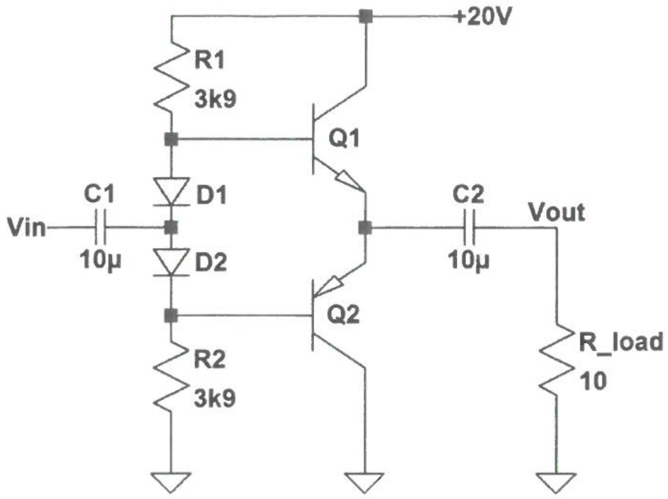

Figure-Q4(b)

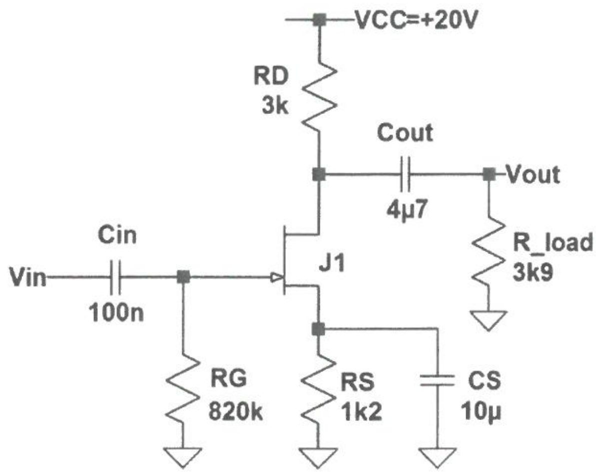

Figure-Q4(c)

Question 5

a. Explain, with the aid of an illustration, the frequency response of an AC-coupled voltage amplifier. [5]

b. Quantitatively show that the current flowing through resistor R_{load} in Figure-Q5(b) is 0.37 mA. [10]

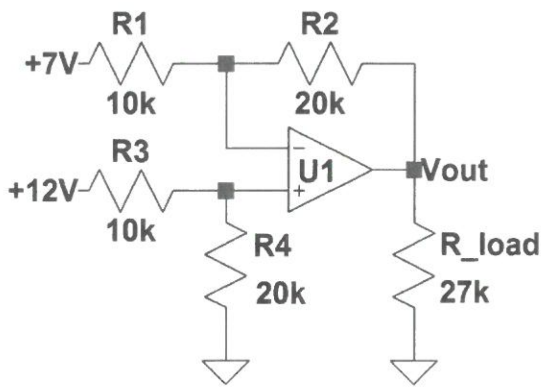

Figure-Q5(b)

c. The transfer function of an active filter is given by,

$$\frac{V_{out}(s)}{V_{in}(s)} = \frac{300000s}{s^2 + 60000s + (900 \times 10^6)}$$

Calculate the maximum voltage gain of the filter in dB unit and its quality factor. [10]

Question 6

a. Figure-Q6(a) shows the AC equivalent circuit model of a single stage BJT-base voltage amplifier. Determine the lower cutoff frequency of the amplifier. [10]

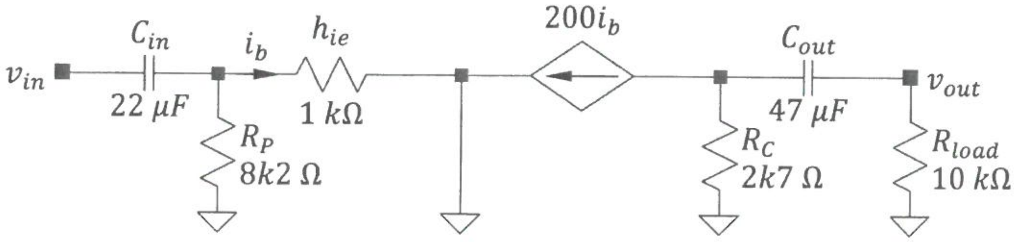

Figure-Q6(a)

b. Show a non-inverting amplifier with a voltage gain of 25, implemented by one op-amp and two resistors in $k\Omega$ range. [5]

c. Figure-Q6(c) shows a non-inverting Schmitt trigger comparator circuit. Determine the comparator's threshold voltages by assuming the op-amp has ideal characteristics. [10]

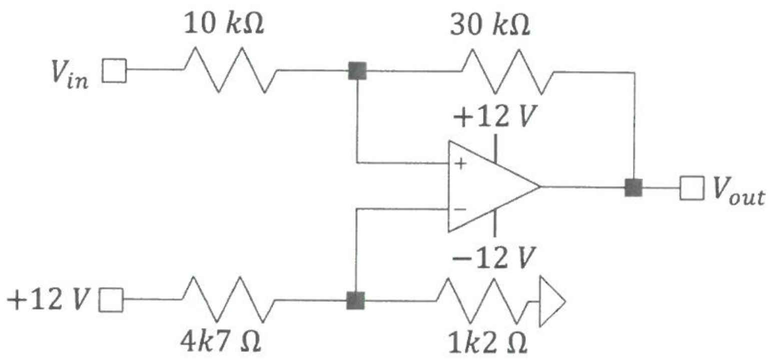

Figure-Q6(c)

~ The End ~