NIRMA UNIVERSITY

School of Technology, Institute of Technology

Electronics & Communication Engineering Department

B. Tech. Semester-IV (Even Academic Year 2020-21)

2EC402: Analog Circuits

INDEX

Name of Student: _____, Roll No: _____

SR No	Title	Date of Experiment	Date of Submission	Signature	Marks
Week 1	**Discussion on Lab Rules, Instructions, and demonstration of Digital Storage Oscilloscope and Analog Discovery Kit.**				
1.	Differential Amplifier using Bipolar Junction Transistor.				**/10**
2.	Measurements of Electrical Parameters Measurements for IC µA741.				**/10**
3.	Audio Amplifier using Open loop and closed loop configuration of OPAMP IC µA741.				**/10**
4.	Mathematical Operations using OPAMP IC µA741				**/10**
5.	Temperature to voltage converter using Instrumentation Amplifier				**/10**
6.	Audio frequency filter using OPAMP IC µA741				**/10**
7.	High-Speed Low Noise Comparator				**/10**
8.	RC Phase Shift Oscillator Using OPAMP IC µA741				**/10**
9.	Digital to Analog Converter using OPAMP IC µA741				**/10**
10.	IC555 Timer as Multivibrator				**/10**
11.	Innovative Project Development using Analog ICs				**/20**
	Total				**/120**

***Lab Experiments Video Link:**
https://www.youtube.com/watch?v=1xtUKhs7IBY&t=161s

LABORATORY RULES

Experiment Lab Manual:

- All students have to create a login in multisim for online circuit simulation. Link to multisim: Multisim Live Online Circuit Simulator
- Other online circuit simulation tool: https://www.circuitlab.com
- All students have to maintain one record book, in which the circuit diagram and the result are available for each experiment. This record book is signed at the end of each lab session by faculty members.
- Students have individually designed one lab experiment with hardware design as part of evolution.
- Students have to design minor projects related to the application of electronics devices.
- There will be a quiz/viva/conclusion discussion in the last 15 minutes of your laboratory session.
- **Students have to carefully read the assessment policy for each experiment. You should have to follow all the steps of the lab experiment.**

Safety Rules:

- Use a grounded power for signal generator and non-grounded power for oscilloscope.
- Always connect DC supply first and then AC supply. In the end, disconnect AC supply and then DC supply.
- Before beginning the measurements, check the calibration of your oscilloscope.
- After the experiment, turn off all the equipment and clean your tables.
- Always use electrical quantities like voltage or ampere on your result sheet. (with units)
- If there is a problem with your equipment, consult the LAB ASSISTANT/FACULTY MEMBERS before replacing it.

Experiment No. 1 Date:

Aim: Differential Amplifier using Bipolar Junction Transistor

Objectives:

1. To Design a differential amplifier for given specifications.
2. To measure operating point and small-signal parameters of the differential amplifier and compare it with the theoretical calculation.
3. To measure differential-mode gain *A*d, common-mode gain *A*c and common-mode rejection ratio CMRR of the differential amplifier.
4. To measure the percentage of noise and optimize the Common Mode Rejection Ratio.

Pre-Lab Quiz:

1. Calculate the operating point of the single-stage amplifier with the following specifications: Vcc=+12V, Current Gain=100. R_B=10k, V_{BE}=0.7V. R_C=4.7k, R_E=6.8kΩ (Hand calculation)

Reference Book:

1. Sendra and Smith-Microelectronics Circuits, Theory and Applications, 7th Edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure & Observation:

1. Construct the circuit, measured the quiescent points (no AC signal applied) by connecting both bases to ground. Measure the DC values of (V_{c1}, V_{c2}, V_E, I_{B1}, I_{B2}, I_{E1}, I_{E2}, I_E)

DC Values	V_{c1}	V_{c2}	V_E	I_{B1}	I_{B2}	I_{E1}	I_{E2}	I_E
Measured								
Calculated								

2. Connect the Analog Discovery Kit as Input source as Vin1 and Vin2.
   - Single and Dual input mode:

Vin1(mV)	Vin2(mV)	Vo1	Vo2	$V_0=V_{01}-V_{02}$	Differential Gain	Common Mode Gain	CMRR(dB)

3. Calculate the amount of noise in terms of percentage for the measured value of CMRR.

   Noise %=$[1+\left(\frac{1}{CMRR}\right)Vcm/Vid]$=_____

4. Optimize the value of CMRR using matching of components values.

   Optimize CMRR=_____

Post Lab Quiz:

Plot Voltage Transfer Characteristics of Differential Amplifier in Multisim Software and attached simulation results.

Conclusion:

_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 2 Date:

Aim: Measurements of Electrical Parameters Measurements for IC µA741.

Objectives:

1. Identification of datasheet parameters for the given op-amp.
2. To develop an experiment set up for measuring various parameters and compared with datasheet value.

Pre-Lab Excises:

1. Download and attached the datasheet of IC µA741 from a web source and separate static and dynamic parameters.

Reference Book:

1. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Practical Circuit Diagram:(Use separate sheet if required)

Circuit Diagram

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

[a] Input offset voltage measurement:

[b] Input bias current and input offset current measurement:

[c] Input Resistance:

[d] Output Resistance:

[e]Common Mode Rejection Ratio:

[f[open loop gain:

[g] Gain Bandwidth Product:

[h]Slew rate:

Observation Table:

Parameters	Datasheet values	Practical Values
Input offset voltage Vio = (Vo * R1) / (R1 + R2)		
Input bias current = (IB1 + IB2)/ 2		
Input Resistance Rin		
Output Resistance Rout		
Open loop gain		
The common mode rejection ratio=Ad/Acm		
Gain Bandwidth Product		
Slew rate		

Post Lab Exercise:

1. Performed circuit simulation of following parameters of IC µA741 and attached the screenshot of simulation results.
   Output Impedance, Open Loop Gain, Gain Bandwidth Product

Conclusion:

_____
_____
_____
_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)

		measurement error and able to account for it statistically. (3 Marks)		
3.	**Documentation (4 Marks)**	Report writing in a proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in the proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 3 Date:

Aim: Audio Amplifier using Open loop and closed loop configuration of OPAMP IC µA741.

Objectives:

1. Implement an open-loop configuration and identify limitations.
2. To design and implement a closed-loop configuration with an inverting and non-inverting amplifier of the desired voltage gain. Compare ideal and practical values in terms of component tolerance.
3. To Modify a circuit for a variable gain amplifier.

Pre-Lab Exercise:

1. Implement an inverting amplifier in a multisim tool. Attached Simulation results.

Reference Book:

2. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

[a] Inverting Amplifier & Non inverting Amplifier:

[b] Variable Gain Amplifier:

[c] Optimize the gain for inverting amplifier by proper selection of resistors in terms of tolerance.

Observation:

[1] Inverting Amplifier:

Sr. No	Input Voltage Vin	Output voltage Vo	Practical Value of Gain=Vo/Vin	Theoretical Value of Gain=Vo/Vin	Percentage Error
1.					
2.					
3.					

[2] Non Inverting Amplifier:

Sr. No	Input Voltage Vin	Output voltage Vo	Practical Value of Gain=Vo/Vin	Theoretical Value of Gain=Vo/Vin	Percentage Error
1.					
2.					
3.					

[3] Variable Gain Amplifier:

Sr. No	Resistance Rf	Input Voltage Vin	Output Voltage Vo	Gain=Vo/Vin
1.				
2.				
3.				

Post Lab Exercise:
Connect the analog discovery kit for the sound signal as input and speaker at the output node. Performed the above three steps for the same.

Conclusion:

_____
_____
_____
_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in a proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in the proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 4 Date:

Aim: Mathematical Operations using OPAMP IC µA741

Objectives:

1. To design and implement the summing amplifier in inverting mode
2. To design and implement a differentiator.

Pre-Lab Exercise:

2. Sketch output signals for mathematical functions differentiator and integrator if input signals are: Sine Wave, Tringualar Wave, Square Wave. Justify your answers also.

Reference Book:

26. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in the below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

[a] Summing Amplifier (Inverting Mode) Amplifier:

[b] Differentiotor

Observation:

Summing Amplifier

Sr No	Input Voltage Va (volt)	Input Voltage Vb (volt)	Input Voltage Vc (volt)	Output Voltage Vo	Theorical Value	Percentage Error

Practical Differentiator: Vin=_____

Sr No	Input Signal Frequency F	Output voltage Vout	Gain(dB)

[plot graph of Frequency F Vs Gain]

Post Lab Exercise:

1. **Modify the circuit for averaging and scaling amplifier and compare results with above measurements**

Conclusion:

_____
_____
_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 5 Date:

Aim: Temperature to voltage converter using Instrumentation Amplifier.

Objectives:

1. To measure the effect of change in resistance for bridge balance and unbalanced conditions.
2. To convert temperature into electrical voltage and calculate the percentage of errors.

Pre-Lab Quiz:

3. Derive the relation between change in temperature and output voltage.

Reference Book:

27. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

1. **Instrumentation Amplifier:**

_____
_____
_____
_____
_____
_____
_____
_____

2. Connect the temperature sensor as one arm of the bridge,hear the thermistor and measure the voltage at the output of OPAMP.

Vout(min)=_____
Vout(max)=_____

Observation:

Sr No	Resistance RT	Voltage Va	Voltage Vb	Output voltage Vout
1.				
2.				
3.				
4.				
5.				

Post Lab Quiz:
Design and Simulate Strain gauge bridge interface for pressure measurement using instrumentation amplifier.

Conclusion:

_____
_____
_____
_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with specifications,	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)

		software used if any (4 Marks)		
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 6 Date:

Aim: Audio frequency filter using OPAMP IC µA741.

Objectives:

3. To design and implement for audio frequency range 20Hz to 20kHz.
4. To design and analyze the second-order low pass filter.

Pre-Lab Quiz:

4. Sketch ideal frequency response for all types of filters.

Reference Book:

45. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

[1] Band Pass Filter:

Observation:

Sr. No.	Frequency Hz	V_{in} (volts)	Vout (volts)	Gain(V/V)	Gain (in dB)

(plot graph on semi-log graph paper)

Post Lab Quiz:

1. Using multisim software, design a second-order high pass filter with cutoff frequency 1kHz.

Conclusion:

_____
_____
_____
_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)

3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 7 Date:

Aim: High-Speed Low Noise Comparator.

Objectives:

1. To design and implement a Schmitt trigger as the comparator circuit for given specifications and plot the hysteresis loop.

Pre-Lab Quiz:

5. State limitation of basic open-loop comparator.

Reference Book:

46. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

[1]Schmitt Trigger Circuit:

_____
_____
_____
_____
_____
_____
_____

Plot Voltage Transfer Characteristics of Circuit.
Observation:

Parameters	Theoretical value	Practical value
Upper Threshold Voltage		
Lower Threshold Voltage		
Hysteresis Voltage		

Post Lab Quiz:

1. On the breadboard, implement the following circuits by each group and demonstrate it in the next lab session.
   (i) Zero Crossing Detector
   (ii) Precision Rectifier

Conclusion:

_____
_____
_____

___

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 8 Date:

Aim: RC Phase Shift Oscillator Using OPAMP IC µA741.

Objectives:

1. Design and implement an RC phase shift oscillator using Op-Amp 741 for a given specification.
2. Measure the frequency of oscillation and convert the circuit into a variable frequency output signal.

Pre-Lab Quiz:

1. Classify different types of Active Oscillators using OPAMP.

Reference Book:

47. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in the below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

_____
_____
_____
_____
___

Observation:

Sr No	Resistance R	Practical Value of oscillator frequency	Theoretical Value of Oscillator Frequency	Percentage error

Post Lab Quiz:

Design and implement the Wein Bridge oscillator of frequency 10kHz.

Conclusion:

_____
_____

_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 9 Date:

Aim: Digital to Analog Converter using OPAMP IC µA741

Objectives:

3. Design and implement a Digital to Analog Converter using Op-Amp 741 for a given specification.
4. Measure and plot output voltage vs input voltage on graph paper.

Pre-Lab Quiz:

2. Classify different types of Data Converter Circuits using OPAMP.

Reference Book:

48. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in the below-given space:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

Procedure:

_____
_____
_____
_____
____
_____
_____
__

Observation:

Sr No	Input Bits	Practical Value of output voltage	Theoretical Value of output Voltage	Percentage error

Post Lab Quiz:

Design and implement the flash type ADC using Analog Discovery kit.

Conclusion:

_____
_____
_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with specifications, software used if any (4 Marks)	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)
Total Marks(10)				

Signature of Faculty Member with date:

Experiment No. 10 Date:

Aim: IC555 Timer as Multivibrator.

Objectives:

1. To design and implement astable mode using the IC555 timer for given specifications
2. To determine the duty cycle and switching frequency.

Pre-Lab Quiz:

6. Design an astable circuit for duty cycle 60% and switching frequency 1KHz.

Reference Book:

49. Ramakant A. Gayakwad- op-amp and Linear Integrated Circuits, Pearson Education; Fourth edition.

Theoretical Calculations:

Design Specifications:	Calculations:

Practical Circuit Diagram:

Requirements:

Select the necessary equipment/apparatus/components required for this experiment and list all of them in the below given space:

Procedure:

Name of Equipment/Components	Range/Value/Specification	Justification of the selection of each component/equipment

[1] Astable configuration:

_____
_____
_____
_____
_____
_____
_____
_____

[2] Modify a circuit for 50% duty cycle.

Practical Duty Cycle=_____

Observation:
[1] Astable configuration:

				Practical Value				Theoretical Values		
Sr.	**R_A**	**R_B**	**ON time**	**OFF time**	**Time period**	**Duty cycle**	**ON time**	**OFF time**	**Time period**	**Duty cycle**

Post Lab Quiz:

1. Design a monostable configuration using IC555 in multisim software for pulse width 1ms.

Conclusion:

_____
_____
_____
_____
_____
_____
_____

Assessment:

1.	**Experimental Procedure (3 Marks)**	Develops and implement the most logical experimental procedures. Included prelab and post-lab exercise. (3 Marks)	Experimental Procedure most often followed but occasionally oversight leads to loss of experimental efficiency and /or loss of data. Partially included pre-lab and post-lab exercise. (2 Marks)	It doesn't follow the experimental procedure. Not included pre-lab and post-lab exercise. (1 Marks)
2.	**Result and measurement error (3 Marks)**	Tries to achieve the results from different viewpoints. He is aware of measurement error and able to account for it statistically. (3 Marks)	Achieve the desired results. He is aware of measurement error but does not account for it statistically. (2 Marks)	Unable to achieve the desired results. Is unaware of measurement error. (1 Marks)
3.	**Documentation (4 Marks)**	Report writing in the proper format for all experiments (No, Date, Objective, Apparatus with	Most of the lab report is in format but some of the formatting guidelines are missed. (2 Marks)	Experiments not written in a pre-lab proper format. (1 Marks)

		specifications, software used if any (4 Marks)		
Total Marks(10)				

Signature of Faculty Member with date: