



COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY (CEST)

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

CERTIFICATE IV IN ELECTRONICS ENGINEERING-STAGE 4

EEE418- ANALOG ELECTRONICS 1B

FINAL EXAMINATION – PENSTER 4, 2012

DAY/DATE: TIME: ROOM: as per timetable.

INSTRUCTIONS TO STUDENTS

1. You are allowed 10 minutes Extra reading time during which you are NOT to write.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Write your candidate-number at the top of each attached sheet
4. Insert all written foolscaps, graph paper, drawing paper, etc. in their correct sequence and secure with string
5. For all sheets of paper on which rough/draft work has been done, cross it though and you MUST ATTACH to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. ANSWER ALL QUESTIONS.
8. Show all workings where necessary.
9. Do not use programmable calculators, especially the ones that does the conversions of number systems.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE ROOM!**

Section A**Multiple Choice****[10 Marks]**

Circle correct letter (A, B, C or D) against each of numbers 1 through 10.
Remove and attach to your Answer Booklet.

1. The 4-layer (Shockley) diode can conduct current if

- A) the anode-to-cathode voltage exceeds V_{BR}
- B) a current pulse is applied to the gate
- C) both a and b are correct
- D) none of the above

2. The SCR can conduct current if

- A) the anode-to-cathode voltage exceeds V_{BR}
- B) a current pulse is applied to the gate
- C) both a and b are correct
- D) none of the above

3. A bidirectional thyristor is the

- A) 4-layer diode
- B) SCR
- C) Triac
- D) Silicon-controlled switch

4. An SCR turns off when the

- A) gate trigger current drops below a specified level
- B) anode current drops below the holding current
- C) both a and b are true
- D) none of the above

5. The purpose of a crowbar circuit is to protect a load from

- A) excessive ripple
- B) low-voltage
- C) over-voltage
- D) all of the above

6. A Diac and Triac are similar in that both devices

- A) can use breakover triggering
- B) can be used in ac circuits
- C) are bidirectional
- D) all of the above

7. A device that has an unstable negative resistance region is the

- A) UJT
- B) Diac
- C) Triac
- D) SCS

8. The ratio between differential gain and common-mode gain is called:

- A) amplitude
- B) differential-mode rejection
- C) common-mode rejection
- D) phase

9. The major difference between ground and virtual ground is that virtual ground is only a:

- A) voltage reference
- B) current reference
- C) power reference
- D) difference reference

10. In an averaging amplifier, the input resistances are

- A) equal to the feedback resistance
- B) less than the feedback resistance
- C) greater than the feedback resistance
- D) unequal

SECTION B

[10 MARKS]

Part One

TRUE OR FALSE

(5marks)

Write true or false for the following questions

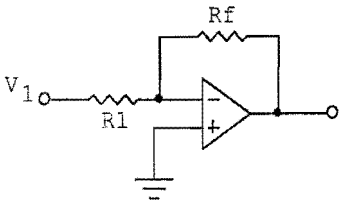
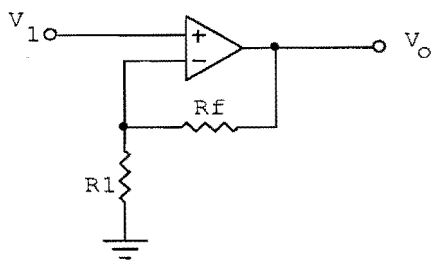
1. Never connect an LED directly to a battery or power supply.
2. A Photojunction light sensor does not produce electricity but simply changes its physical properties when subjected to light energy .
3. The most popular type of tri-colour LED has a white and a blue LED combined in one package with three leads.
4. A voltage-follower op-amp has the output connected directly to the inverting input.
5. Thyristors are devices constructed of four semiconductor layers (*pnpn*).

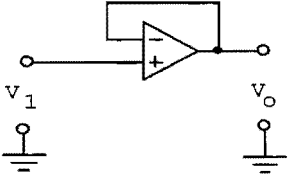
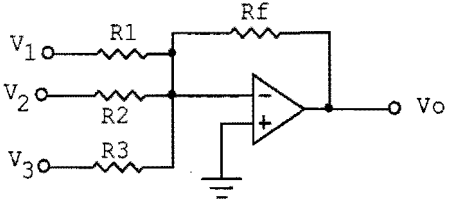
Part Two

Fill in the blanks

1. a). Fill in the blank spaces.

(5marks)

| | Circuit | Name | V_{out} / Voltage Gain , A_v |
|-----|---|-----------|----------------------------------|
| i. |  | Inverting | |
| ii. |  | | |

| | | | |
|-------------|---|--------------------------|-----------------------------|
| <p>iii.</p> |  | | $A_v = \frac{V_o}{V_i} = 1$ |
| <p>iv.</p> |  | <p>Summing Amplifier</p> | |

Section C

Long Answer Questions

[80 Marks]

Question 1

Operational Amplifiers

[20 Marks]

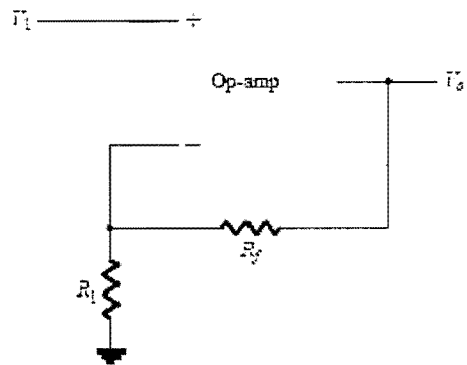
1. List Three (3) characteristics of an ideal Op-amp.

[3 marks]

2. Determine the input voltage for the op-amp given below that would produce an output voltage of 12 V having the following resistor values:

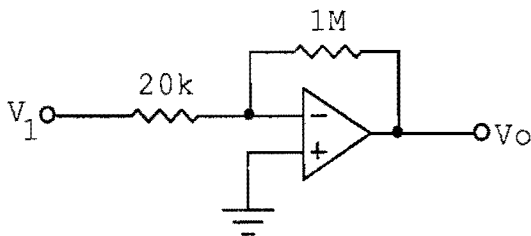
$R_f = 150 \text{ k}$, and $R_1 = 12 \text{ k}$.

[2 marks]

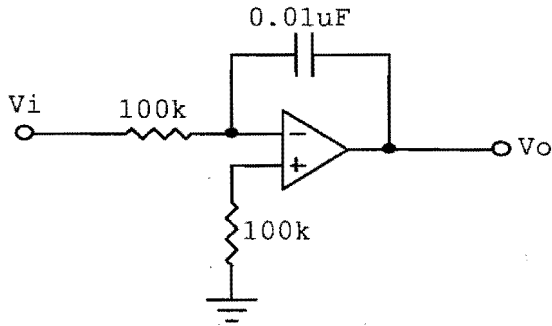


3. What input voltage results in an output of -1V in the circuit shown below?

(2marks)



4. A circuit is shown below



Find the peak value of the output of the ideal circuit, if the output is $V_i = 5 \sin(100t)$ V

(3 marks)

5. a). Define *Common Mode Rejection*

(1 mark)

b). Calculate the CMRR (in dB) using the circuit measurements shown in figure 1 & 2 below.

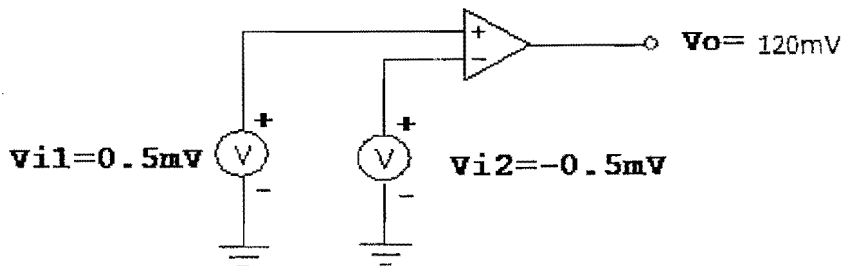


Figure 1

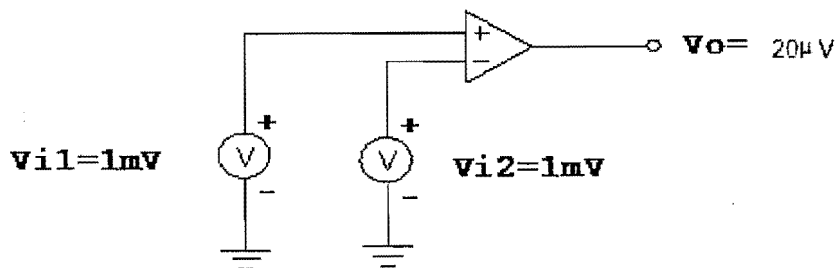
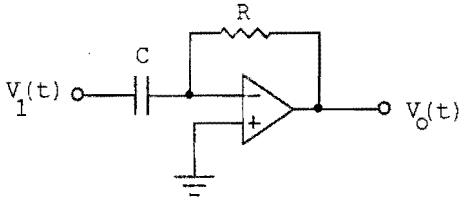
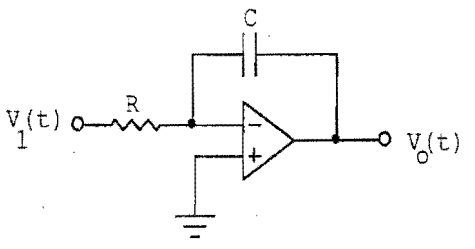


Figure 2

(4 marks)

6. a). Define slew rate? (1 mark)
- b). The output of a particular op-amp increases goes form -6.9V to 8.1 Vin 0.1 μ s. What is the slew?
rate in volts/ μ s? (2 marks)

7. Fill in the blank spaces. (2 marks)

| | Circuit | Name | Output Voltage, V_o |
|-----|--|----------------|-----------------------|
| i. |  | Differentiator | |
| ii. |  | Integrator | |

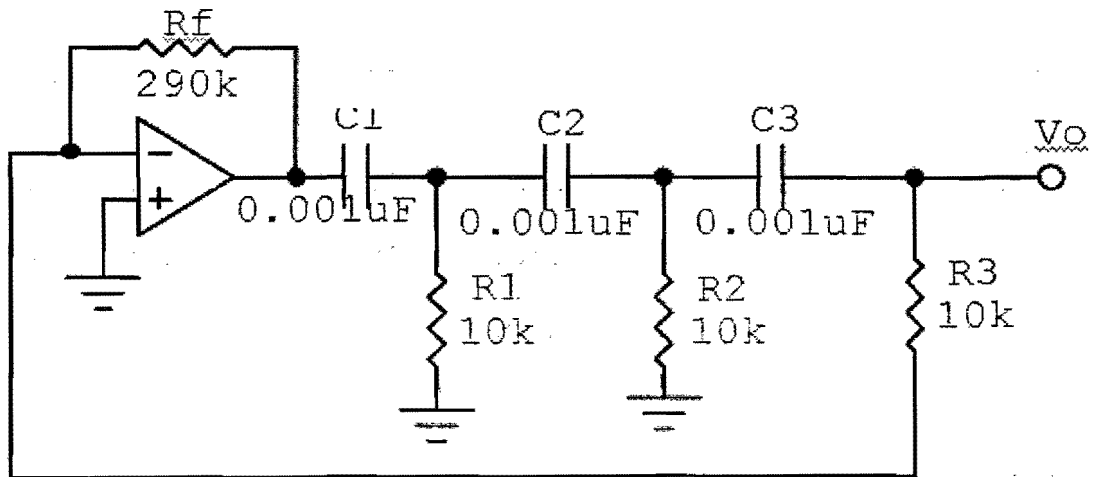
Question 2

Oscillators and waveform generators.

[20Marks]

1. What is an oscillator and draw the basic block diagram of an oscillator. [3marks]

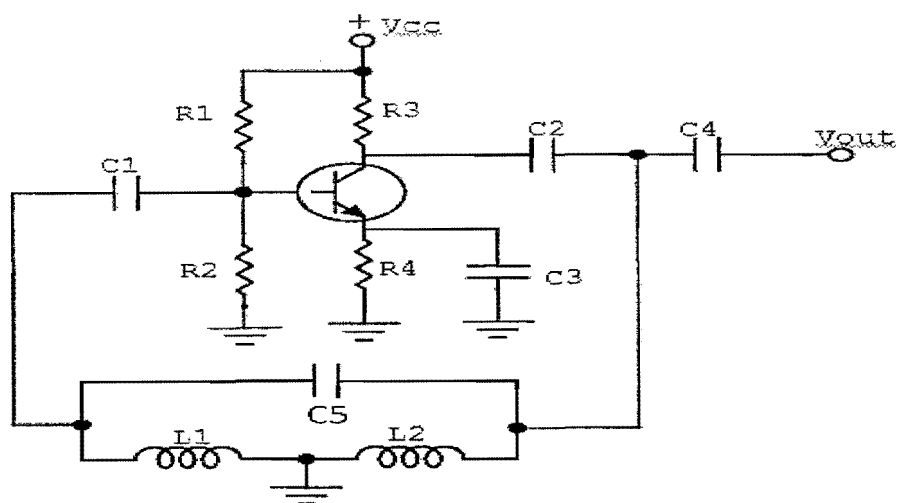
2. An RC phase shift oscillator is shown below:



Determine the following quantities:

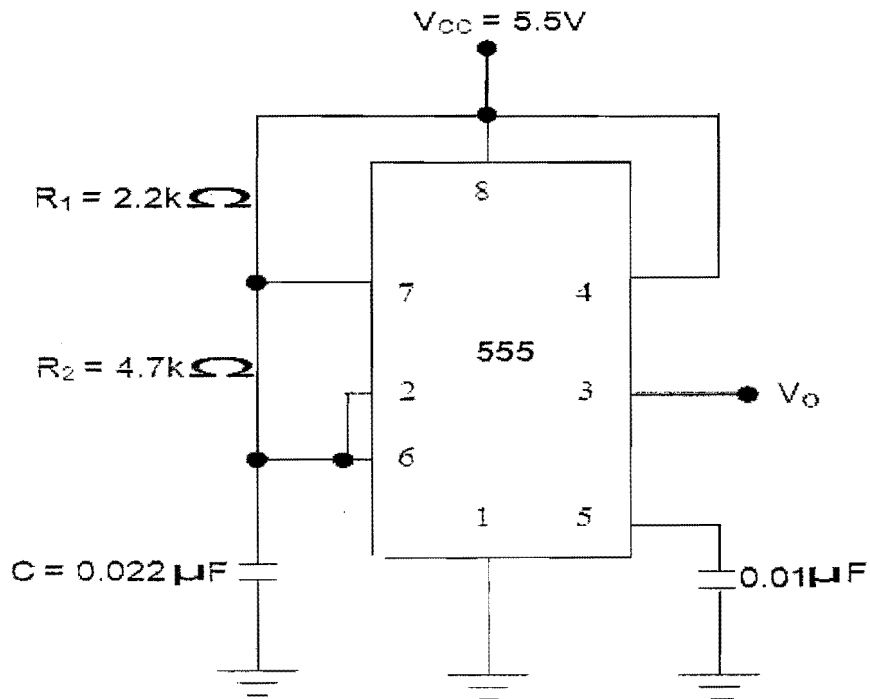
- i). Frequency of oscillation (2 marks)
- ii). Voltage Gain, A_v (1 marks)
- iii). Feedback factor, β (2 marks)

3. An LC oscillator is shown below:



- i). Identify the oscillator type. (1 mark)
- ii). State the expression for the frequency of oscillation. (1 mark)

4. A 555 timer configured to run in *Astable* mode is shown below:



Determine the following:

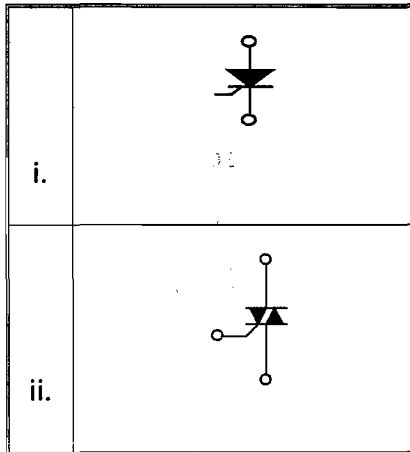
- i). T_{Low} (2 marks)
- ii). T_{HIGH} (2 marks)
- iii). T (2 marks)
- iv). $f_{osc.}$ (2 marks)
- v). Duty cycle (2 marks)

Question 3

Thyristors / Tuned amplifiers

[20Marks]

1. Identify the following devices:



(2 marks)

2. a). Give **two** application of SCR

(2 marks)

b). State the **two** methods of switching off an SCR.

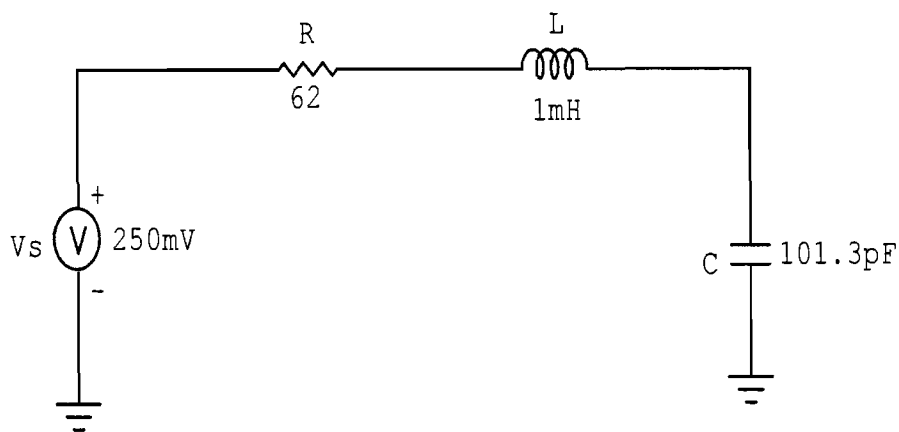
(2 marks)

3. Sketch the Current, I versus Voltage, V characteristic curve for the SCR at $I_G=0$, clearly indicate all relevant parameters and regions. (4 marks)

4. a). Sketch the typical Gain Vs Frequency characteristic for a tuned amplifier and clearly label all relevant parameters. (3 marks)

b). Give an application of tuned amplifier. (1 mark)

5. A tuned amplifier circuit is shown below:



Calculate the frequency of resonance, f_0

(4 mark)

6. Tuned op-amp circuits are generally referred to as **active filters**. What are the four basic types of active filters:

(2 marks)

Question 4

Opto-electronics

[20Marks]

1. The two main divisions of optoelectronic hardware are *light-emitting* or *light-activated*. Describe the two divisions. (2 marks)
2. a) Draw the symbols of:
- i. Phototransistor
 - ii. Photodarlington
 - iii. LED
 - iv. Photodiode
- (4 marks)
- b). When a photodiode is not exposed to a light source, there is a very small leakage current. What is this current called? (1 mark)
- c). A particular photodiode is reverse-biased with a 12V dc. If a current of $600\mu\text{A}$ is measured, what is the resistance of the device? (3 marks)
3. Design an LED voltage indicator of 12V supply. (4 marks)
4. Define the term *dark current*. (1 mark)

5. The optical coupler shown below is required to deliver at least 10mA to the external Load of 1000Ω . If the current transfer ratio is 60 percent, how much current must be supplied to the input and supply voltage of 20V?

(5 marks)

THE END