BITS, PILANI-DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY

FIRST SEMESTER 2008-2009 TEST 1 (CLOSED BOOK)

COURSE NO.: EEE C364 DATE: 21-09-2008 MAXIMUM MARKS: 40 (20% wt.)

COURSE NAME: ANALOG ELECTRONICS DURATION: 50 MINUTES

- **Answer All the Questions**

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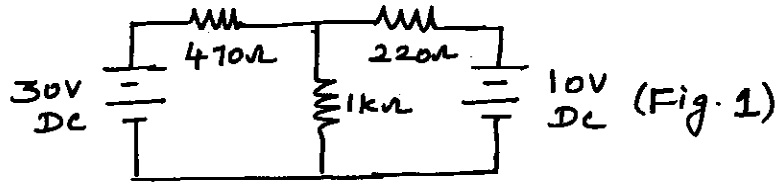
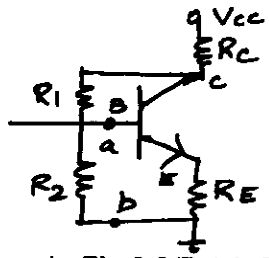
1 Consider the circuit in **Fig.1**. Find the current through the 1kΩ resistor using superposition theorem.



(Fig. 1)

[10 marks]

2(a) A common emitter configuration of a BJT (Bipolar Junction Transistor)with potential divider biasing is given in **Fig.2.** Draw the Thevenin equivalent of the base circuit and obtain an expressions for Thevenin voltage and Thevenin resistance.



(Fig. 2)

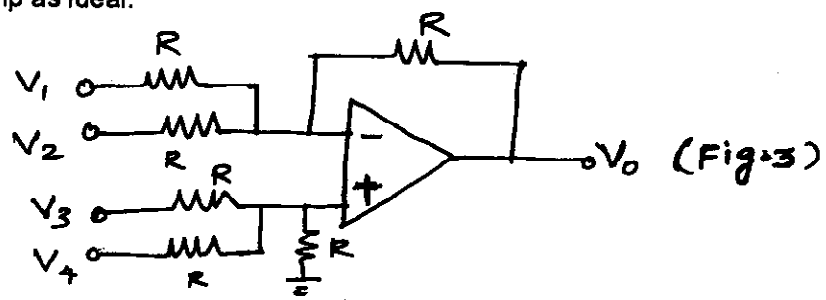
[5 marks]

2(b) For the circuit shown in **Fig.2,**ß(Beta)=70,V_{CC}=10V,Rc=2 kΩ,V_E=1.5V. Fix Q point at the centre of load line V_{CEQ}=5V. Find I_{CQ} and R_E. **[5 marks]**

3(a) List out the characteristics of an ideal operational amplifier. **[5 marks]**

3(b) Draw the transfer characteristics of operational amplifier and explain briefly three regions of operations. **[5 marks]**

4(a) Find the expression for V_o for the circuit shown in **Fig.3**.consider the op amp as ideal.



(Fig. 3)

[5 marks]

4(b) Draw an inverting operational amplifier to form the weighted sum V_o of two inputs V_1 and V_2. It is required that $V_o = -(V_1+5V_2)$.Choose values for R_1,R_2 and R_f(feedback resistor)so that for a maximum output voltage of 10V,the current in the feedback resistor will not exceed 1mA. Design the values for R_1,R_2 and R_f. **[5 marks]**

---END---

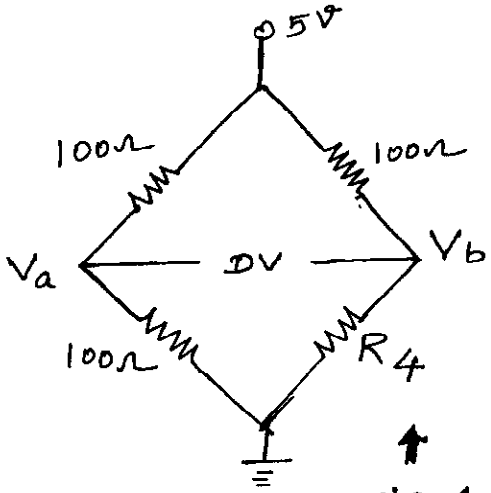
BITS, PILANI-DUBAI
INTERNATIONAL ACADEMIC CITY, DUBAI

TEST-2(OPEN BOOK) WEIGHTAGE:**15%** MAX. MARKS:**30**
COURSE NO: EEE C364 COURSE TITLE: ANALOG ELECTRONICS
DURATION: 50 MINUTES DATE: 02.11.08 INSTRUCTOR: Dr.V.KALAICHELVI

Text books (TB1 and TB2) and hand written class notes are allowed
Photo copy of materials are **not allowed** in the Examination Hall
Semi log sheet is provided along with the question paper.

Answer all questions

1. Fig.1 shows a bridge circuit for which R_4 varies with **100Ω to 102Ω.** Show that how an instrumentation amplifier like that in Fig.2 could be used to provide an output of **2.5V**. Assume that $R_2=R_3=1k\Omega$ and that $R_1=100k\Omega$.Draw the circuit diagram that contains bridge circuit and an instrumentation amplifier and find the value of R_G.



DV - Differential Voltage

Fig. 1

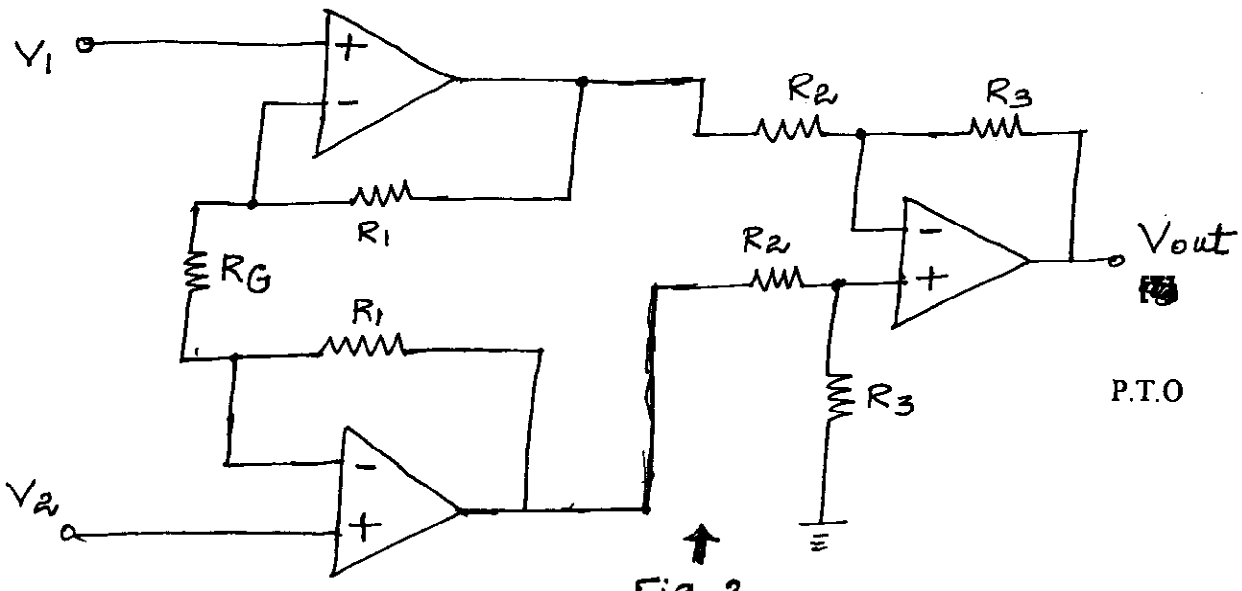
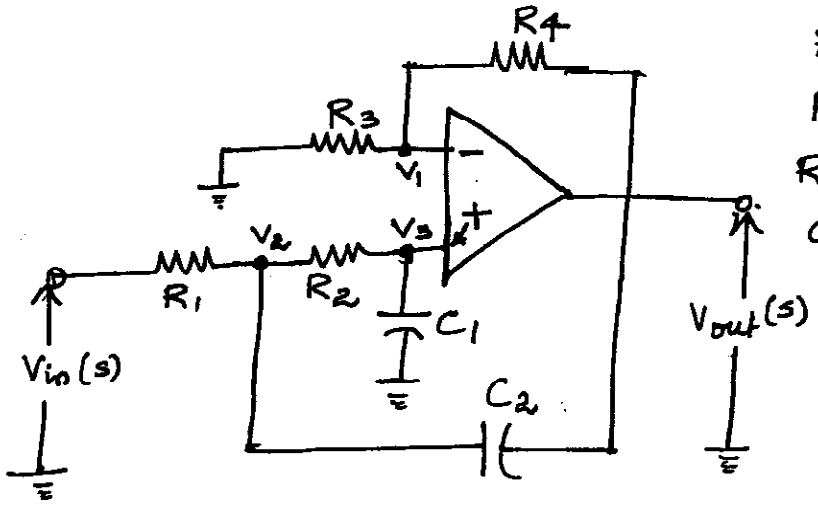


Fig.2

P.T.O

[7]

2. Derive the transfer function for the network of Fig.3 ~~using op amp~~ and find the order of the filter. Plot $|G(j\omega)|$ versus frequency in Hertz, on a **semi log scale** and identify the type of filter from the frequency response.



$R_1 = 11.3\,k\Omega$
$R_2 = 22.6\,k\Omega$
$R_3 = R_4 = 68.1\,k\Omega$
$C_1 = C_2 = 0.01\,\mu F$

Fig. 3

[15]

3. Use $C_1=C_2=20PF$ and design the circuit in Fig.4 to realize a band pass function with f_0=10KHZ,Q=20 and unity center-frequency gain. Use a clock frequency f_c = 400 kHz. Find the values of C_3, C_4, C_5 and C_6.

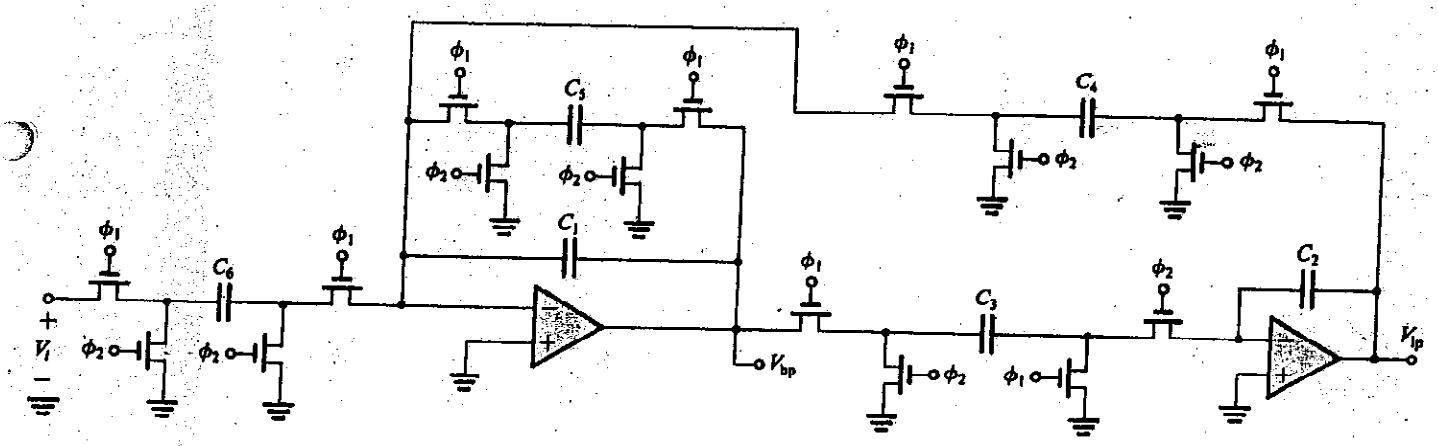
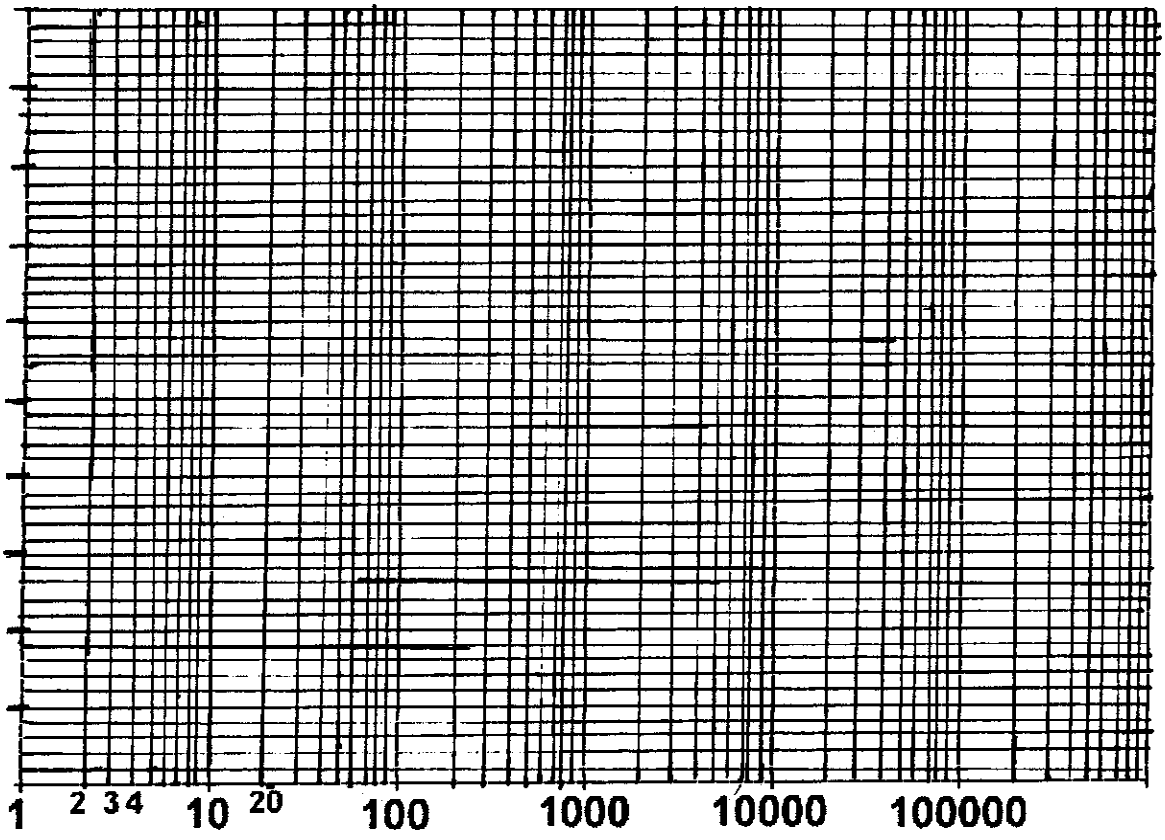


Fig. 4

[8]


1
2
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10
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100
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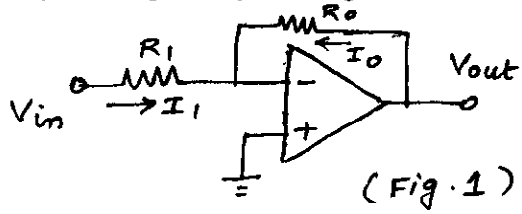
BITS, PILANI-DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY

FIRST SEMESTER 2008-2009 QUIZ 1 (CLOSED BOOK)

COURSE NO : EEE C364 DATE: MAXIMUM MARKS: **10 (5% wt.)**
COURSE NAME: ANALOG ELECTRONICS DURATION:15 MINUTES

- **Answer All the Questions**

1 Consider the circuit in **Fig.1**. What is the expression for the ratio of the output voltage to input voltage?



(Fig. 1)

[1]

2 For the circuit shown in **Fig.1** gain is -10. If R_1=5kΩ,what is the value of R_0? Give your answer in ohms.

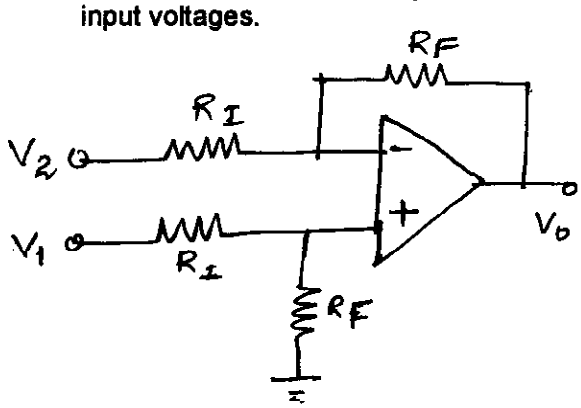
[1]

3 An ideal operational amplifier has ----------slew rate and ---------- bandwidth. [1]

4 Draw an inverting amplifier with input resistance of 10kΩ,determine the value of feedback resistance that will produce an amplifier with a gain of 3.3.

[1]

5 Consider the circuit in **Fig.2** An operational amplifier has a gain of 250,000. The output voltage is 3.75V. Calculate the difference of the input voltages.



(Fig. 2)

[1]

P.T.O

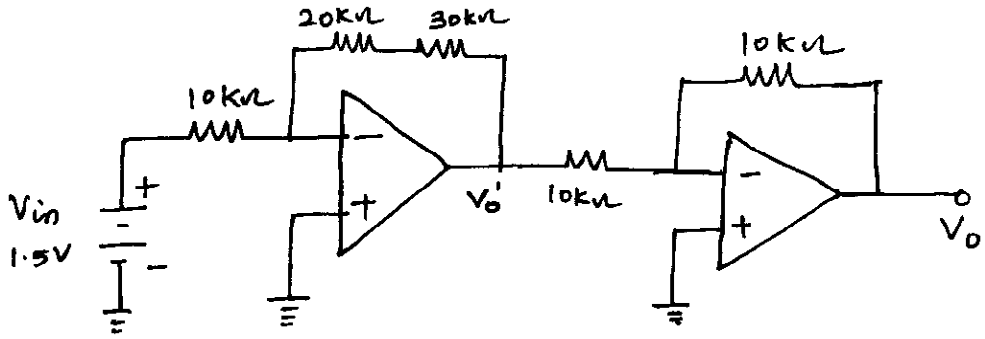
6 What kind of an amplifier is an operational amplifier?

[1]

7 What are the typical power supply voltages of a typical 741 op amp?

[1]

8 For the circuit shown below, if V_{in}=1.5V, what is V_o in volts?



[1]

9 What is the difference between continuous time signal and discrete time signal?

[1]

10 Draw the output characteristics of a bipolar device.

[1]

END

quiz-II

BITS, PILANI-DUBAI

QUIZ-II(CLOSED BOOK) WEIGHTAGE:5%
COURSE TITLE: ANALOG ELECTRONICS DURATION: 15 MINUTES
COURSE NO: EEE C364 MAX MARKS:**10**

NAME OF THE STUDENT: **ID NO:**

Answer all questions

1. The following circuit (**Fig.1**) is a type of difference amplifier, similar in behaviour to the instrumentation amplifier, but only using two operational amplifiers

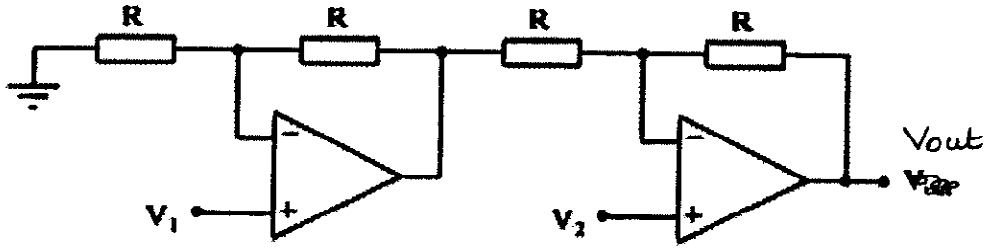


Fig.1

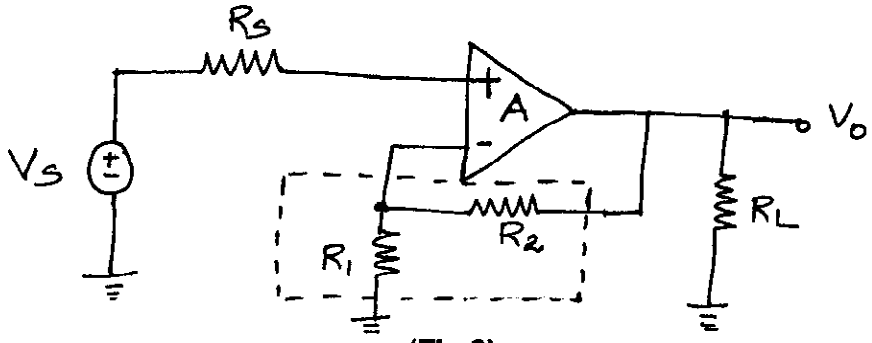
instead of three. Complete the table of values for this op-amp circuit, calculating the output voltage for each combination of input voltages shown.

V_1	V_2	V_{out}
+1 V	0 V	
0 V	+1 V	
+2 V	+1.5 V	
+3.4 V	+1.2 V	
+5 V	+5 V	
-3 V	-3 V	

From the calculated values of output voltage, determine which input of this circuit is inverting, and which is non-inverting, and also how much differential voltage gain this circuit has and express these conclusions in the form of an **equation.**

[5]

2. The non-inverting op amp configuration is shown in **Fig.2**



(Fig.2)

(i) Assume that the op amp has infinite input resistance and zero output resistance. Find an expression for the feedback factor **(ß)**

(ii) If the open loop voltage gain **A=100** find R_2/R_1 to obtain a closed loop voltage gain A_f of **10**.

(iii) What is the amount of feedback in **decibels**?

(iv) If V_s=**1v**, find V_o,V_f and V_i

(v) If A decreases by **20%**, what is the corresponding decrease in A_f?

[5]

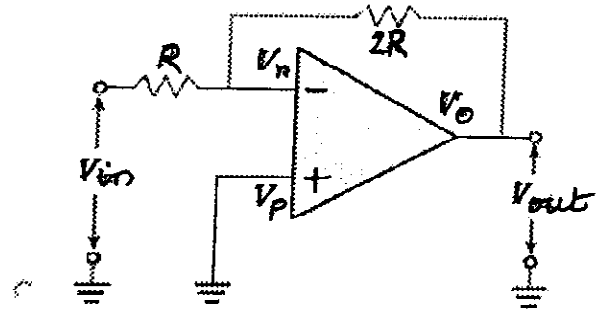
quiz-(3)

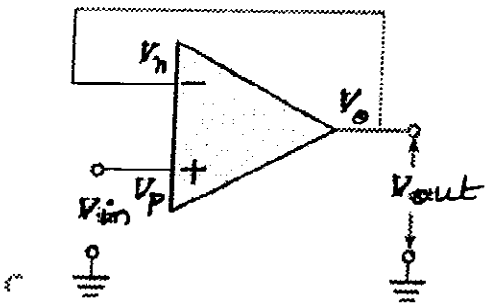
BITS PILANI – DUBAI
INTERNATIONAL ACADEMIC CITY, DUBAI

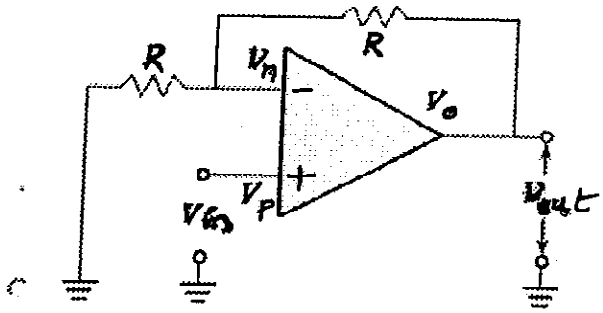
COURSE NO:EEE C364 COURSE TITLE :ANALOG ELECTRONICS (SET A)
QUIZ-III(CLOSED BOOK) MAX MARKS:10 WEIGHTAGE:5%
INSTRUCTOR:Dr. V.KALAICHELVI DURATION:15 MINUTES
ID NUMBER: NAME OF THE STUDENT:
DATE :

ANSWER ALL QUESTIONS

1.. Choose the circuit below that would take a DC input voltage V_{in} = 1 V and produce an output voltage V_{out} = 2 V.



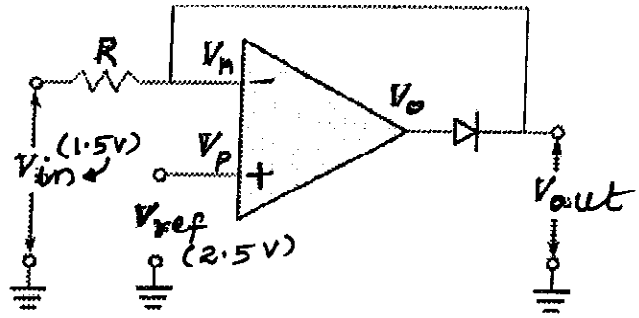




2. Which choice below best defines the purpose of a buffer (constructed with an op-amp)?

- To invert the input signal.
- To amplify the input signal.
- To invert *and* amplify the input signal.
- To isolate the input signal from the rest of the circuit.
- To effectively increase the input impedance of the op-amp.

3. Consider the following schematic diagram:

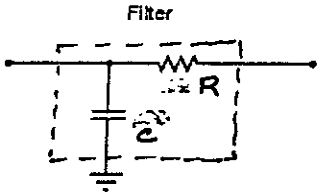


If V_{in} = 1.5 V, and V_{ref} = 2.5 V, what is V_{out} (in volts)?

4. In which of the following scenarios can an op-amp running in an open-loop configuration be used to amplify the signal?

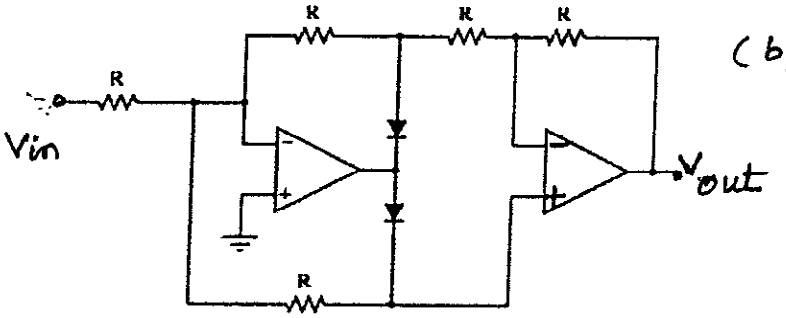
- A voltage with a mean of 1.0 V, and with superimposed noise with peak-to-peak amplitude of less than one microvolt.
- A distant radio signal with zero mean, and less than a microvolt peak-to-peak amplitude.
- A voltage with zero mean, and a peak-to-peak amplitude of around 0.2 V.
- A voltage with a mean of -1.0 V, and with superimposed noise with peak-to-peak amplitude of a few mill volts.
- All of the above.

5. Identify what type of filter this circuit is, calculate its cut off frequency, and distinguish the input terminal from the output terminal:



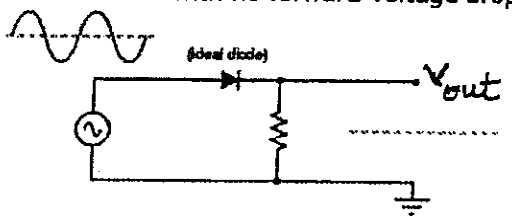
[R = 15KΩ C = 22μf]

6. Explain how you could reverse the output polarity of this precision rectifier circuit:

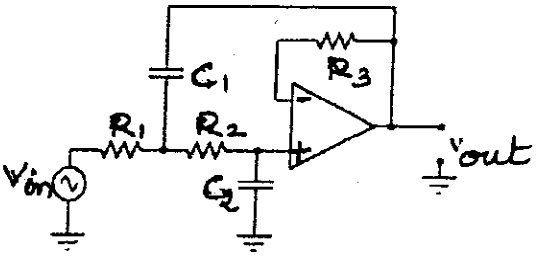


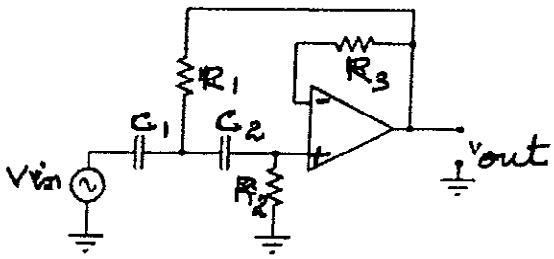
(by diagram)

7. Sketch the shape of the output voltage waveform for this "clipper" circuit, assuming an ideal diode with no forward voltage drop:



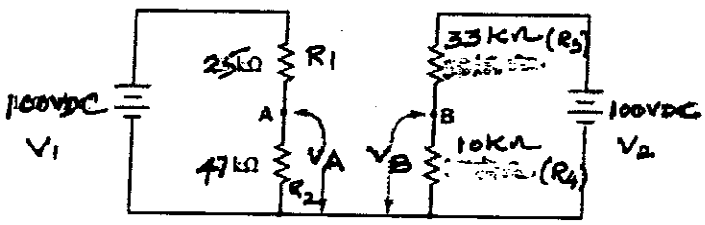
8. A very popular active filter topology is called the *Sallen-Key*. Two examples of Sallen-Key active filter circuits are shown here:





Determine which of these Sallen-Key filters is low pass and which is high pass. Explain your answers

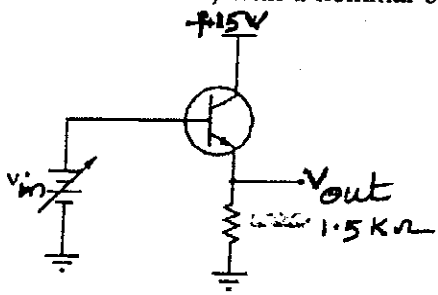
9. Calculate the output voltages of these two voltage divider circuits (V_A and V_B):



$R_1 = 25\,k\Omega$
$R_2 = 47\,k\Omega$
$R_3 = 33\,k\Omega$
$R_4 = 10\,k\Omega$
$V_1 = V_2 = 100\,VDC$

Now, calculate the voltage between points **A** (red lead) and **B** (black lead) (V_{AB}).

10. Complete the table of output voltages for several given values of input voltage in this common-collector amplifier circuit. Assume that the transistor is a standard silicon NPN unit, with a nominal base-emitter junction forward voltage of 0.7 volts:



V_{in}	V_{out}
0.0 V	
0.5 V	
1.0 V	
1.5 V	
5.0 V	

xxxxxx END xxxxxxxx.

quiz-(3) (1)

BITS PILANI- DUBAI
INTERNATIONAL ACADEMIC CITY, DUBAI

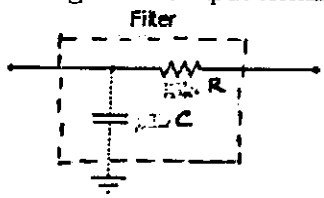
COURSE NO:EEE C364 COURSE TITLE :ANALOG ELECTRONICS (SET B)
QUIZ-III(CLOSED BOOK) MAX MARKS:10 WEIGHTAGE:5%
INSTRUCTOR:Dr.V.KALAICHELVI DURATION:15 MINUTES
ID NUMBER: NAME OF THE STUDENT:
DATE :

ANSWER ALL QUESTIONS

1.In which of the following scenarios can an op-amp running in an open-loop configuration be used to amplify the signal?

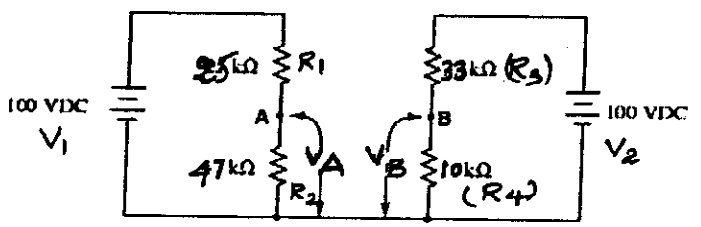
- A voltage with a mean of 1.0 V, and with superimposed noise with peak-to-peak amplitude of less than one microvolt.
- A distant radio signal with zero mean, and less than a microvolt peak-to-peak amplitude.
- A voltage with zero mean, and a peak-to-peak amplitude of around 0.2 V.
- A voltage with a mean of -1.0 V, and with superimposed noise with peak-to-peak amplitude of a few mill volts.
- All of the above.

2. Identify what type of filter this circuit is, calculate its cut off frequency, and distinguish the input terminal from the output terminal:



[R = 15kΩ & C = 22kF]

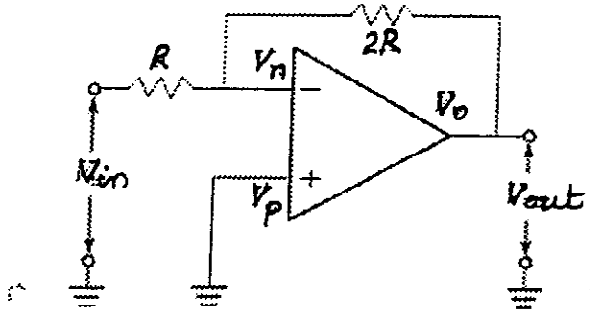
3. Calculate the output voltages of these two voltage divider circuits (V_A and V_B):

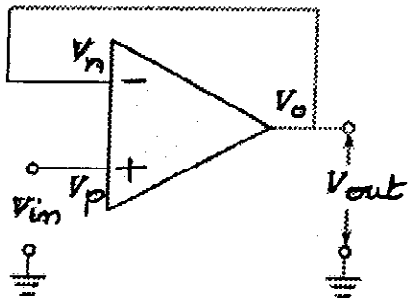


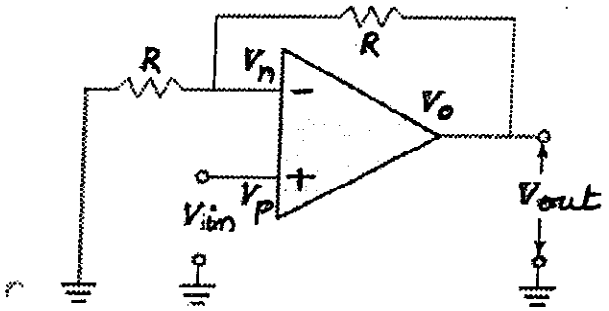
$R_1 = 25k\Omega$
$R_2 = 47k\Omega$
$R_3 = 33k\Omega$
$R_4 = 10k\Omega$
$V_1 = V_2 = 100V\ DC$

Now, calculate the voltage between points A (red lead) and B (black lead) (V_{AB}).

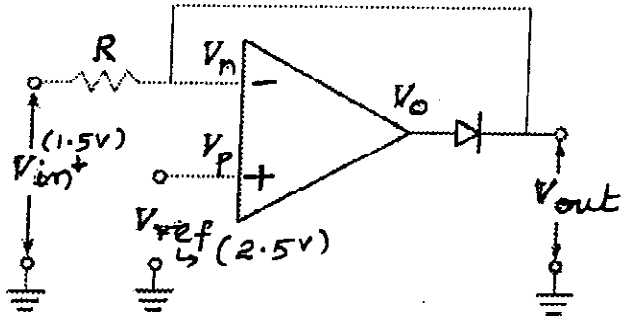
4. Choose the circuit below that would take a DC input voltage V_{in} = 1 V and produce an output voltage V_{out} = 2 V.







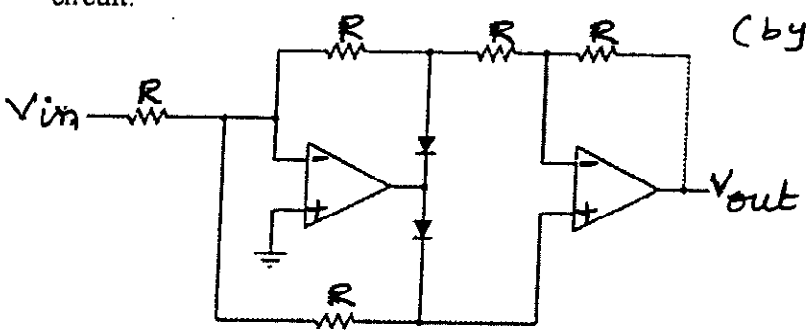
5. Consider the following schematic diagram:



If V_{in} = 1.5V, and V_{ref} = 2.5V, what is V_{out} (in volts)?

6. Explain how you could reverse the output polarity of this precision rectifier circuit:

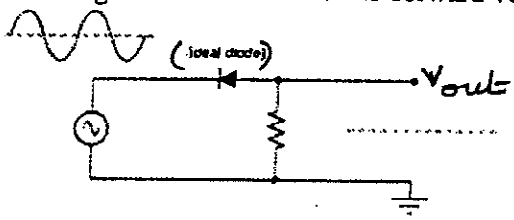
(by diagram)



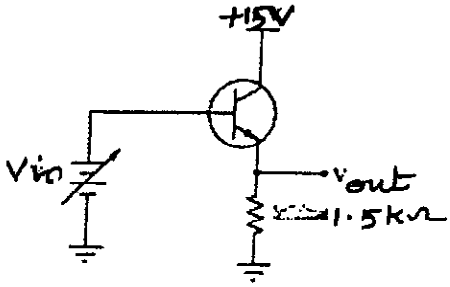
7. Which choice below best defines the purpose of a buffer (constructed with an op-amp)?

- To invert the input signal.
- To amplify the input signal.
- To invert and amplify the input signal.
- To isolate the input signal from the rest of the circuit.
- To effectively increase the input impedance of the op-amp.

8. Sketch the shape of the output voltage waveform for this "clipper" circuit, assuming an ideal diode with no forward voltage drop:

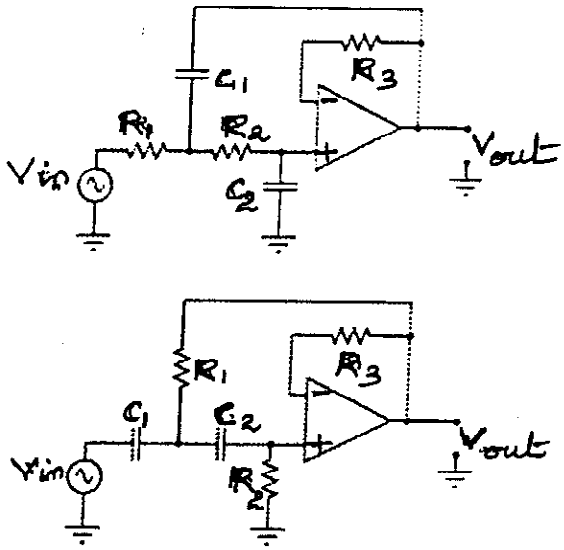


9. Complete the table of output voltages for several given values of input voltage in this common-collector amplifier circuit. Assume that the transistor is a standard silicon NPN unit, with a nominal base-emitter junction forward voltage of 0.7 volts:



V_{in}	V_{out}
0.0 V	
0.5 V	
1.0 V	
1.5 V	
5.0 V	

10. A very popular active filter topology is called the Sallen-Key. Two examples of Sallen-Key active filter circuits are shown here:



Determine which of these Sallen-Key filters is low pass and which is high pass. Explain your answers

xxxxxx. END xxxxxx.

BITS PILANI-DUBAI
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
FIRST SEMESTER 2008-2009

CLASS: III YEAR EEE
COMPONENT: COMPREHENSIVE EXAM (CLOSED BOOK) DATE: 23-12-08
COURSE NO: EEE C364 COURSE TITLE: ANALOG ELECTRONICS
DURATION: 3 Hours MAX MARKS: **50** WEIGHTAGE: **25%** INSTRUCTOR: Dr.KLS

- **Answer All Questions**
- **Any required data not explicitly given, may be suitably assumed and stated.**

1(a) Convert the following Thévenin equivalent circuit (**Fig.1**) into Norton Equivalent circuit: [2Marks]

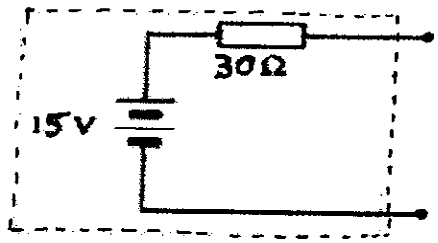


Fig.1

(b) A weighted summer circuit using an ideal op amp has three inputs using **100kΩ** resistors and a feedback resistor of **50kΩ** .A signal v_1 is connected to two of the inputs while a signal v_2 is connected to the third. Express v_o in terms of v_1 and v_2. If $v_1 = 3V$ and $v_2 = -3V$, what is v_o? [5Marks]

(c) A signal of magnitude **1** to **5V** is obtained from a sensor. It is required to transmit the signal to the control room. Design a suitable circuit using operational amplifier to convert the signal into a current signal of range **4** to **20mA**. [3Marks]

2(a) List the topologies used for realizing active filters. [2Marks]

(b) Draw the circuit of Schmitt trigger and derive an expression for Hysterisis voltage. Also sketch its input and output waveforms. [5Marks]

(c) The input to the Zener diode regulator shown in **Fig.2** varies from **20V** to **30V.** Use the ideal characteristic of Zener diode to work out the maximum and minimum Zener current. [3Marks]

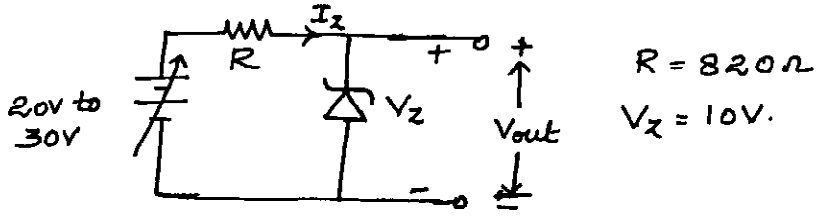


Fig.2

P.T.O

3(a) Explain briefly what the **Barkhausen criterion** is for an oscillator circuit. How will the oscillator circuit's performance be affected if the Barkhausen criterion falls below 1, or goes much above 1? [4Marks]

(b) Find the frequency of oscillation of the circuit in **Fig.3** for the case R_1=**10kΩ** , R_2=**16kΩ**, C=**10nF** and R= **62kΩ**.

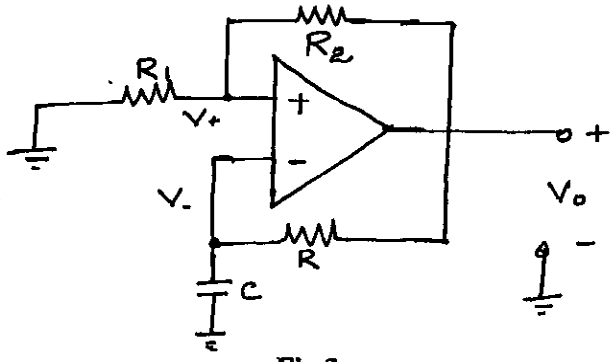


Fig.3

[4Marks]

(c) Sketch the transfer characteristics of the circuit in **Fig.4**

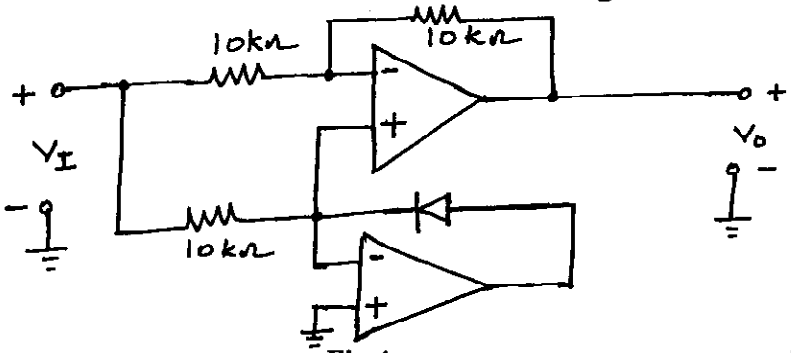


Fig.4

[2Marks]

4(a) Draw the circuit of Class A output stage of an amplifier and derive an expression for Power conversion efficiency. Also sketch its transfer characteristics. [6Marks]

(b) An inductance of **30μH** is resonated with a **1000pF** capacitor. If the inductor is tapped at one-third of its turns and a **1kΩ** resistor is connected across the one-third part, find f_0 and **Q** of the resonator. [4Marks]

5(a) Design a D/A converter using resistive divider network for the following specifications:
Input - 3 bit digital inputs
Output- 0 to 5V analog output [5Marks]

(b) Define sensor and a transducer. [2Marks]

(c) What are MEMS? Mention some applications of MEMS. [3Marks]

END