PRACTICAL WORK BOOK

For Academic Session 2012

ELECTRONIC DEVICES & CIRCUITS
(EL-231) For S.E(EL)

Name: _____

Roll Number: _____

Class: _____

Batch: _____

Department : _____

Department of Electronic Engineering

NED University of Engineering & Technology, Karachi

LABORATORY WORK BOOK

FOR THE COURSE

EL -231 Electronic Devices & Circuits

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Electronic Devices and Circuits Laboratory

CONTENTS

Lab Session 01

OBJECTIVES

To investigate the Inverting Amplifier i.e.

To determine the phase shift between the input and output signals.

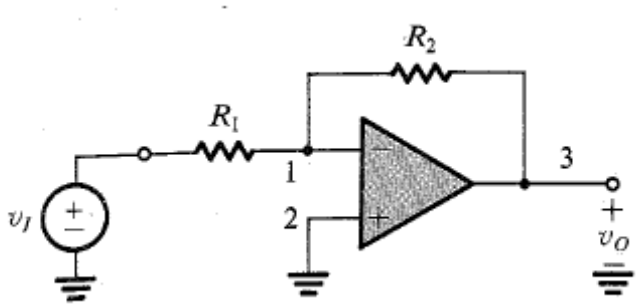
To measure the frequency response of an op amp and demonstrate the effect of negative feedback

EQUIPMENT REQUIRED:

Protoboard
741 Opamps
Resistors
Digital Multimeter
Function Generator
Oscilloscope

Theory:

Figure shows the inverting configuration. It consists of one opamp & two resistors R1 & R2. R2 is connected frpm output terminal back to inverting or inverting input terminal. If R2/R1 =10, & we apply the sine wave input of 1V pk-pk, output will be a sine wave of 10V pk-pk, & phase shifted 180^o



Observations:

S.No	Frequency	Input (p-p)	Output (p-p)	Gain
1	1k			
2				
3				
4				
5	10k			
6				
7				
8				
9	100k			
10				
11				
12				

Calculations:

Calculated Gain:

$$G=Vo/Vi=-(R2/R1)$$

Lab Session 02

OBJECTIVES

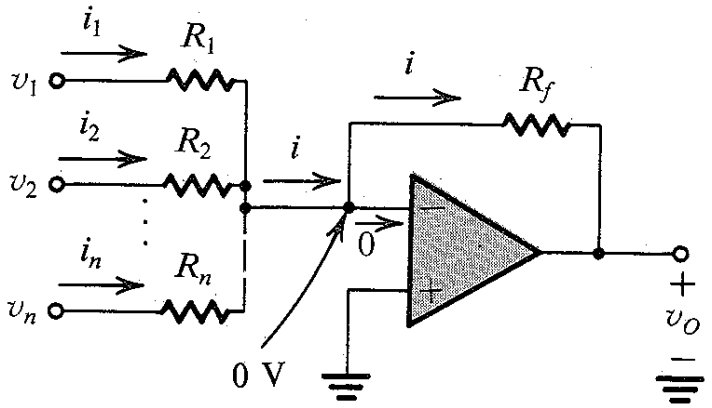
To investigate the Weighted Summer Operation

EQUIPMENT REQUIRED:

Protoboard
741 Opamps
Resistors
Digital Multimeter
Function Generator
Oscilloscope

THEORY:

Figure shows that there are number of input signals, V1, V2 ……. Vn each applied to a corresponding resistor R1, R2, …….Rn, which are connected to inverting terminal of Opamp
Output is the weighted sum of the input signals V1, V2……. Vn. Each summing coefficient may be independently adjusted using R1, R2…….Rn



$$v_O = -\left(\frac{R_f}{R_1}v_1 + \frac{R_f}{R_2}v_2 + \cdots + \frac{R_f}{R_n}v_n\right)$$

OBSERVATIONS:

S. No	INPUT SIGNALS		OUTPUT	Gain
	V1 (p-p)	V2 (p-p)	p-p	
1				
2				
3				
4				
5				

CALCULATIONS:

Calculated Gain:

Lab Session 03

OBJECTIVES

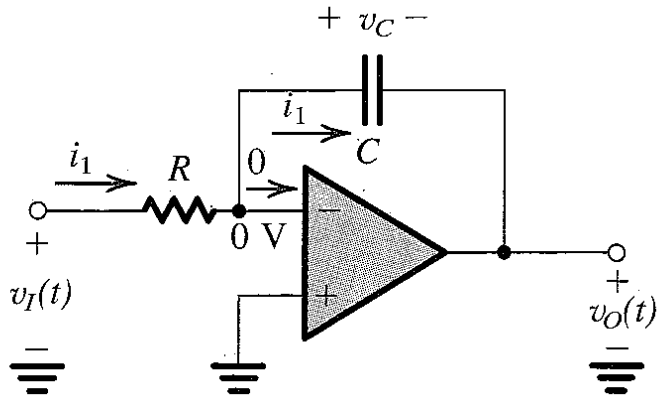
To investigate the Operation of Inverting Integrator

EQUIPMENT REQUIRED:

Protoboard
741 Opamps
Resistors, Capacitors
Digital Multimeter
Function Generator
Oscilloscope

THEORY:

By placing the capacitor in the feedback path, and resistor at the input realizes the mathematical operation of integration.



OBSERVATIONS:

S. No	Frequency	Input (p-p)	Output (p-p)	Gain
1	1k			
2				
3				
4				
5	10k			
6				
7				
8				
9	100k			
10				
11				
12				

CALCULATIONS:

The integrating frequency according to the values of C & R is:

Lab Session 04

OBJECTIVES

To investigate the Operation of BJT Current Mirror.

EQUIPMENT REQUIRED:

Protoboard
Q2N2222 BJT npn transistors
Resistors, Capacitors
Digital Multimeter
Function Generator
Oscilloscope
Connecting wires

THEORY:

The basic BJT Current Mirror is shown in figure. Neglecting base current, the reference current Iref is passes through the diode connected transistor Q1, & thus produces corresponding voltage Vbe, which in turn is applied between base & emitter of Q2. If Q2 is matched to Q1, then the collector current of Q1 is equal to that of Q1

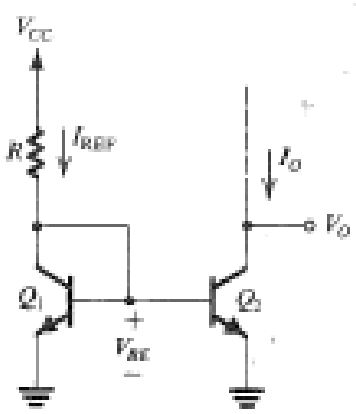


FIGURE 1

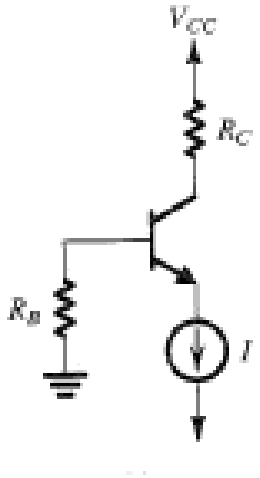


FIGURE 2

PROCEDURE:

- Implement the circuit given in figure 2, using current source in figure 1.
- Vary the potentiometer and observe changes in Iref and Io

OBSERVATIONS:

S. No	Iref	Io
1		
2		
3		
4		
5		
6		
7		
8		

CALCULATIONS:

Lab Session 05

OBJECTIVES

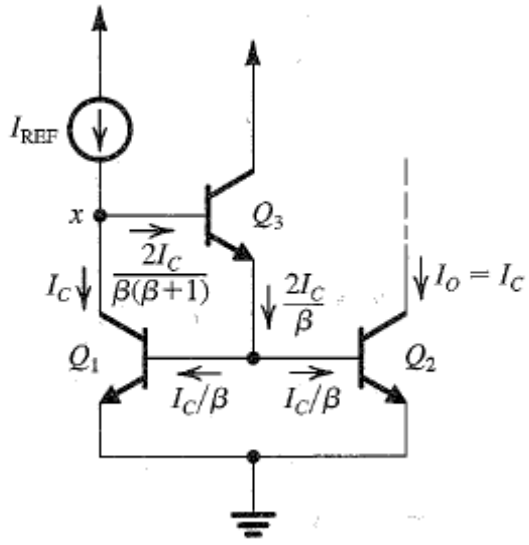
To illustrate the operation of current source implemented using BJT, with Base-Current Compensation.

EQUIPMENT REQUIRED:

Protoboard
Q2N2222 BJT npn transistors
Resistors, Capacitors
Digital Multimeter
Function Generator
Oscilloscope
Connecting wires

THEORY:

Figure shows a bipolar current mirror with a current transfer ratio that is much less dependent on β than that of simple current mirror. The reduced dependence is achieved by using transistor Q3



PROCEDURE:

- Implement the circuit in figure 2 of previous lab session using above current source, using potentiometer in place of Iref
- Vary potentiometer & observe readings for Iref & Io

OBSERVATIONS:

S. No	Iref	Io
1		
2		
3		
4		
5		
6		
7		
8		

CALCULATIONS:

Lab Session 06

OBJECTIVES

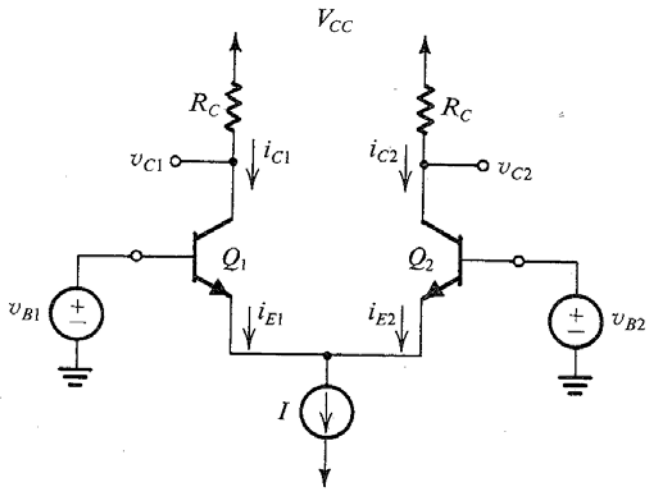
To illustrate the operation of BJT Differential Pair
As a Swith
As an Amplifier

EQUIPMENT REQUIRED:

Protoboard
Q2N2222 BJT npn transistors
Resistors, Capacitors
Digital Multimeter
Function Generator
Oscilloscope
Connecting wires

THEORY:

It consists of two matched transistors, Q1 & Q2, whose emitters are joined together and biased by constant current source I. It is essential that, collector circuits be such that Q1 & Q2 never enter saturation.



OBSERVATIONS:

S.NO	V B1	VB2	VB1-VB2	Vc1	Vc2	Vc1-Vc2
1						
2						
3						
4						
5						
6						
7						
8						

RESULTS:

Lab Session 07

OBJECTIVES

To illustrate the operation of Wilson MOS Mirror

EQUIPMENT REQUIRED:

Protoboard
MOSFET
Resistors, Capacitors
Digital Multimeter
Function Generator
Oscilloscope
Connecting wires

THEORY:

Figure 1 shows the Wilson MOS Mirror. Advantage of MOS Wilson lies in its enhanced output resistance. To balance the two branches of the mirror, and to avoid systematic current error resulting from the difference between Q1 & Q2, other two transistors Q3 & Q4 connected.

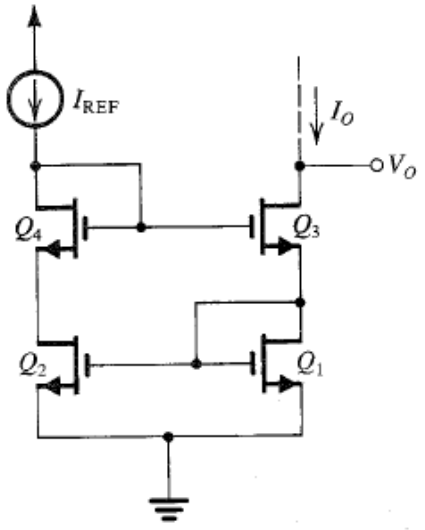
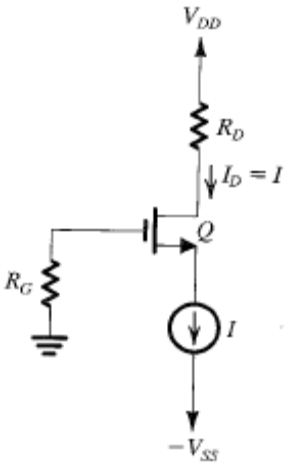


FIGURE 1



PROCEDURE:

- Implement the circuit in figure 2 using MOS Wilson current Mirror as that in figure 1, using potentiometer in place of Iref
- Vary potentiometer & observe readings for Iref & Io

OBSERVATIONS:

S. No	Iref	Io
1		
2		
3		
4		
5		
6		
7		
8		

CALCULATIONS:

Lab Session 08

OBJECTIVES

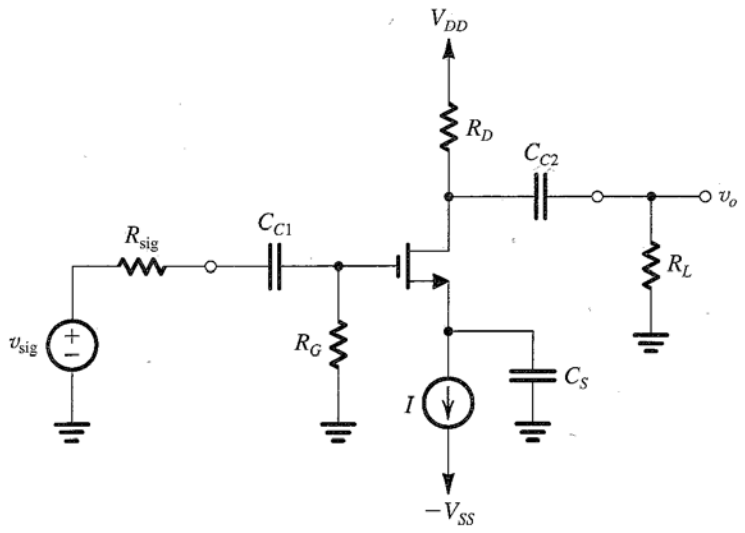
To illustrate the operation of Common Source Amplifier and also determine phase shift between input and ouput.

EQUIPMENT REQUIRED:

Protoboard
Q2N2222 BJT npn transistors
Resistors, Capacitors
Digital Multimeter
Function Generator
Oscilloscope
Connecting wires

THEORY:

A Common Source Amplifier or Grounded Source Configuration is shown in figure. To establish a signal ground, or ac ground, a large capacitor is connected between source & ground. The signal current bypasses the output resistance of the current source & is called a bypass Capacitor. Cc1 is known as Coupling Capacitor, & acts as a perfect short circuit at all signal frequencies of interest.



OBSERVATIONS:

S.No	Frequency	Input (p-p)	Output (p-p)	Gain
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

CALCULATIONS:

Calculated Gain:

Lab Session 09

OBJECTIVES

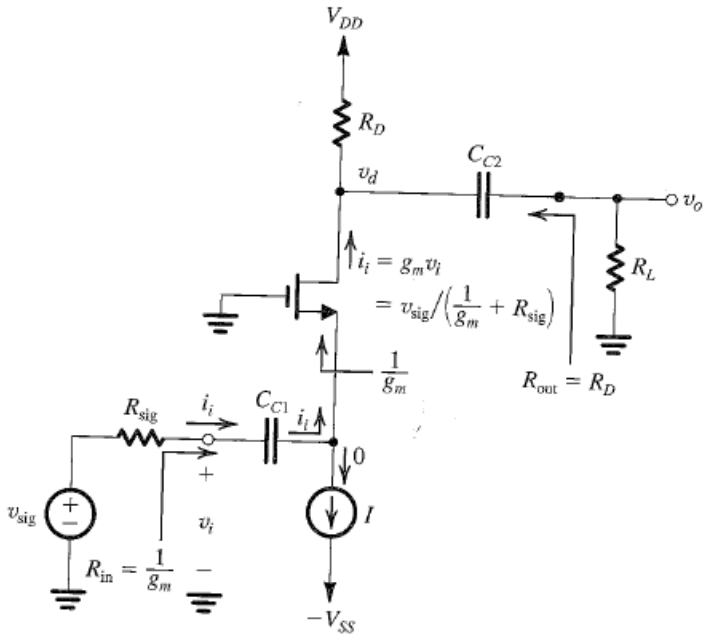
To illustrate the operation of Common Gate Amplifier.

EQUIPMENT REQUIRED:

Protoboard
MOSFET
Resistors, Capacitors
Digital Multimeter
Function Generator
Oscilloscope
Connecting wires

THEORY:

By establishing a signal ground on the MOSFET gate terminal, a circuit configuration called Common Gate is obtained. The input is applied to the source and output is taken at the drain terminal, with gate being the common terminal between input & output ports.



OBSERVATIONS:

S.No	Frequency	Input (p-p)	Output (p-p)	Gain
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

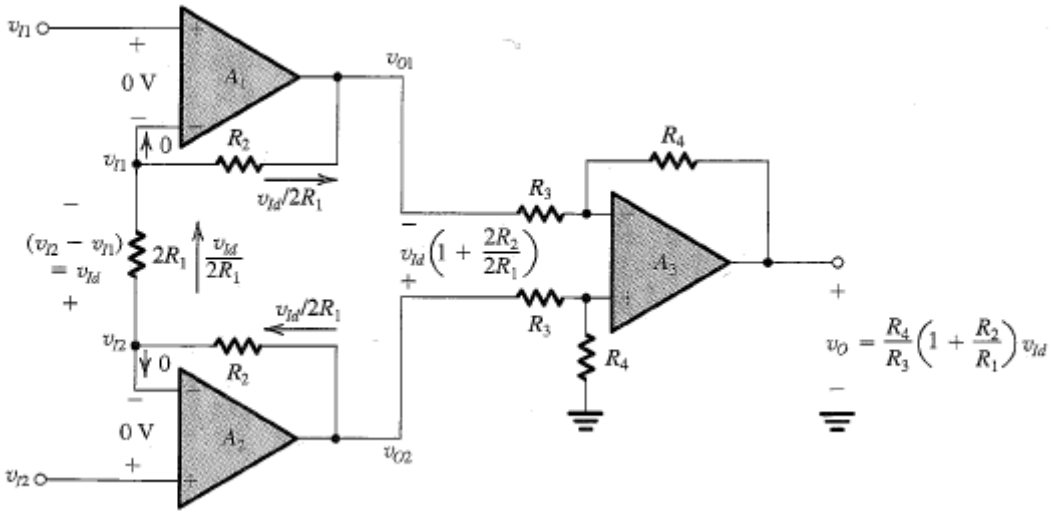
CALCULATIONS:

Calculated Gain:

Lab Session 10

PROJECT # 1

To illustrate the operation of Instrumentation Amplifier

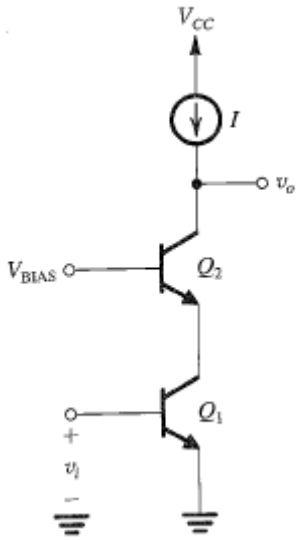


Lab Session 11

PROJECT # 2

To illustrate the operation of BJT Cascode Configuration and thus find:

1. Gain
2. Frequency Response



Lab Session 12

PROJECT # 3

To illustrate the operation of Common Drain Amplifier