MUEO

MOI UNIVERSITY

OFFICE OF THE CHIEF ACADEMIC OFFICER

UNIVERSITY EXAMINATIONS
2010/2011 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF
BACHELOR OF ENGINEERING
IN
ELECTRICAL & COMMUNICATIONS ENGINEERING

COURSE CODE: ECE 352

COURSE TITLE: ANALOGUE ELECTRONICS III

DATE: 18TH APRIL, 2011 **TIME:** 9.00 A.M. – 12.00 NOON

INSTRUCTION TO CANDIDATES

- ANSWER ANY FIVE QUESTIONS.
- ALL QUESTIONS CARRY EQUAL MARKS.

THIS PAPER CONSISTS OF (4) PRINTED PAGES

PLEASE TURN OVER

QUESTION ONE

a) With the aid of a well illustrated diagram show the basic steps of lithograph. What are the major functions of a photo resist? {5mks}.

b) What do you understand by a current mirror? {4mks}.

c) From the op-amp intermediate stage, derive the relationship which will put the output dc component to zero {5mks}.

QUESTION TWO

a) A sinusoidal waveform may be obtained from a rectangular waveform x(t) using the following expression:

$$\sin X = X - X^3/3! + X^5/5! - X^7/7! + \ldots.$$

Using the first two terms of the expression, give the arrangement to implement this in an electrical circuit {4mks}.

b) Figure Qstn.2 shows waveform generator:

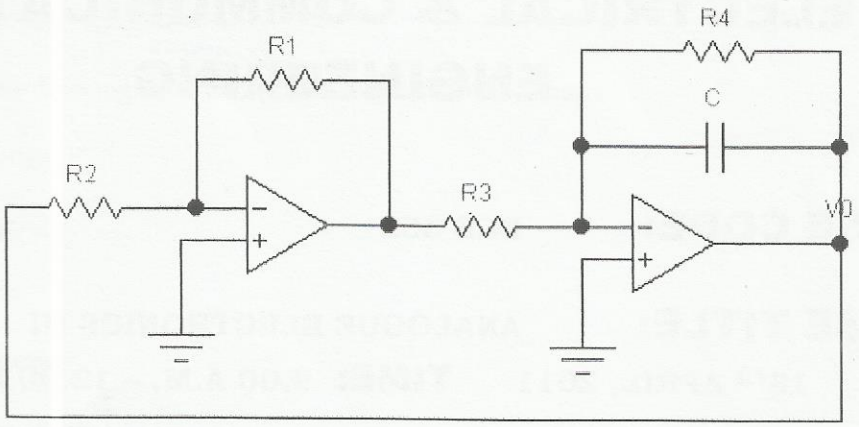

Figure Qstn.2

i. Explain how the circuit works {2mks}.

ii. Arrive at an expression for frequency of the waveform {8mks}.

QUESTION THREE

a) What is an ideal current source? List two types of current sources {5mks}.

b) Why is it that the internal ~~current~~ resistance of an ideal current source is equal to infinity? {2mks}.

c) The figure **Qstn.3** below shows a differential amplifier based on an ideal op-amp.

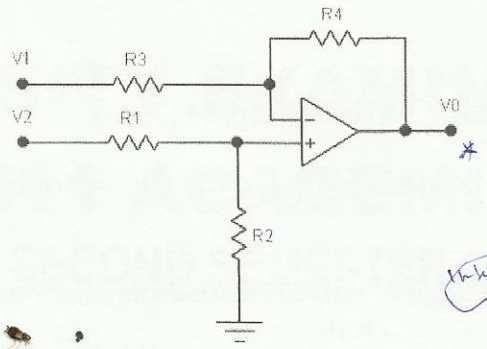

Fig. **Qstn.3**

i. Find the output voltage V_o

ii. Show that the output corresponding to common-mode voltage $V_{CM}=\{\frac{V1+V2}{2}\}$ is zero if $\frac{R4}{R3}=\frac{R2}{R1}$. Find V_o in this case.

iii. Find the CMRR of the amplifier if $\frac{R4}{R3}\neq\frac{R2}{R1}$ {7mks}.

QUESTION FOUR

a) Discuss the limitations of ICs {5mks}.

b) In the circuit of a Schmitt trigger, $R_2=100\Omega$, $R_1=50K\Omega$, $V_{ref}=0V$, $V_i=1V_{pp}$(peak-to-peak) sine wave and saturation voltage $=\pm 14V$. Determine the threshold voltages V_{UTP} and V_{LTP} {6mks}.

c) What is the function of a peak detector {3mks}?

QUESTION FIVE

a) What are the advantages of OTA over conventional Op Amps? {2mks}.

b)

i. Describe how an operational amplifier comparator may be used to generate a square waveform.

ii. Derive the expression for the period of a symmetrical waveform {12mks}.

QUESTION SIX

a) What are the advantages of Darlington pair? {2mks}.

b) With the aid of a circuit diagram, explain the principle of operation of a Schmitt trigger {8mks}.

c) Enumerate the advantages of instrumentation amplifier {4mks}.

QUESTION SEVEN

a) Draw a block diagram of a typical PLL and briefly explain the functions of each block {8mks}.

b) How can one obtain a flat gain frequency response and improved signal to noise ratio in audio signals? {1mk}.

c) Define the following terms as applied in phase locked loops

i. Capture range

ii. Hold range

iii. Pull in time

iv. Tracking range

v. Lock range {5mks}.

....the end.

Bonne chance

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MOI UNIVERSITY

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UNIVERSITY EXAMINATIONS

2011/2012 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF

BACHELOR OF ENGINERING

COURSE CODE: ECE 352

COURSE TITLE: ANALOGUE ELECTONICS III

DATE: 21ST MAY, 2012 **TIME:** 9.00 A.M. – 12.00 NOON

INSTRUCTION TO CANDIDATES

- ANSWERN ONLY FIVE QUESTION
- ALL QUESTIONS CARRY EQUAL MARKS.

THIS PAPER CONSISTS OF (5) PRINTED PAGES

PLEASE TURN OVER

QUESTION ONE

a) What do you understand by a *current mirror*? Explain using a simple sketch diagram {3mks}.

b) Sketch a sample and hold circuit diagram and explain how it works {7mks}.

c) With the aid of a well illustrated diagram show the basic steps of lithograph. What are the major functions of a photo resist? {4mks}.

QUESTION TWO

a) Draw a well annotated circuit diagram of a multivibrator (square wave generator) and explain how it works {5mks}

b) An amplifier draws 900mA from its 12V d.c. supply. If 8W of audio output power is delivered to loudspeaker, calculate

i. D.C. power {1mk}.

ii. Collector power dissipation {1mk}.

iii. Efficiency of the amplifier {1mk}.

c) Figure Qstn 2 shows waveform generator. Arrive at an expression for frequency of the waveform generated {6mks}.

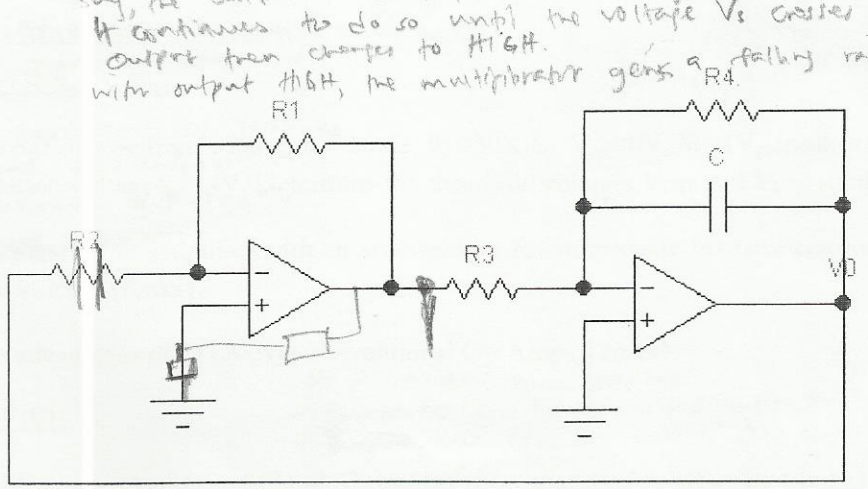
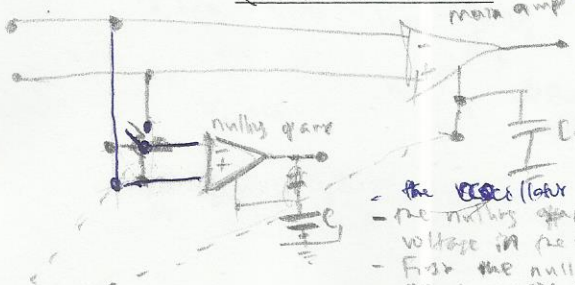


Figure Qstn.2

QUESTION THREE



a) State four characteristics which make Op Amps useful {4mks}

b) The figure **Qstn.3 (b)** shows a source connected to a load with a voltage follower. It is given that R_S= 10KΩ and R_L=100Ω

i. Calculate V_0 {2mks}.

ii. Calculate V_0 if the voltage follower is removed and the source connected to the load {2mks}.

c) The figure **Qstn.3(c)** below shows a differential amplifier based on an ideal op-amp.

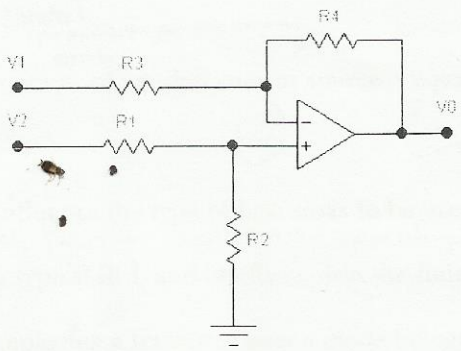


Fig. **Qstn.3(c)**

i. Find the output voltage V_0

ii. Show that the output corresponding to common-mode voltage $V_{CM}=\{\frac{V1+V2}{2}\}$ is zero if $\frac{R4}{R3}=\frac{R2}{R1}$. Find V_o in this case.

iii. Find the CMRR of the amplifier if $\frac{R4}{R3}\neq\frac{R2}{R1}$ {6mks}.

QUESTION FOUR

a) In the circuit of a Schmitt trigger, R_2=100Ω, R_1=50K Ω, V_{ref}=0V, V_i=1V_{pp}(peak-to-peak) sine wave and saturation voltage=±14V. Determine the threshold voltages V_{UTP} and V_{LTP} {6mks}.

b) Design a logarithmic amplifier with an arrangement to compensate for temperature effects. Deduce its output voltage {6mks}.

c) State two advantages of OTA over conventional Op Amps {2mks}.

QUESTION FIVE

a) For the difference amplifier of Figure **Qstn.5(a)** show that $R_1//R_2=R_3//R_4$ {4mks}.

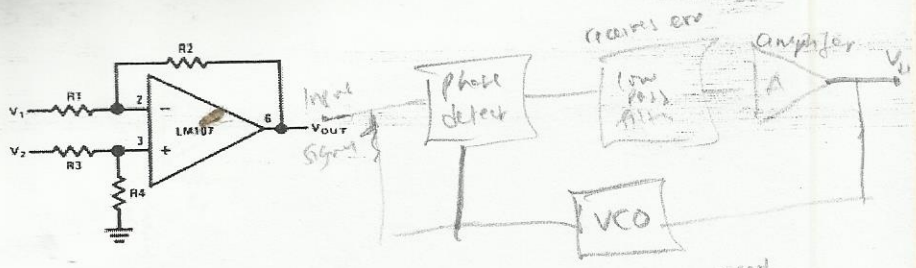


Figure **Qstn.5(a)**

b) State *three* factors that affect overall efficiency of a power amplifier {3mks}.

c) List *five* limitations of ICs {5mks}.

d) Why is it that the internal current of an ideal current source is equal to infinity? {2mks}.

QUESTION SIX

a) State *three* properties that influence the type of heat sinks to be used in any application {3mks}.

a) Draw a block diagram of a typical PLL and briefly explain the functions of each block {8mks}.

d) State *three* advantages of employing a transistor over a diode in logarithmic amplifiers {3mks}.

QUESTION SEVEN

a) From the op-amp intermediate stage, derive the relationship which will put the output dc component to zero {5mks}.

b) Define the following terms as applied in phase locked loops

i. Capture range

ii. Hold range

iii. Pull in time

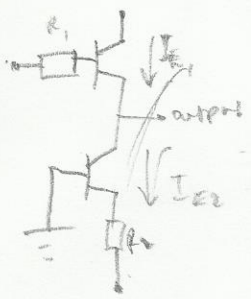
iv. Tracking range

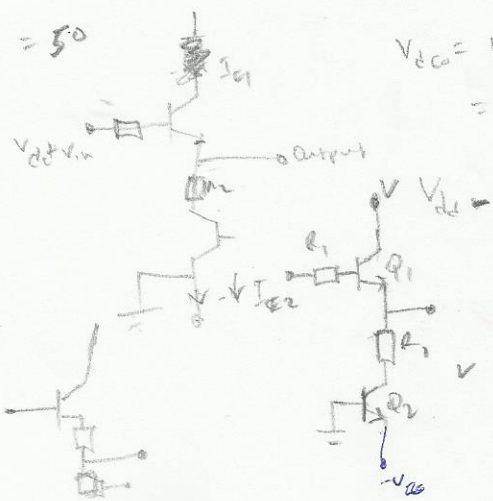
v. Lock range {5mks}.

1) The circuit diagram of Figure **Qstn.7(c)** has an open loop gain of 10,000. R_F=98kΩ, R_1=2kΩ.

i. Determine the closed loop gain {2mks}.

ii. If the input voltage is 1mV compute the output voltage and the error voltage {2mks}.





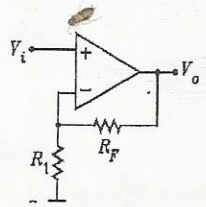


Figure **Qstn.7 (c)**

....the end.

Bonne chance

1, 1, 6, 4, 2

(5)(5)

ECE 352: ANALOGUE ELECTRONICS III. CAT 1.

Instructions to candidates:

- *Attempt all questions.*
- *Marks will be awarded to clear, legible work. Slovenly work will be penalized.*

1. Describe the most important process in the fabrication of integrated circuits

2. The differential amplifier shown in **Qstn.2** is desired to have the following specifications:
   Voltage gain, $\frac{V_{out}}{V_{in}} = 150$
   Maximum output voltage swing =12V peak-to-peak.
   Input resistance seen by the signal source = 10K ohm.
   Given that hFE=130 for all the transistors find:
   i. Resistor RC
   ii. Power supplies ±V
   iii. Bias resisitor RB

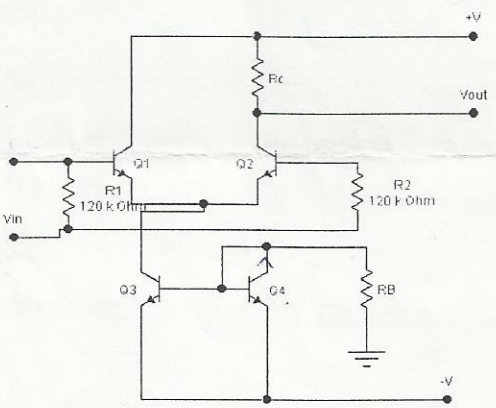


Fig. **Qstn.2**

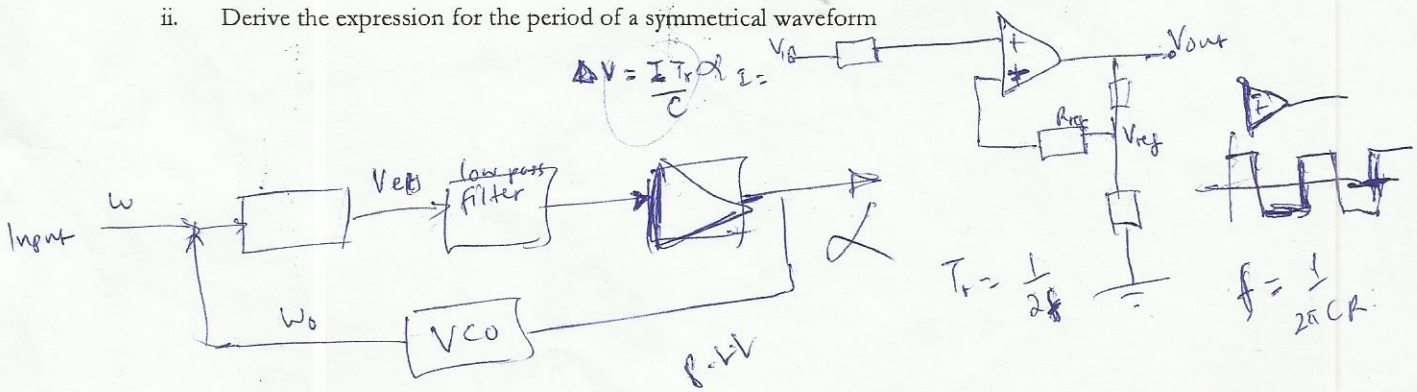
3. Explain briefly how the dc offset error voltages and currents that occur in real operational amplifiers are caused by mismatch of the input transistor

4. With the aid of a circuit diagram, explain how low frequency response of an Op-Amp may be obtained.

5.

i. Describe how an Op-Amp comparator may be used to generate a square waveform

ii. Derive the expression for the period of a symmetrical waveform



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UNIVERSITY EXAMINATIONS
2009/2010 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF

BACHELOR OF TECHNOLOGY

COURSE CODE: ECE 352

COURSE TITLE: ANALOGUE ELECTRONICS III

DATE: 15TH APRIL 2010 **TIME:** 2.00 PM – 5.00 PM.

INSTRUCTION TO CANDIDATES

- SEE INSIDE

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Question one

a) List the four advantages of ICs (4mks)

b) With a well illustrated schematic diagram classify the ICs.(3mks)

c)
i) List the steps involved in preparation of si-wafer (5mks)
ii) Give the importance of SiO2 in plannar process. (2mks)

Question two

a) Give two important advantages of ion implantation technique (4mks)

b) List package configurations that you know (3mks)

c)
i) How do you reduce the collector series resistance of the IC transistor? (2mks)
ii) With a well illustrated diagram show the basic steps of lithograph. What are the major functions of a photoresist? (5mks)

Question three

a) PR is a photosensitive organic material which contains three ingredients, name them.(3mks)

b) With aid of a diagram differentiate between positive and negative resist. (4mks)

c)
i) What is a mask? (1mks)
ii) Briefly explain the parameters that determine the performance of exposure tool. (6mks)

Question four

b) What is an ideal current source? List two types of current sources. (5mks)

d) Why is it that the internal current of an ideal current source is equal to infinity? (2mks)

e) The differential amplifier shown in figure 4.c is desired to have the following specifications:

Volfage gain, V_{out}/V_{in}= 100
Maximum output voltage swing = 10V peak-to-peak.
Input resistance seen by signal source = 5K ohm.
Given that h_{FE} = 125 for all the transistors, find:

i) Resistor Rc (2mks)
ii) Power supplies ± V (2.5mks)
iii) Bias resistor R_B. (2.5mks)

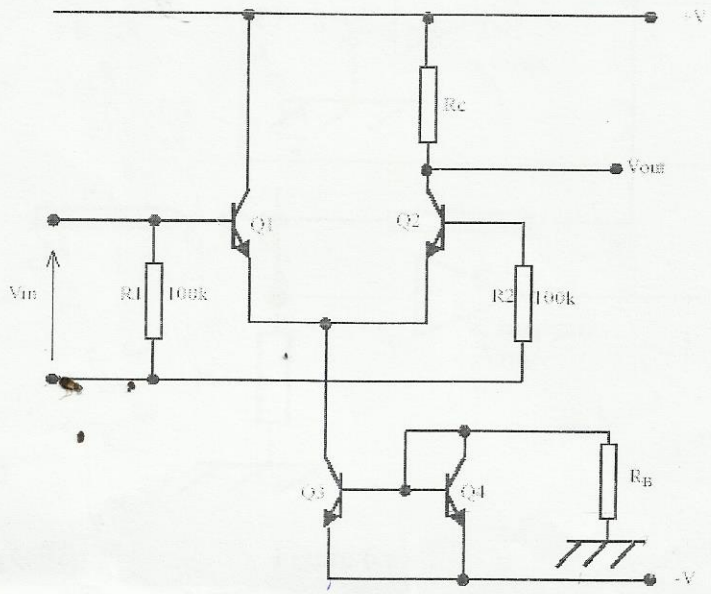

Figure 4.c

Question five

a) With aid of a diagram show that for a Widlar current source $I_{c1} \approx I_{ref}$ (10mks)

b) Design a Widlar current source for generating a constant current $I_o = 10\mu A$. Assume $V_{cc} = 10V$, $V_{BE} = 0.7V$, $\beta = 125$. Use $V_T = 25mV$(4mks)

Question six

a) For the diagram shown in figure 6.a, show that

$$A1 = \frac{R2}{R3A2}$$

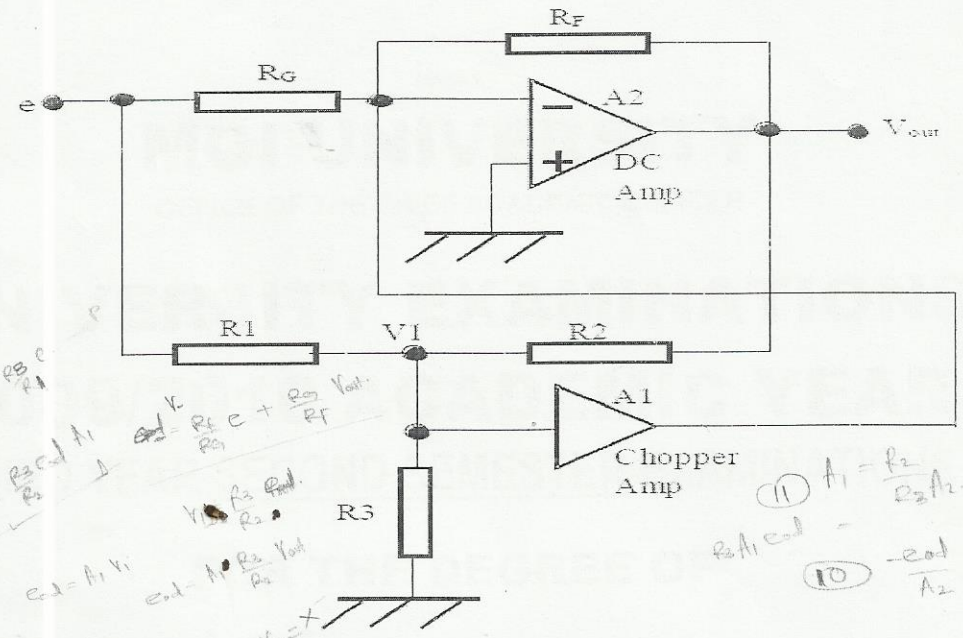

Figure 6.a.

(6mks)

b) Give the disadvantages of chopper based amplifiers. (2mks)

c) Show that for a PLL in lock;

$$Vd(t) = \frac{KdViVoA}{2}\cos\phi \ .$$

(6mks)

Question seven

a) What are the advantages of the OTA? (4mks)

b) With aid of a diagram show how PLL is applied in frequency translation. (6mks)

c) In the regenerative comparator circuit, assume that $R_2 = 100\Omega$, $R_1 = 50k\Omega$, $V_{ref} = 0V$, $V_i = 1Vpp$ sine wave and saturation voltage = $\pm 14V$. Determine threshold voltages V_{UT} and V_{LT}. (4mks)