



FIJI NATIONAL UNIVERSITY

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, 2016

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 through 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.
10. **ALWAYS CHECK YOUR WORK BEFORE YOU LEAVE THE ROOM!**

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Section A

Multiple Choice

[20 Marks]

Circle correct letter (A, B, C or D) against each of numbers 1 through 20.
Remove and attach to your Answer Booklet.

1. The Circuit shown in **Figure 1** below is

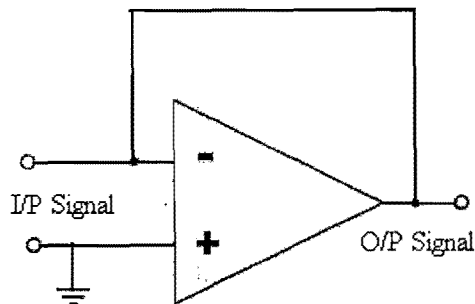


Figure 1

- A) A Comparator
 - B) A Differentiator
 - C) An Intergrator
 - D) A Voltage Follower
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. The output of a particular Op-amp increases 9V in $15\mu s$. The slew rate is
- A) $96V/\mu s$
 - B) $0.6V/\mu s$
 - C) $1.5V/\mu s$
 - D) None of the above
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

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11. In High pass filter,

- A) Passes all frequencies from 0Hz to f_{c2}
- B) Passes all frequencies above f_{c1}
- C) Passes all frequencies between f_{c1} and f_{c2}
- D) Block all frequencies between f_{c1} and f_{c2}

12. In a Notch filter,

- A) Passes all frequencies from 0Hz to f_{c2}
- B) Passes all frequencies above f_{c1}
- C) Passes all frequencies between f_{c1} and f_{c2}
- D) Block all frequencies between f_{c1} and f_{c2}

13. Two pole filter refers to

- A) One RC circuit
- B) Two RC circuit
- C) One LC circuit
- D) Two LC circuit

14. The most commonly used type of active filter circuit is

- A) Chebyshev filter
- B) Bessel filter filter
- C) Butterworth filter
- D) Notch filter

15. The Total Gain Roll – off of second order filter type is

- A) 20dB/decade
- B) 10dB/decade
- C) 30dB/decade
- D) 40dB/decade

16. The most stable type of oscillator is the

- A) Colpitts oscillator
- B) Hartley oscillator
- C) Crystal oscillator
- D) Wein bridge oscillator

17. The Phase Locked Loop (PLL) is a system that combines

- A) Long stability of the crystal oscillator with the variable frequency output of VCO.
- B) The Hartley oscillator with the variable frequency output of VCO.
- C) The Wein bridge oscillator with the variable frequency output of VCO.
- D) The Hartley oscillator with the variable frequency output of VCO.

18. Another name given to Astable multivibrator is

- A) One shot
- B) Free running
- C) Monostable
- D) Bistable

19. A voltage follower op – amp has its output connected directly to

- A) ground
- B) Supply voltage
- C) Inverting input
- D) Non – inverting input

20. Thyristors are devices constructed of

- A) 2 layers of PN semiconductor
- B) 3 layers of PNP semiconductor
- C) 3 layers of NPN semiconductor
- D) 4 layers of PNPN semiconductor

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Section B

Long Answer Questions

[80 Marks]

Question 1

Operational Amplifiers

[20 Marks]

- List Three (3) characteristics of a practical Op-amp. [3 marks]
- a) Calculate the output offset voltage of the circuit in Fig. 1 below. The op-amp spec lists $V_{IO} = 1.2 \text{ mV}$. (3 marks)
b) Calculate the offset voltage for op-amp specification listing $I_{IO} = 100 \text{ nA}$. (2 marks)

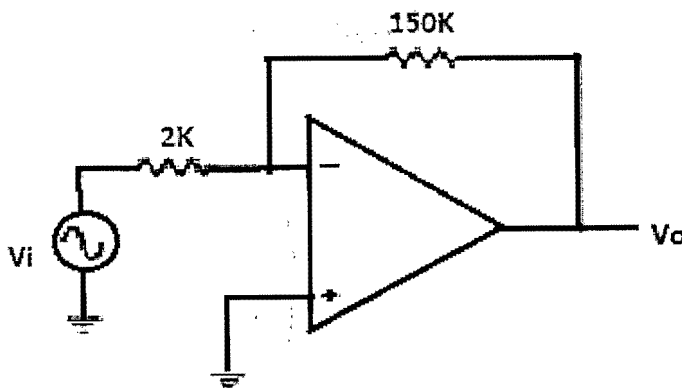
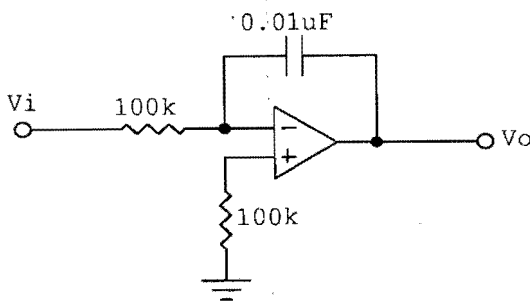


Fig - 1

4. A circuit is shown below



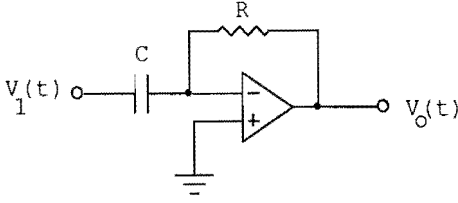
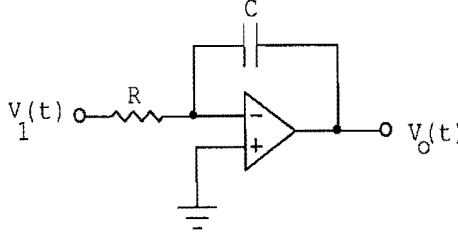
Find the peak value of the output of the ideal circuit, if the output is $V_i = 5 \sin(100t) \text{ V}$
(5 marks)

5. Define the following:

a) *Common Mode Rejection Ratio*

(1.5 marks)

- b) *Slew Rate* (1.5 marks)
6. The output of a particular op-amp increases from 5.6V to 9.2 V_{in} at 0.1μs. What is the slew rate in volts/μs? (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.

[20 Marks]

1. What is an oscillator. **[2 marks]**

2. a) Calculate the resonant frequency of the Wien bridge oscillator of Fig – 2 below **[2 marks]**

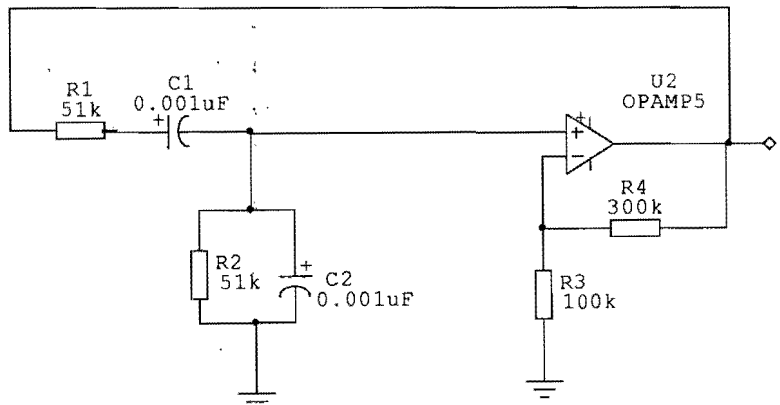
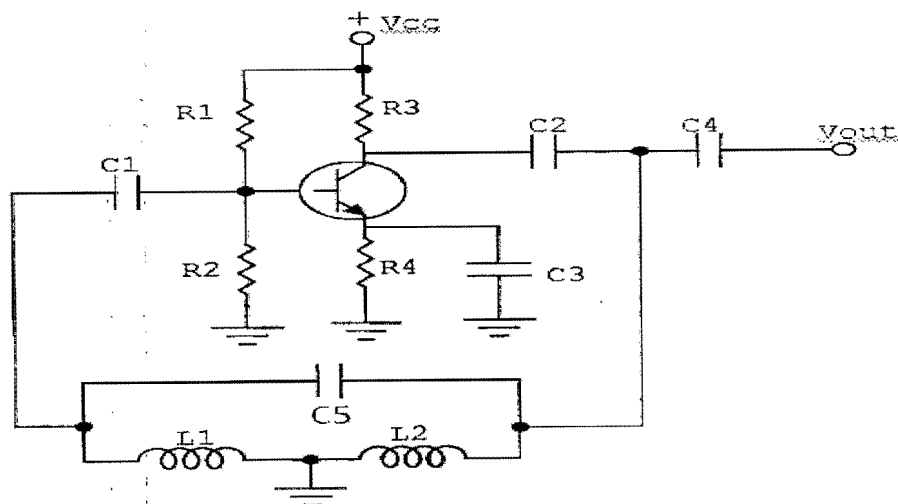


Fig – 2

b) Construct the *RC* elements of a Wien bridge oscillator as in Fig – 2 above for operation at $f_o = 10$ kHz. **[2 marks]**

3. An LC oscillator is shown below:

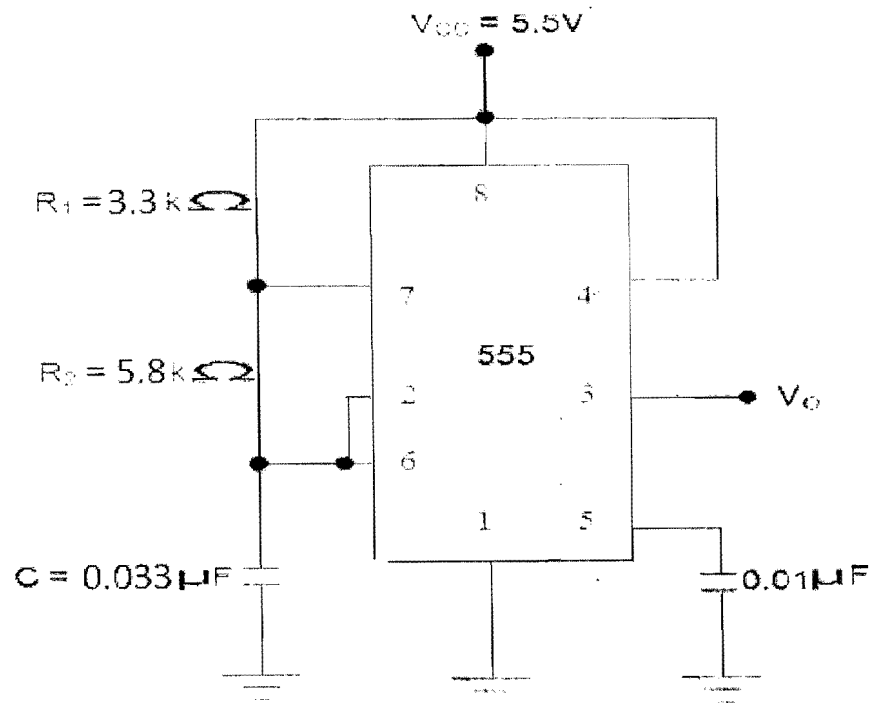


i). Identify the oscillator type. **(1 mark)**

ii). State the expression for the frequency of oscillation. **(1 mark)**

- iii) Calculate the oscillation frequency if $C_5 = 250\text{pF}$, $L_1 = 1.5\text{mH}$, $L_2 = 1.5\text{mH}$ and $M = 0.5\text{mH}$. (2 marks)

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)

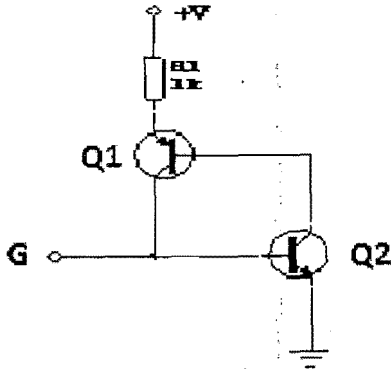
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Question 3

Thyristors / Tuned amplifiers

[20 Marks]

1. a). Give **two** application of SCR (2 marks)
- b). State the **two methods** of switching off an SCR. (2 marks)
2. Explain how the SCR equivalent circuit operates using 2 transistors



(3 marks)

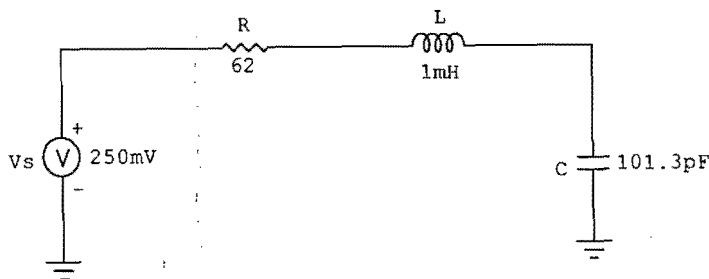
3. List one application of the following devices:

- a) Shockley Diode
- b) Triac.
- c) Unijunction Transistor (UJT)

(3 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

(2 marks)

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

(4 marks)

Question 4

Opto-electronics

[20 Marks]

1. The two main divisions of optoelectronic hardware are *light-emitting* or *light-activated*. Describe the two divisions. (3 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 μ A is measured, what is the resistance of the device? (3 marks)
3. Design an LED voltage indicator of 12V supply. (4 marks)
4. The opto coupler is required to deliver at least 15mA to the external Load of 1500 Ω . The current transfer ratio is 60 percent,
- a. Draw the circuit of an opto coupler connected with a load. (2.5 marks)
 - b. How much current must be supplied to the input and supply voltage of 25V? (2.5 marks)

THE END

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Candidate No:

Section A **Multiple-Choice Matrix** **[20 marks]**

Circle the correct letter (A, B, C or D) against each of numbers 1 through 20.

Remove and attach to your Answer Booklet.

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D