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INTERNATIONAL COLLEGE PENANG (507232-U)
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session : JANUARY 2012

Programmes : Diploma in Electrical and Electronic Engineering (DEEI)

Course : **EEE1103 : ELECTRONIC DEVICES AND CIRCUIT THEORY 2**

Date of Examination : 7 March 2012

Time : 11a.m. – 1p.m. Reading Time : Nil

Duration : 2 Hours

Special Instructions :

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

Students are not allowed to remove this question paper from the examination venue.

Materials permitted : Non-programmable scientific calculator

Materials provided : **Appendix-A**

Examiner(s) : **Chan Tse Wei**

Moderator : Liong Han Wen

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

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEEI)

EEE1103 : ELECTRONIC DEVICES AND CIRCUIT THEORY 2
FINAL EXAMINATION : JANUARY 2012 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.

Question 1

a. Distinguish between class-A, class-B and class-C power amplifiers in terms of the conduction cycles of their respective amplifying components and their efficiency. [5]

b. What does it mean when a power amplifier is said to have 70% efficiency? [5]

c. Figure-Q1(c) shows a power amplifier circuit and Appendix-A shows the output characteristic curves of transistor T_1.

i. Determine the value of resistor R_B so that transistor T_1 is midpoint biased to form a class-A power amplifier. Assume V_{BE} = 0.7V. Attach Appendix-A to your answer script. [5]

ii. With the resistance found in part (c)(i) for resistor R_B, approximate the circuit's efficiency in percentage if an input voltage that results in a base current of 10mA peak is applied at the input terminal. Show all workings clearly. [6]

iii. Estimate the theoretical maximum efficiency achievable by the power amplifier without any amplitude distortion occurring. [4]

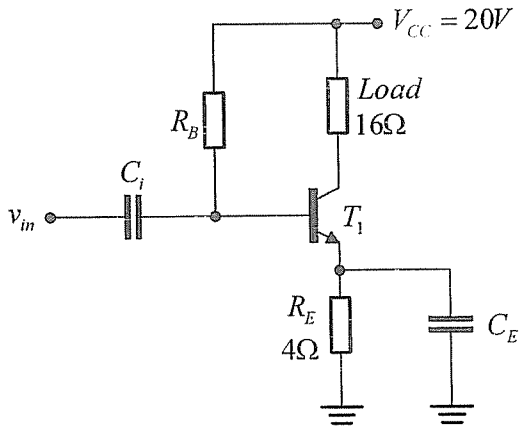

Figure-Q1(c)

Question 2

a. What is the meaning of "midrange" in an amplifier frequency response? [3]

b. The voltage transfer function of an amplifier circuit is given by,

$$A_v = \frac{49 \times 10^6 s}{49s^2 + 6144600\, s + (1936 \times 10^6)}$$

i. Quantitatively prove that the maximum gain of the amplifier is approximately 18 dB and this occurs approximately at f = 1kHz. [10]

ii. Determine the lower and upper cutoff frequencies of the amplifier. [9]

iii. Determine the bandwidth of the amplifier. [3]

Question 3

a. Figure-Q3 shows an op-amp based circuit.

i. State the name of the given op-amp configuration. [2]

ii. Assume ideal op-amp operation, determine the values of resistors R_1 and R_2 so that the op-amp circuit has a gain of 20 and maximum op-amp output current of 0.5mA for output voltage of 8V. [8]

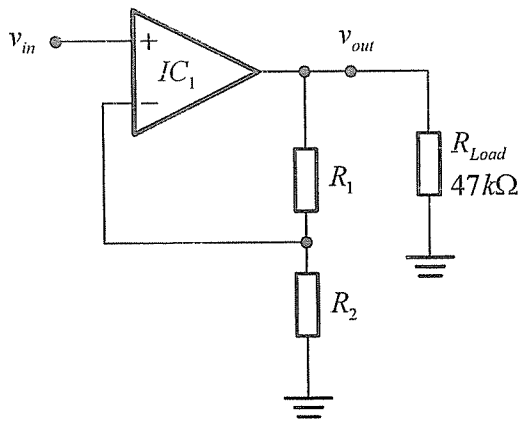

Figure-Q3

b. i. A practical op-amp, having input resistance $R_{in} = 68k\Omega$, output resistance $R_{out} = 560\Omega$ and a differential gain $A_d = 10^4$, is to be used for the circuit in Figure-Q3. Draw a circuit model that represents the circuit in Figure-Q3. [3]

ii. Using the same resistance values found in part (a)(ii) for R_1 and R_2, how does this op-amp affect the voltage gain value quantitatively as compared to the ideal op-amp operation? [12]

Question 4

a. Figure-Q4(a) shows a second order high pass filter circuit.

i. Derive the voltage transfer of the circuit and hence show that the Q-factor of the circuit is 0.7071. [8]

ii. Determine the cutoff frequency of the filter circuit in Hz. [2]

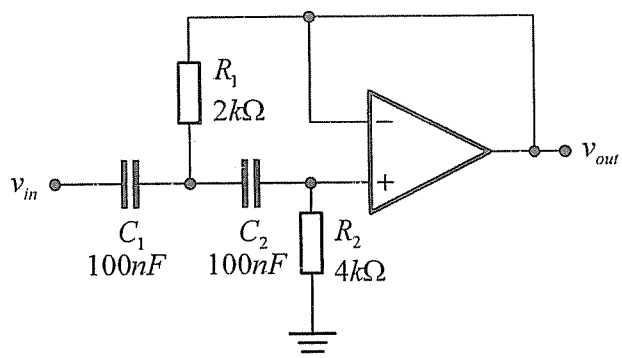

Figure-Q4(a)

b. i. With the aid of a clear schematic diagram, show how a non-inverting integrator circuit can convert the high pass filter in Figure-Q4(a) to a band pass filter with its central frequency defined by the high pass filter cutoff frequency. [9]

ii. Using the circuit implemented in part (b)(i), suggest two different methods to adjust the maximum gain of the band pass filter. [6]

Question 5

a. i. Assume ideal op-amp operation; prove that the oscillation frequency expression of the circuit shown in Figure-Q5 is given by $f_o = \frac{1}{2\pi\sqrt{C_1 C_2 R_1 R_2}}$. Hence, calculate the oscillation frequency for the given component values. [8]

ii. What is the limiting value of R for oscillation? [3]

iii. A thermistor is to be used to stabilize the amplitude of the oscillation. Which resistor should it replace? [2]

iv. What factor limits the upper limit of such an oscillator circuit? [2]

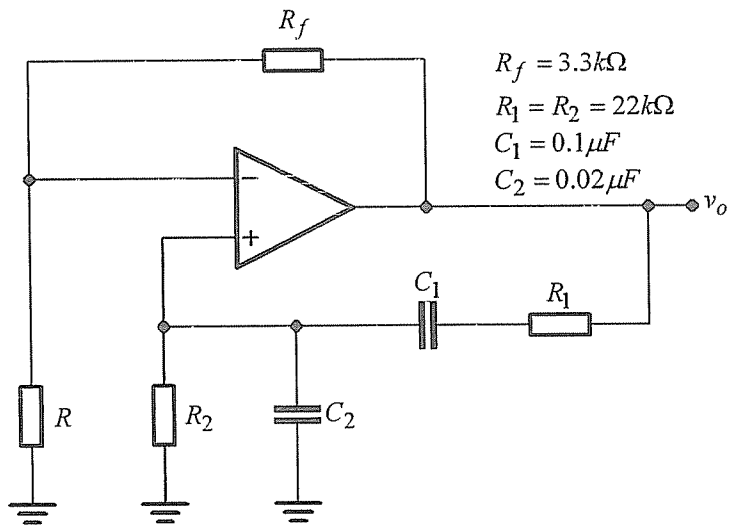

Figure-Q5

b. At a temperature $T°C$ above ambient, the resistance (in Ω) of a thermistor R_T is given by the equation $\log_{10} R_T = 4.3 - \frac{T}{70}$, and $T = 80P$ where P is the power dissipation in mW. Calculate the resulting value of v_o in Figure-Q5 if this thermistor is replacing the resistor mentioned in part (a)(iii). [10]

Question 6

a. Three terminal IC voltage regulators are popular option when one needs to regulate a specific DC voltage. State the two advantages of such IC as compare to other voltage regulation techniques. [4]

b. Figure-Q6(b) shows a voltage regulator circuit configured around a 78XX series.

i. What is the significant feature(s) of the circuit? [2]

ii. Explain the operation of the circuit. [4]

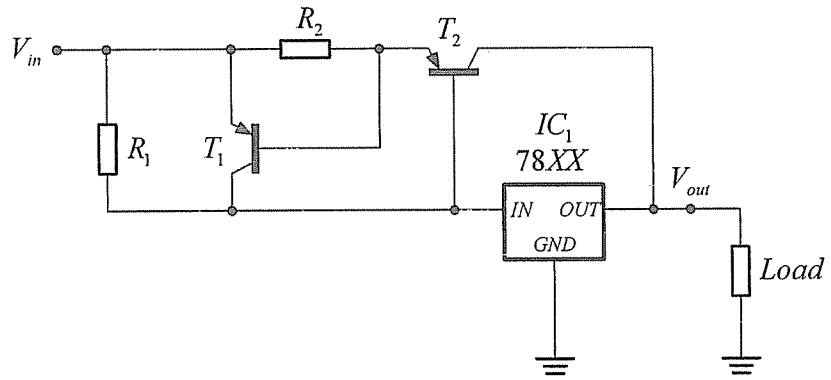

Figure-Q6(b)

c. The circuit in Figure-Q6(c) is to develop a regulated output voltage of 12V to load R_L at $I_L \leq 3$A. Transistor T_1 has I_{DSS} = 2mA and $V_{GS_{off}}$ = −1.5V. Zener diode D_1 has a rating of 6.7V at I_Z = 1mA. Complete the design by,

i. determining the value of, R_1, [6]

ii. determining the values of R_2 and R_3, [6]

iii computing the worst case power efficiency of the op-amp. Assume the output stage of the op-amp is class-AB power amplifier configuration. [3]

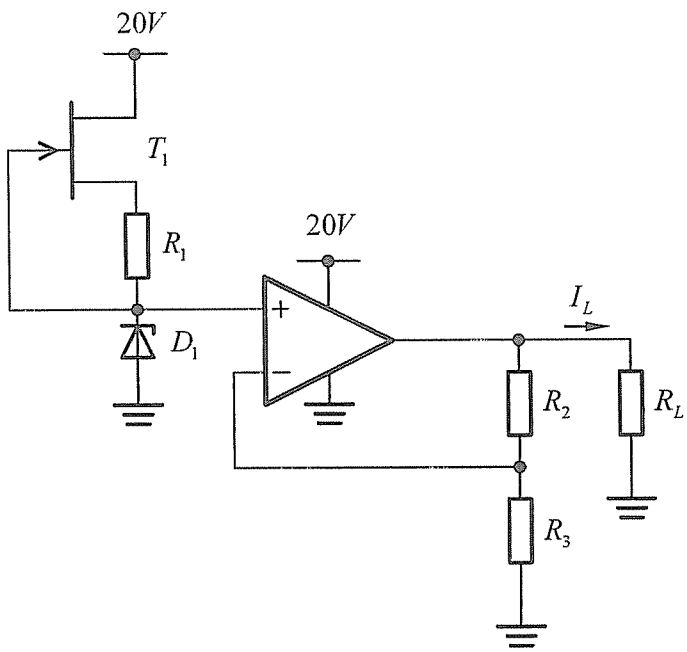

Figure-Q6(c)

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Appendix-A [For Question 1(c)]

Student Name: _____

Student ID No.: _____