I

Name _____

Roll No. _____ Year 20____ 20____

Exam Seat No. _____

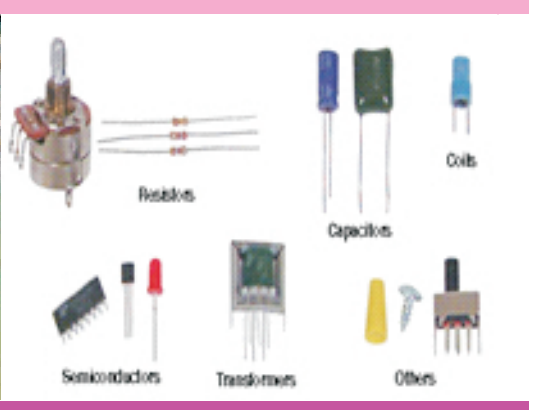
COMPUTER GROUP | SEMESTER - II | DIPLOMA IN ENGINEERING AND TECHNOLOGY

A LABORATORY MANUAL

FOR

BASIC ELECTRONICS

(22225)



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual for

Basic Electronics

(22225)

Semester-II

(CO/CM/CW/IF)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO 9001 : 2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
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(Printed on December, 2017)

MAHARASHTRA STATE

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Certificate

This is to certify that Mr. / Ms. …… Roll No. ……., of First Semester of Diploma in…….. …… of Institute,…….…….. ……..…… (Code: ……...) has completed the term work satisfactorily in Subject **Basic Electronics (22225)** for the academic year 20…….. to 20…….. as prescribed in the curriculum.

Place: …… Enrollment No:.……

Date: …… Exam. Seat No: ……

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practical to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

In today's world most of the consumer appliances are based on electronic circuits and devices. The foundation for working of computer or any of its peripherals are based on electronics. This course has been designed to develop skills to understand and test simple electronic components and circuits. After studying this course students will develop an insight to identify, build and troubleshoot simple electronic circuits.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Programme Outcomes (POs) to be achieved through Practicals

Program Outcomes:

PO1. Basic knowledge: An ability to apply knowledge of basic mathematics, science andengineering to solve engineering problems.

PO2. **Discipline knowledge:** Apply Basic Electronics engineering knowledge to solve broad-based Computer Engineering related problems.

PO3.**Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based ComputerEngineeringproblems.

PO4.**Engineering tools:** Apply relevant technologies and tools with an understanding of the limitations.

PO5.The engineer and society:Assess social, health, safety, legal and cultural issues andthe consequent responsibilities relevant to practice in field of engineering.

PO6.Environment and sustainability:Applyengineering solutions also forsustainable development practices in social and environmental contexts.

PO7.Ethics:Apply ethical principles for commitment to professional ethics,responsibilitiesand norms of the practice also in the field of engineering.

PO8. Individual and team work: Function effectively as a leader and team member indiverse / multidisciplinary teams.

PO 9. : **Communication:** Communicate effectively in oral and written form.

PO10. Life-long learning: Engage in independent and life-long learning activities in the context of technological changes in the Computer Engineeringfield and allied industry.

Program Specific Outcomes:

PSO1. **Computer Software and Hardware Usage**

PSO2. **Computer Engineering Maintenance**

Practical- Course Outcome matrix

Course Outcomes (COs)

- **a.** Identify electronic components in electronic circuits.
- **b.** Use diodes in different applications.
- **c.** Interpret the working of junction transistor in the electronic circuits.
- **d.** Interpret the working of unipolar devices in the electronic circuits.
- **e.** Use sensors and transducers.

S. No.	Title of the Practical	CO a.	CO b.	CO c.	CO d.	CO e.
1	Measure amplitude, time period and frequency of sine wave and square wave using CRO.	✓				
2	Identify active and passive electronic components in the given circuit.	✓				
3	Test the performance of the PN junction diode.		✓			
4	Test the performance of the given Zener diode.		✓			
5	Test the performance of the given Zener voltage regulator.		✓			
6	Convert AC signal into DC signal using Half wave rectifier.		✓			
7	Convert AC signal into DC signal using Full wave rectifier.		✓			
8	Use filters to get regulated DC.		✓			
9	Convert AC signal into DC signal through Bridge rectifier.		✓			
10	Test the performance of the given Bridge rectifier using filter.		✓			
11	Test input/output characteristics of NPN Transistor in CE mode.			✓		
12	Test input/output characteristics of NPN Transistor in CB mode.			✓		
13	Test input/output characteristics of NPN Transistor in CC mode.			✓		
14	Determine gain and bandwidth of Single stage RC coupled amplifier.			✓		
15	Determine gain and bandwidth of 2 Stage RC coupled amplifier.			✓		
16	Test the performance of the given JFET.				✓	
17	Measure temperature of the given Liquid using thermocouple sensor.					✓
18	Test the performance of the given circuit consisting of photoelectric sensor.					✓

List of Industry Relevant Skills

The following industry relevant skills of the competency '***Use simple electronic circuits of computer system'*** are expected to be developed in you by undertaking the practical of this laboratory manual.

I Connect circuits.

II Record Measurements.

III Analyze Circuits.

IV Plot graphs

V Infer results

Guidelines to Teachers

The experiments are developed such that the major practical learning outcomes are achieved. Each experiment is designed to achieve the course outcomes mentioned in the curriculum.

1. For incidental writing on the day of each practical session every student should maintain a ***dated log book*** for the whole semester, apart from this laboratory manual which s/he has to ***submit for assessment to the teacher*** in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters which is not mentioned in the printed practical.
3. For difficult practical, if required, teacher could provide the demonstration of the practical emphasizing the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. Teacher shall ensure that required equipments are in working condition before start of experiment.
7. Explain the prerequisite concepts before start of experiment.
8. Teacher shall assess the performance of the students continuously as per the norms of MSBTE.
9. Teacher may provide additional knowledge and skills to the students that are not included in the manual but are expected from students by the industries.
10. Teacher may suggest additional related literature of technical papers/ Reference books.
11. During assessment the teacher is expected to ask questions to the students to ensure that the learning outcomes are satisfied.
12. The assessment of experiments should be on a regular basis.

Instructions for Students

1. Listen carefully to all the information regarding curriculum, its course outcomes, and major learning outcomes, equipments and instruments in the laboratory, method of assessment.
2. Read the writeup of each experiment to be performed, a day in advance
3. Organize the work in group and record all the observation.
4. Understand the practical implication of the experiments.
5. Students should not hesitate to ask any question while performing the experiment.
6. Students should develop troubleshooting and maintenance skills
7. Students should develop the habit of discussion about experiments that is performed to enhance the understanding and sharing of knowledge.
8. Students to attend the practical class regularly and complete the laboratory work during the stipulated hours and submit the manuals for assessment regularly.
9. Students shall refer to technical magazines, refer websites, proceedings of seminars, related to scope of the course and enhance the knowledge and skills.
10. Student should develop self-learning methods.

Content Page

List of Practical and Progressive Assessment Sheet

* To be transferred to Proforma of CIAAN-2017 .

Practical No.1: Measure Amplitude, Time Period and Frequency of Sine Wave and Square Wave Using CRO.

I Practical Significance

In industries, for manufacture and maintenance of Electronic circuits, measurement / testing are a prime requirement. The various parameters are to be tested with utmost accuracy and precision. For this purpose testing instruments like CRO are used. Through this experiment, student will be able to handle CRO and multimeter efficiently for measuring amplitude, time period and frequency of a given input

II Relevant Program Outcomes (POs)

PO1. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve engineering problems.

PO3.Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

PO8. Individual and team work: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO10.Life-long learning: Engage in independent and life-long learning activities in the context of technological changes in the Computer Engineering field and allied industry.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***

I Record Measurements.

II Draw Waveform and calculate Amplitude and Time period.

IV Relevant Course Outcome(s)

This experiment is a prerequisite to achieve various course outcomes.

V Practical Outcome

To measure Amplitude, Time period and Frequency of Sine wave and Square wave using CRO.

- Identify the controls of CRO.
- Identify the controls of Signal generator
- Measure amplitude of sine wave and square wave given from signal generator
- Measure time period and frequency of sine wave and square wave given from signal generator.
- Make connections between the input source and measuring instrument.
- Adjust the various controls to observe the input signal and measure voltages and frequency.

VI Relevant Affective domain related Outcome(s)

i. Handleequipment carefully.

ii. Follow safety practices.

VII Minimum Theoretical Background:-

CRO:

A Cathode RayOscilloscope is a type of electronic test instrument that allows observation of constantly varying signal voltages, usually as a two-dimensional plot of one or more signals as a function of time. Other signals (such as Temperature/sound or vibration) can be converted to voltages and displayed.
A graticule with a 1cm grid enables one to take measurements of voltage and time from the screen.The graph, usually called the trace, is drawn by a beam of electrons striking the phosphor coating of the screen making it emit light, usually green or blue.
Oscilloscopes use high voltages to create the electron beam and these remain for some time after switching off.For your own safety do not attempt to examine the inside of an oscilloscope, An Oscilloscope is a test instrument which allows to observe the shape of the electrical signals by displaying the graph of voltage against time on its screen.

Signal generator

A Signal generatoris electronic test equipment used to generate different types of waveforms over a wide range of frequencies. Signal generators are capable of producing the following types of repetitive waveforms as shown below:

Sine wave:

A Signal generator will normally have the capability to produce a standard Sinewave output. This is the standard waveform that oscillates between two levels with a standard sinusoidal shape.

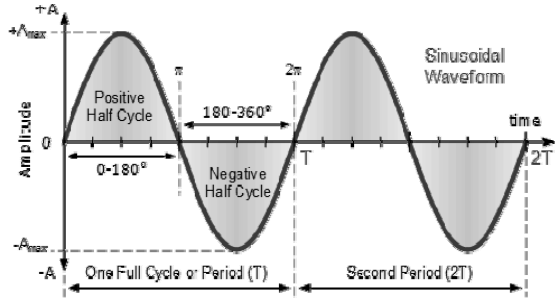

Figure 1: Sine Wave

Square wave:

A square wave consists of a signal moving directly between high and low levels.

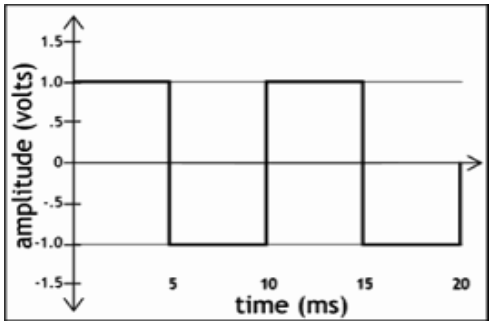

Figure 2: Square Wave

VIII PracticalCircuit diagram:

(a) Sample

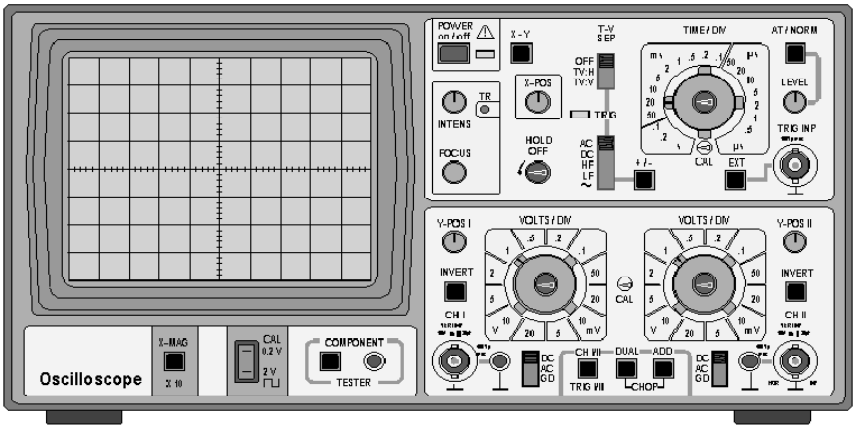

Figure 3: Front panel of CRO

Figure 4: Front panel of Signal Generator

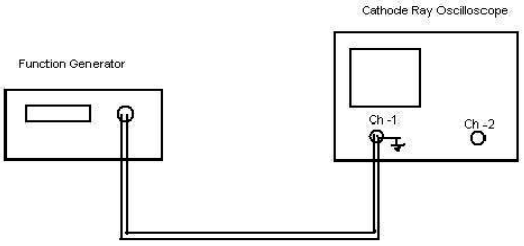

Figure 5: Connecting Function Generator to CRO

(b) Actual Circuit used in laboratory

(c)Actual Experimental set up used in laboratory

IX Resources required

Sr. No.	Name of Resource	Suggested Specification	Quantity
1.	CRO	0- 20MHz, dual trace, dual beam,	1 No.
2.	Signal Generator	0- 1 MHz	1 No.
3.	Connecting wires	Banana plugs	4 No.
4.	CRO Probes	Any	1No. each

X Precautions

1. An Oscilloscope should be handled gently to protect its fragile vacuum tube.
2. Never advance the Intensity control so far that an excessively bright spot appears. Bright spots imply burning of the screen. A sharp focused spot of high intensity (great brightness) should never be allowed to remain fixed in one position on the screen for any length of time. It may cause damage to the screen.

XI Procedure

Sine Wave

A) Measurement of Amplitude:

1. Make the connections as per the diagram shown above (fig 5).
2. Put the CRO on a single channel mode and bring the CRO into operation by adjusting the trace of the beam to a normal brightness and into a thin line.
3. Now apply the sinusoidal wave of different amplitudes by using signal generator
4. Note on the vertical scale the peak to peak amplitude (Vpp).

B) Measurement of Frequency:

1. Make the connections as per the diagram shown above (fig 5).
2. Put the CRO on a single channel mode and bring the CRO into operation by adjusting the trace of the beam to a normal brightness and into a thin line.
3. Now apply the sinusoidal wave of different frequencies by using signal generator
4. Note down the horizontal scale period (T) in second by observing difference between the two successive peaks of the waveform.

Square Wave:

A) Measurement of Amplitude:

1. Make the connections as per the diagram shown above (fig 5).
2. Put the CRO on a single channel mode and bring the CRO into operation by adjusting the trace of the beam to a normal brightness and into a thin line.
3. Now apply the square wave of different amplitudes by using signal generator
4. Note on the vertical scale the peak to peak amplitude (Vpp).

B) Measurement of Frequency

1. Make the connections as per the diagram shown above (Fig 5).
2. Put the CRO on a single channel mode and bring the CRO into operation by adjusting the trace of the beam to a normal brightness and into a thin line.
3. Now apply the square wave of different frequencies by using signal generator.
4. Note down the horizontal scale period (T) in second by observing difference between the positive transitions of two successive waveforms.

XII Resources Used

Sr. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

1. ……
2. ……
3. ……
4. ……
5. ……
6. ……

XIV Precautions followed

1. ……
2. ……
3. ……
4. ……

XV Observations and Calculations:

Function	Vertical Division (a)	Volts/div (b)	Amplitude (p-p) a x b	Horizontal division(c)	Time / div (d)	Time period (T) c x d	Frequency (1/T)
Sine							

Square							

XVI Results

Amplitude of sine wave is …… (any one)
Amplitude of square wave …….. (any one)
Frequency of sine wave is ……..(any one)
Frequency of square wave is ……..(any one)

XVII Interpretation of results (Give meaning of the above obtained results)

……..
……..
……..
……..

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……
……
……
……

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Determine the amplitude of the waveform from Vp-p calculated.
2. If time period of sine wave is 1*m*S, calculate the frequency.

[Space for answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book/Website	Author	Publication
1	Web References	--	*https://www.youtube.com/watch?v=oGRtDfk-qgM* *https://www.youtube.com/watch?v=tCpChoMWhjE*

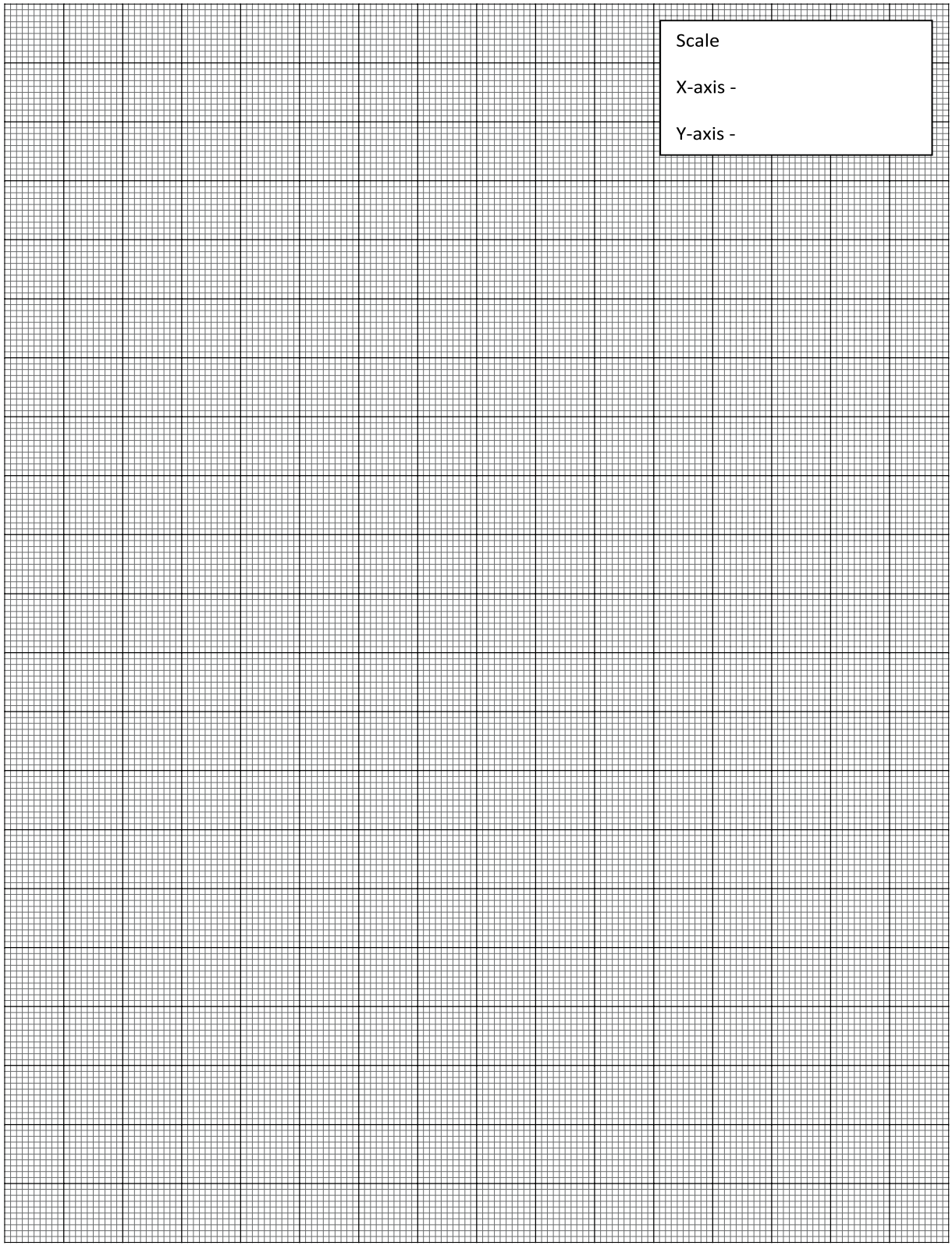
XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Proper connection of electrical circuit and Handling of the instrument	20%
2	Taking proper readings	20%
3	Calculation of amplitude and frequency.	20%
Product related (10 Marks)		**40%**
1	Interpretation of result&Conclusions	20%
2	Practical related questions	10%
3	Completion and submission of experiment in time	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. …….……
3. ……..……
4. ……...

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	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Practical No.2: Identify Active and Passive Electronic Components in the given Circuit.

I Practical Significance

In industries, to build any hardware, it is necessary to identify electronic component, their terminals, values and packaging. Depending on application appropriate components need to be selected for better performance. In this experiment student will identify active and passive electronic components on the basis of physical verification and basic knowledge about the components. Multimeter /LCR-Q meter are used to verify the components value.

II Relevant Program Outcomes (POs)

PO1. **Basic knowledge**: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.

PO4. E**ngineering Tools:** Apply appropriate technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***:

i. Identify electronic components.
ii. Calculate/ Measure value of component.

IV Relevant Course Outcome(s)

- Identify electronic components in electronic circuits.

V Practical Outcome

To identify active and passive Electronic components in a given circuit.

- Identify active and passive electronic components in the given circuit
- Identify component, terminals and packaging of a component.
- Measure/ Calculate the valuesof given components.

VI Relevant Affective domain related Outcome(s)

i. Handle components and instruments with care.
ii. Work in team.

VII Minimum Theoretical Background

Active components: Those devices or components which required external source for their operation is called Active Components. An active component may provide power gain to a circuit.
Example: Diodes & Transistors

Passive Components: Those devices or components which do not require external source for their operation are called Passive Components. A passive component does not provide any power gain to a circuit.
Example: Resistor, Capacitor and Inductor

VIII Practical Circuit diagram

(a) Sample

Figure 1: Passive Components and Active Components

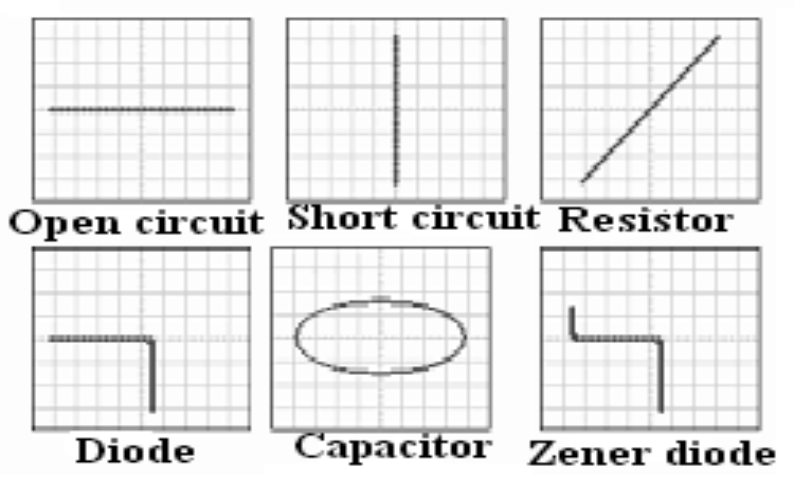


Figure 2: Testing components on CRO

(b) Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory: NA

IX Resources required

S.No.	Name of Resource	Suggested Specification	Quantity
1	Digital Multimeter / LCR-Q meter / CRO	3 ½ Digit DMM 20MHz Dual Trace Dual Beam CRO LCR/Q meter	1 No. each
2	Electronic Components	Resistors, Capacitors, inductors, PN junction diode, Zener diode, LED, BJT	10 No.
3	Any other		

X Precautions

1. Care should be taken while handling terminals of components.
2. Select proper range & mode of ammeter and voltmeter.
3. Connect probes of measuring instrument tightly to terminals of a component.

XI Procedure

Part I

Passive Components:

1. Identify each terminal of the given component.
2. Select the proper range and position of various knobs of multimeter/ LCR-Q to test the given component.
3. Observe the value of the given component on the multimeter / LCR-Q meter.
4. Compare the obtained value with its theoretical value.

Passive /Active Components:

1. Switch on CRO.
2. Select component test mode on CRO.
3. Ensure short stable horizontal line on screen.
4. Connect the probe to CRO.
5. Perform open circuit test by keeping two terminals open. Observe waveform on the screen as shown in above figure.
6. Perform short circuit test by shorting two terminals. Observe waveform on the screen as shown in above figure.
7. Connect resistance component in terminals of probe.
8. Observe waveform on the screen as shown in above figure.
9. Repeat procedure step 11 and 12 for other components such as capacitor, diode, Zener diode, inductor.
10. Switch off the CRO.
11. Infer from the patterns obtained on the display screen of the CRO.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII Actual Procedure Followed

1. Select the electronic component available in the laboratory.
2. ……
3. ……
4. ……
5. ……
6. ……

XIV Precautions

1. ……..
2. ……..

XV Observations and Calculations(use blank sheet provided if space not sufficient)

a. Identify component by its physical observation.
b. Label its terminals.

Table 1: Measure values of components

Component	Measured value	Theoretical value
Resistor	1 2 3	
Inductor	1 2 3	

Component	Measured value	Theoretical value
Capacitor	1 2 3	

(Minimum 3 components for each)

Draw the waveform obtained on CRO for the various components

Open Circuit		**Short Circuit**	
Resistor		**Capacitor**	
PN Diode		**Zener**	

XVI Results

……

……

XVII Interpretation of results (Give meaning of the above obtained results)

……

……

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……...

……...

XVIII Practical related Questions

Note: Below given are few sample questions for reference. Teachers must designmore such questionsso as to ensure the achievement of identified CO.

1. Sketch the given components and label them.
2. Write the range of the Multimeter used for measuring 10KΩ resistor.
3. ……...?
4. ……..?

[Space for answers]

XIX References / Suggestions for further Reading

S. No	Title of Book / Website	Author	Publication
1	Laboratory Manual for introductory electronics experiments	Maheshwari, L.K.; Anand, M.M.S.	New Age International Pvt. Ltd. New Delhi, ISBN:9780852265543
2	Web References		1.http://www.electricaltechnology.org 2.nptel.ac.in/courses/IITMADRAS/Basic_Electronics_Lab/LECTURE2.pdf

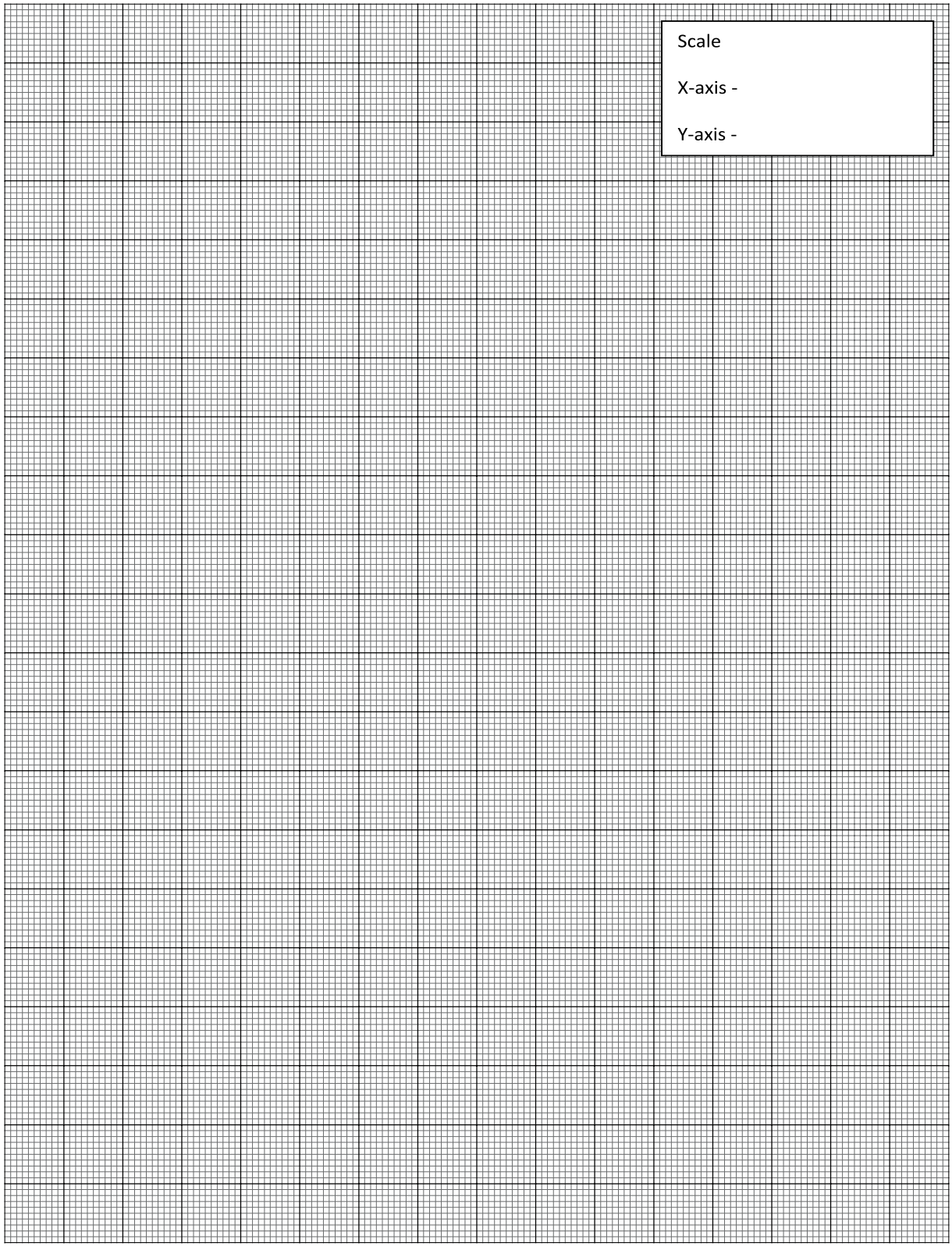
XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of components and instruments.	20%
2	Taking proper readings and comparing with theoretical values	20%
3	Working in team	20%
Product related (10 Marks)		**40%**
1	Interpretation of result&Conclusions	20%
2	Practical related questions	10%
3	Completion and submission of experiment in time	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	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Practical No.3: Test the Performance of the given PN Junction Diode.

I Practical Significance

In industries as well as in domestic appliances PN Junction diode is used in detector circuits, wave shaping circuits and in rectification of DC Power Supplies. For these applications diode selection plays a vital role. In this practical, students will draw V-I characteristics of the given diode to understand unidirectional behavior of diode.

II Relevant Program Outcomes (POs)

PO2. **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad-based Computer Engineering related problems.

PO3.**Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Computer Engineering problems.

PO4.**Engineering tools:** Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***:

i. Connect circuits.
ii. Record Measurements.
iii. Analyze Circuits.

IV Relevant Course Outcome(s)

Use of diodes in different applications.

V Practical Outcome

Test the performance of the given PN junction diode:

- Calculate static resistance of a given diode.
- Calculate dynamic resistance of a given diode.
- Determine knee voltage of a given diode.

VI Relevant Affective domain related Outcome(s)

i. Handle components and equipment carefully.
ii. Work in Team.
iii. Aesthetically connecting the circuit.

VII Minimum Theoretical Background

A PN Junction Diode supports uni- directional current flow.

Forward bias

If +ve terminal of the input supply is connected to p-side (anode) and –ve terminal of the input supply is connected to the n-side (cathode), the diode is said to be forward biased. A depletion region is formed in a p-n diode due to the absence of charge carriers. This region gives rise to a barrier potential called cut-in voltage or knee voltage.

When the diode is forward biased, the height of the barrier potential at the junction is lowered by an amount equal to given forward biasing voltage. Both the holes from p-side and electrons from n-side cross the junction simultaneously and constitute a forward current. The diode is considered as a short circuited switch.

Reverse bias

If –ve terminal of the input supply is connected to p-side (anode) and +ve terminal of the input supply is connected to n-side (cathode), then the diode is said to be Reverse biased. The barrier potential here increases at the junction by an amount equal to reverse biasing voltage. This increases the depletion region. A small current due to minority carriers called reverse saturation current continues to flow in the diode. This is negligible and hence the diode is approximated as an open circuited switch.

Static resistance: (R_{dc}) of a PN junction diode is a ratio of forward voltage (V_F) to the forward current (I_F).

$$\text{Static forward resistance } R_{dc} = \frac{V_F}{I_F}$$

The ratio of reverse voltage V_R to reverse current I_R is the static reverse resistance.

$$\text{Static reverse resistance } R_{dc} = \frac{V_R}{I_R}$$

Dynamic resistance: (r_{ac}) of a PN junction diode is a ratio of small change in forward voltage (ΔV_F) to small change the forward current (ΔI_F).

$$\text{Dynamic forward resistance } r_{ac} = \frac{\Delta V_F}{\Delta I_F}$$

The ratio of small change in reverse voltage (ΔV_R) to small change the reverse current (ΔI_R).

$$\text{Dynamic reverse resistance } r_{ac} = \frac{\Delta V_R}{\Delta I_R}$$

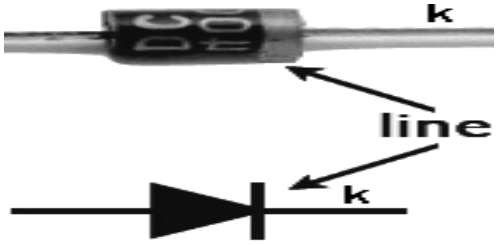

Figure 1: Diode and its symbol

Courtesy: (https://www.google.co.in/search?q=image+of++1n4007+diode&)

VIII Practical Circuit diagram

i. Sample

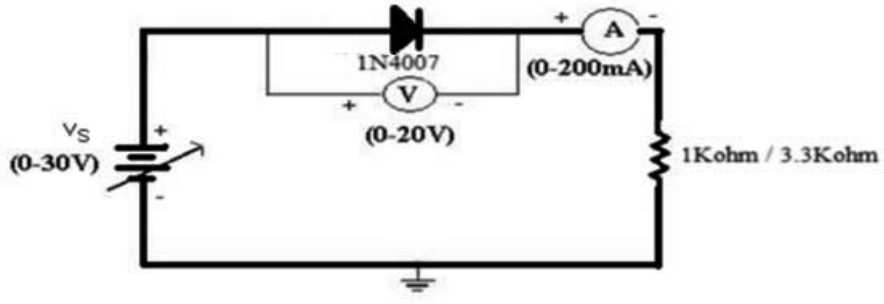

Figure 2: Forward bias condition

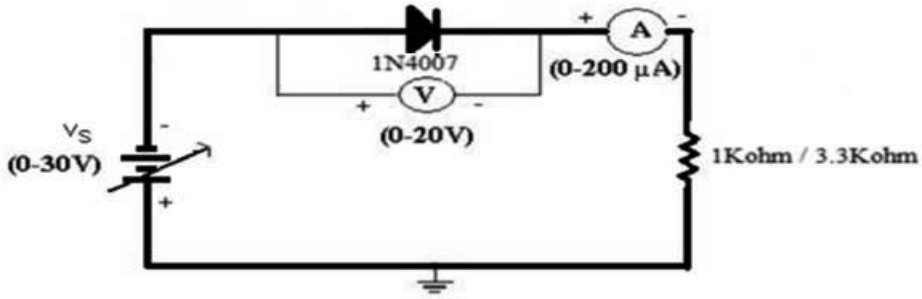

Figure 3: Reverse bias condition

(b) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory: NA

IX Resources Required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	1 No.
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1 No.
3.	DC Voltmeter	0-20 V	1 No.
4.	DC Ammeter	(0 - 200 mA, 0 - 200 µA)	1 No.
5.	Bread board		1 No.
6.	Diode	IN4007 (or any other equivalent diode)	1 No.
7.	Resistor	1KΩ/ 3.3 KΩ(0.5watts/0.25watts)	1 No.
8.	Connecting wires	Single strand	-
9.	Any other		

X Precautions

1. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode.
2. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
3. Do not switch ON the power supply unless the circuit connections are checked as per the circuit diagram.

XI Procedure

Forward bias condition

1. Connect the components as shown in Figure 2.
2. Switch on the power supply.
3. Vary the supply voltage V_S such that the voltage across the silicon diode (V_F) gradually changes from 0 to 0.6 V in steps of 0.1V and then in steps of 0.05 V from 0.6 to 0.76V. For each step (voltage across the diode) record the current flowing through the diode (I_F)
4. Tabulate different forward currents for different forward voltages.

Reverse bias condition

1. Connect the silicon diode in reverse bias as shown in Figure 3.
2. Vary the supply voltage V_S such that the voltage across diode (V_R) changes in steps of 1V from 0 to 10V. In each step note the current flowing through the diode (I_R).
3. Tabulate different reverse currents for different reverse voltages.

Graph

1. Take a cm graph sheet and divide it into 4 equal parts. Mark origin at the center of the graph sheet.
2. Mark +ve X- axis as V_F and –ve X-axis as V_R . +ve Y-axis as I_F and –ve Y-axis as I_R
3. Mark the readings tabulated for forward bias condition in first quadrant and reverse bias condition in third quadrant.

Calculate static resistance and dynamic resistance of the diode in forward and reverse bias condition

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

1. ……
2. ……
3. ……
4. ……
5. ……
6. ……

XIV Precautions

1. ……
2. ……..……...

XV Observations and Calculations(use blank sheet provided if space not sufficient)

Forward bias condition

Table 1: Measurement of V_F and I_F

S.No.	Forward Voltage across the diode V_F (VOLTS)	Forward Current through the diode $I_{F(mA)}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Reverse bias condition

Table 2: Measurement of V_R and I_R

S.No.	Reverse Voltage across the diode $V_{R(VOLTS)}$	Reverse Current through the diode $I_{R(\mu A)}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Calculations :

From graph

Static forward resistance

$R_{dc} = \frac{V_F}{I_F}$

Static reverse resistance

$R_{dc} = \frac{V_R}{I_R}$

Dynamic forward resistance

$r_{ac} = \frac{\Delta V_F}{\Delta I_F}$

Dynamic reverse resistance

$r_{ac} = \frac{\Delta V_R}{\Delta I_R}$

XVI Results

1. Static forward resistance of given diode = ……
2. Dynamic forward resistance of given diode = ……
3. Static reverse resistance of given diode = ……
4. Dynamic reverse resistance of given diode = ……..
5. Knee Voltage of given diode = ……

XVII Interpretation of Results (Give meaning of the above obtained results)

……

……

XVIII Conclusion(Actions/decisions to be taken based on the interpretation of results).

……

……

XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Repeat the above experiment for germanium diode and find its knee voltage.
2. Find out the voltage across silicon diode at knee voltage.
3. Find out the voltage across germanium diode at knee voltage.

[Space for answers]

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XX References / Suggestions for Further Reading

S.No.	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S. Chand and Co., New Delhi 2008,ISBN 978-8121927833
2	Principles of Electronics	V.K.Mehta	S. Chand and Co., Ram Nagar ,New Delhi-110055,11th Edition,2014.ISBN 978812192405
3	Web Reference		1.https://www.youtube.com/watch?v=_vKeaPHXF9U 2.https://www.youtube.com/watch?v=7U8NzRAvy-I 3.https://www.youtube.com/watch?v=UqJ258EPTkI 4.https://www.youtube.com/watch?v=Coy-WRCfems 5.http://www.mouser.com/ds/2/149/1N4007-888322.pdf

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
1	Calculate theoretical values of given component	10 %
2	Interpretation of result	05 %
3	Conclusions	05 %
4	Practical related questions	15 %
5	Completion and submission of experiment in time	05%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. …….
2. …….
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No.4: Test the Performance of the given Zener Diode

I Practical Significance

In industries, Zener diodes are widely used as voltage references and as shunt regulators to regulate the voltage across small circuits, over voltage protection circuits and switching applications. Zener diodes are used in Surge suppression circuitry for device protection. Zener diodes are used in clipping and clamping circuits especially peak clippers. The student will be able to plot the forward and reverse characteristics of the Zener diode and measure the Zener voltage.

II Relevant Program Outcomes (POs)

PO2. Discipline knowledge: Apply basic electronics engineering knowledge to solve broad-based Computer engineering related problems.

PO3. Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Computer engineering problems.

PO4. Engineering tools: Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***:

i. Connect circuits.
ii. Record Measurements.
iii. Analyse Circuits.

IV Relevant Course Outcome(s)

- Use of diodes in different applications.

V Practical Outcome

Test the performance of the given Zener diode.

- Identification of components
- Mounting components on the circuit board
- Use DC Power supply to give different voltages
- Use Digital multimeter to measure the voltage and current

VI Relevant Affective domain related Outcome(s)

i. Handle components and equipment carefully.
ii. Work in Team.

VII Minimum Theoretical Background

Zener diode is a heavily doped silicon diode. It conducts in reverse biased condition. These diodes operate at a precise value voltage called breakdown voltage. A Zener diode when forward biased behaves like a PN junction diode. A Zener diode when reverse biased can undergo avalanche breakdown or Zener breakdown.

Avalanche Breakdown

If both p-side and n-side of the diode are lightly doped, depletion region at the junction widens. Application of a very large electric field at the junction increases the

kinetic energy of the charged carriers which collides with the adjacent atoms and generates charged carriers by breaking the bond; they in turn collide with other atoms by creating new charge carriers. This process is cumulative which results in the generation of large currents and is called “Avalanche breakdown”.

Zener Breakdown

If both p-side and n-side of the diode are heavily doped, depletion region at the junction decreases, it leads to the development of strong electric field and application of a very small voltage at the junction may rupture the covalent bonds. This generates large numbers of charge carriers resulting in “Zener breakdown”.

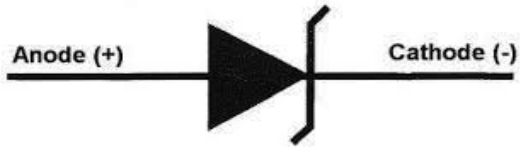

Figure 1: Zener Diode and its symbol

VIII Practical Circuit diagram:

(a) Sample

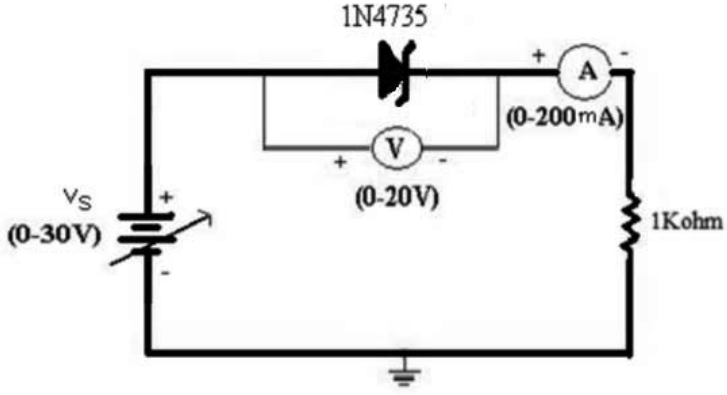

Figure 2: Forward Bias Condition

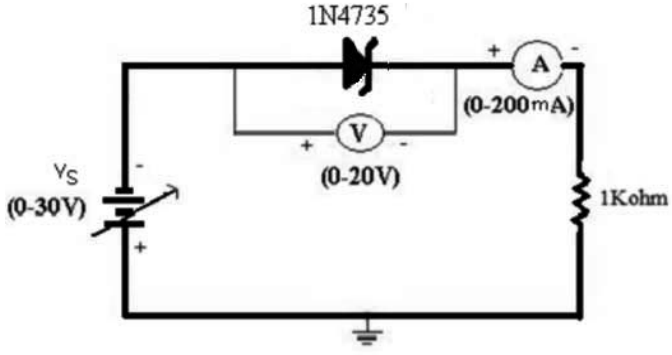

Figure 3: Reverse Bias Condition

(b) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory: NA

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Digital Multimeter	3 1/2 digit display.	1 No.
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1 No.
3.	DC Voltmeter	0-20 V	1 No.
4.	DC Ammeter	(0 - 200 mA)	2 No.
5.	Bread board		1 No.
6.	Zener Diode	IN4735 (or any other equivalent diode)	1 No.
7.	Resistor	1KΩ(0.5watts/0.25watts)	1 No.
8.	Connecting wires	Single strand	-
9.	Any other		

X Precautions

1. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode
2. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
3. Do not switch ON the power supply unless the circuit connections are checked as per the circuit diagram.

XI Procedure

Forward bias condition

1. Connect the electrical circuit as in Figure 2.
2. Switch ON the power supply.
3. Vary the supply voltage Vs such that the voltage across the Zener diode (V_F) varies gradually from 0 to 0.6 V in steps of 0.1V and then in steps of 0.05 V from 0.6 to

0.76V. For each step (voltage across the diode) record the current flowing through the diode (I_F)

4. Tabulate different forward currents for different forward voltages.

Reverse bias condition

1. Connect the Zener diode in reverse bias as shown in Figure 3.
2. Vary the supply voltage Vs such that the voltage across Zener diode (V_R) changes in steps of 1V from 0 to 6V and in steps of 0.1 V till the breakdown voltage is reached. In each step note the current flowing through the diode (I_R).
3. Tabulate different reverse currents for different reverse voltages.

Graph

1. Take a cm graph sheet and divide it into 4 equal parts. Mark origin at the center of the graph sheet.
2. Mark +ve X- axis as V_F and –ve X-axis as V_R . +ve Y-axis as I_F& –ve Y-axis as I_R.
3. Mark the readings tabulated for forward bias condition in first quadrant and reverse bias condition in third quadrant.

Calculate static resistance and dynamic resistance of the diode in forward bias condition.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed

1. Connect the electrical circuit as per circuit used in laboratory.
2. ……..
3. ……..
4. ……..
5. ……..
6. ……..
7. ……..

XIV Precautions

1……..

2. ……..

XV Observations and Calculations

Forward bias condition

Table 1: Measurement of V_F and I_F

S. No.	Forward Voltage across the diode $V_{F(VOLTS)}$	Forward Current through the diode $I_{F(mA)}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Reverse bias condition

Table 2: Measurement of V_R and I_R

S. No.	Reverse Voltage across the diode $V_{R(VOLTS)}$	Reverse Current through the diode $I_{R(mA)}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Calculations :

From graph :

Static forward resistance

$R_{dc} = \frac{V_F}{I_F}$

Dynamic forward resistance

$r_{ac} = \frac{\Delta V_F}{\Delta I_F}$

XVI Results

a. Zener breakdown voltage = …….
b. Static forward resistance of Zener diode = …….
c. Dynamic forward resistance of Zener diode = ……

XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. State the value of Zener voltage for the given Zener diode?
2. State the maximum value of reverse current for the given Zener diode?

[Space for answers]

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XX References / Suggestions for further Reading

S. No.	Title of Book /WebSite	Author	Publication
1	Web References	--	https://www.youtube.com/watch?v=itzPT3UbClI

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
	Handling of the components	10 %
	Identification of component	20 %
	Measuring value using suitable instrument	20 %
	Working in team	10 %
Product related (10 Marks)		**40%**
	Calculate theoretical values of given component	10 %
	Interpretation of result	05 %
	Conclusions	05 %
	Practical related questions	15 %
	Completion and submission of experiment in time	05%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No.5: Test the Performance of the Given Zener Voltage Regulator

I Practical Significance

In industries, it is required to provide regulated power supply to various circuits and Integrated Circuits. Zener diode finds a wide application commercially and industrially. The reverse characteristics of Zener diode exhibit a constant voltage across the device and allow the current to increase through it without damage up to certain level. Zener diodes have a primary application as a voltage regulator. Various electronic equipments and circuits require regulated power supply which can be provided by Zener regulator.

II Relevant Program Outcomes (POs)

PO2. **Discipline knowledge:** Apply basic electronics engineering knowledge to solve broad-based Computer engineering related problems.

PO3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Computer engineering problems.

PO4. **Engineering tools:** Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use simple electronic circuits of computer system'***:

I Connect circuits.
II Record Measurements.
III Analyze Circuits.

IV Relevant Course Outcome(s)

Use of diodes in different applications.

V Practical Outcome

Test the performance of the given Zener diode voltage regulator:

(i) Identification of components.
(ii) Mounting components, connect inputs and measure outputs.
(iii) Vary the input voltage.
(iv) Use Digital multimeter to measure the voltage and current.

VI Relevant Affective domain related Outcome(s)

i. Careful handling of components and circuits.
ii. Visually aesthetic connections.

VII Minimum Theoretical Background

Zener diode is designed to operate in the breakdown region without damage by changing the doping level. It is possible to construct Zener diode with required breakdown voltage in reverse bias condition.

After breakdown, Zener diode acts as a constant voltage source i.e. if the applied reverse voltage exceeds the Zener voltage, it keeps the voltage across the device constant. Since it acts as a constant voltage regulator i.e. it keeps the output voltage constant irrespective of changes in load current or changes in input voltage.

VIII Practical Circuit diagram

i. Sample

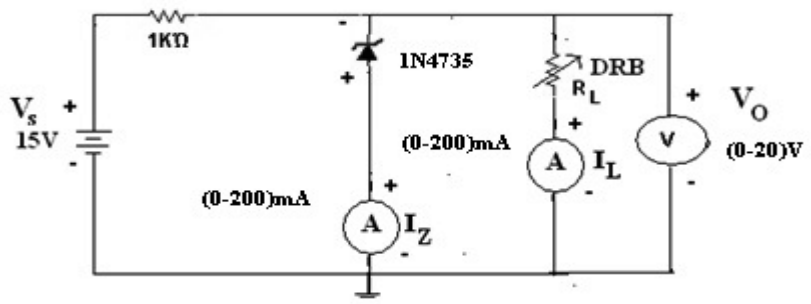

Figure 1: Load Regulation

Courtesy:https://www.google.co.in/search?q=zener+diode+as+voltage+regulator+experiment&sa=X&dcr=0

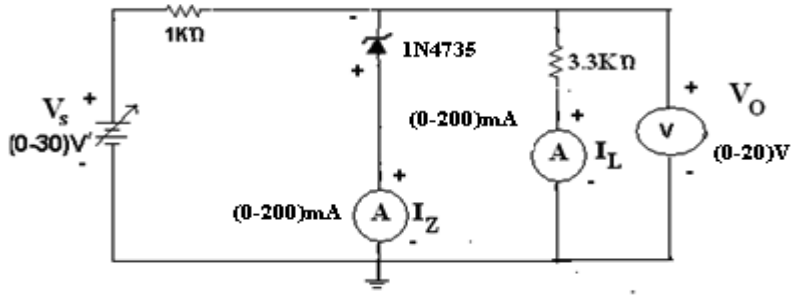

Figure 2: Line Regulation

Courtesy:https://www.google.co.in/search?q=zener+diode+as+voltage+regulator+experiment&sa=X:

(b) Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory: NA

IX Resources Required

Sr. No.	Name of Resource	Suggested Specification	Quantity
I	DC Regulated Power supply	Variable DC power supply 0-30V,2A display for current & voltage	1 No.
II	DC Ammeter	0-200 mA	02
III	Digital Multimeter	3 ½ digit display	01
IV	Zener Diode	IN 4735(or any other equivalent diode)	01
V	Resistor	1K, 3.3KΩ	2 Nos.
VI	Potentiometer	10KΩ	01
VII	Connecting Wires		

X Precautions

1. Do not switch ON the power supply unless the circuit connection are checked as per the circuit diagram.
2. See the data sheet to know the reverse breakdown voltage of the given diode before starting the experiment.
3. Connect Voltmeters/Ammeters in correct polarities as shown in the circuit diagram.
4. Switch OFF the power supply after taking reading.

XI Procedure

1. Connect the circuit as per the circuit diagram.
2. Switch ON the power supply.

Load Regulation :(Keep the Input voltage at 5V – 10V)

1. By changing the Load Resistance, $R_{L,}$Measure the corresponding output (Voltmeter) voltage.
2. Measure the current in the two ammeters to measure Zener current I_Z and Load current $I_{L.}$

Line Regulation:

1. Keep the Load resistance R_L constant. Vary the input supply V_S &note down the corresponding output voltage.

Graph

Plot the graph of Load current I_L(X-axis) Versus Load voltage V_O (Y-axis)

Plot a graph between Input voltage V_s(X-axis) Versus Output Voltage V_O (Y-axis)

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..
6. ……..
7. ……..

XIV Precautions

1. ……
2. ……_……..

XV Observations and Calculations (use blank sheet provided if space not sufficient)

a. Load Regulation

Input Voltage V_S = **---------**

Table: 1

Sr. No	I_Z(mA)	I_L(mA)	V_O(V)

Calculation: No Load Voltage V_{NL}- Output voltage across $R_L$when Load current is minimum. Full load Voltage V_{FL}- Output voltage across $R_L$when Load current is maximum.

b. Line Regulation

Table: 2

Sr. No	V_S(V)	I_Z (mA)	I_L (mA)	V_O(V)

Calculations:

i. Load Regulation=$\frac{V_{NL}-V_{FL}}{V_{FL}}$ x 100 (From Table: 1)

ii. Line Regulation= $\frac{\Delta V_0}{\Delta V_S}$x 100 (From Table: 2)

XVI Results

1. % Load Regulation= ……..
2. % Line Regulation= ……

XVII Interpretation of Results (Give meaning of the above obtained results)

……
……

XVIII Conclusions(Actions/decisions to be taken based on the interpretation of results).

……
……

XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Give the value of input voltage when Zener current starts increasing?
2. For what value of Load resistance the Load current is Minimum?
3. For what value of Load resistance the Load current is Maximum?

[Space for answers]

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XX References / Suggestions for Further Reading

S. No.	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S. Chand and Co., New Delhi 2008,ISBN 978-8121927833
2	Principles of Electronics	V.K.Mehta.	S. Chand and Co., Ram Nagar,New Delhi-110055,11th Edition,2014.ISBN 978-812-192405

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
1	Calculate theoretical values	10 %
2	Interpretation of result	20 %
3	Conclusions	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. .....
2. .....
3. .....
4. .....

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No.6: Convert AC Signal into DC Signal Using Half Wave Rectifier (HWR)

I Practical Significance

Electrical energy is distributed as alternating current because AC Voltage can be increased or decreased with the help of transformers. This allows power to be transmitted through power lines efficiently. AC voltage is represented as sine wave voltage. For certain electronic applications like computers, DC power supply is required. Rectifier is a circuit that converts AC to pulsating DC. The student will be able to analyze the unidirectional behavior of diode for rectification.

II Relevant Program Outcomes (POs)

PO2. **Discipline knowledge**: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO3. **Experiments and practice:** An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***:

i. Connect Circuits
ii. Record measurements.
iii. Observe waveforms
iv. Analyze results

IV Relevant Course Outcome(s)

Use diodes in different applications.

V Practical Outcome

Convert AC signal into DC signal using Half Wave Rectifier.

i. Identify terminals of the component.
ii. Mount the circuit components of Half Wave Rectifier.
iii. Use functions of CRO required for Half Wave Rectifier
iv. Evaluate performance of Half Wave Rectifier by observing Output DC voltage waveform

VI Relevant Affective domain related Outcome(s)

i. Handle equipments and components carefully
ii. Work in team

VII Minimum Theoretical Background

Rectifier is an electronic circuit used for converting a pure AC into a pulsating DC and this process of conversion is known as Rectification. A half wave rectifier uses a single diode to carry out this conversion. During the positive half cycle of the input wave, the diode will be forward biased and it conducts and hence current flows through the load resistor. During the negative half cycle of input wave, the diode will be reverse biased and it is equivalent to an open circuit. Hence current through load resistance is zero. Thus, the rectifier (diode) conducts current during positive half cycle of AC input and does not conduct current during negative half cycle. This is

called **half wave rectification.** Rectifier performance is based on efficiency of DC output.

Ripple factor:
Ripple factor is defined as the ratio of the effective value of AC components to the average DC value. It is denoted by the symbol 'γ'.

$\gamma =$ ——

For Half Wave Rectifier (HWR),

Ripple factor = ——= 1.21

VIII Practical Circuit diagram:

(a) Sample

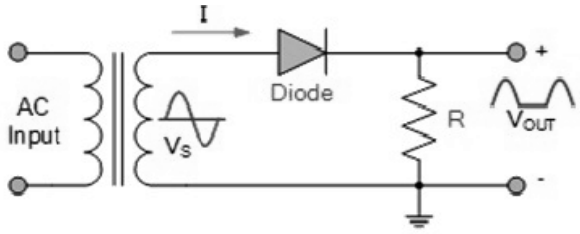

Figure1: Half Wave Rectifier

(b) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory

IX Resources Required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	CRO	0-20MHz (Dual Trace)	1
2.	DC Voltmeter	0-20 V	1 No.
3.	DC Ammeter	(0 - 200 mA, 0 - 200 μA)	1 No.
4.	Bread board		1 No.
5.	Transformer	220V/9V AC, 500 mA	1 No.
6.	Diode	1N4001 (or any other equivalent diode)	1 No.
7.	Resistor	1KΩ (0.5watts/0.25watts)	1 No.
8.	Connecting wires	Single strand	-
9.	CRO Probes		2

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode
3. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

XI Procedure

1. Connect the Electronic circuit for half wave rectifier on bread board as shown in Figure 1.
2. Connect the primary side of the transformer to AC mains. Connect the CRO probe across the secondary and measure the V_{inp-p}appearing across diode. Now connect the probes across the resistance R.
3. Keep CRO in DC mode, adjust the zero dc level and measure accurately the peak value of output voltage (V_m).
4. Trace the waveforms.
5. Calculate the average or dc value of output voltage and frequency of the waveform
6. Using a DC voltmeter, measure the DC voltage across the load resistance (V_{dc})
7. Measure the AC voltage across the load resistance by setting multi-meter to AC mode (V_{ac}).
8. Calculate Ripple factor.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed

1. Connect the electrical circuit as per Circuit used in laboratory.
2. ……..
3. ……..
4. ……..
5. ……....
6. ……..
7. ……..

XIV Precautions

1. ……
2. ……
3. ……

XV Observations and Calculations:

A. Waveform at Secondary of the Transformer (V_S):

Waveform at the output Resistor R_L (V_{OUT}):

B.

Table: 1

Load Resistance(R_L)	V_{ac}(V)	V_{dc}(V)	Ripple Factor $= \frac{V_{ac}}{V_{dc}}$	Input Signal		Output Signal	
				Vin p-p(V)	Frequency (Hz)	Vin p-p(V)	Frequency (Hz)

C. Calculation

$V_{dc}= \frac{V_m}{\pi}$ = ……V

Ripple Factor =$\frac{V_{ac}}{V_{dc}}$=……

Theoretical value of Ripple factor =…….

XVI Results

V_{dc} calculated = ……..……. V

Ripple factor = ……..

XVII Interpretation of results (Give meaning of the above obtained results)

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……..

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……..

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XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. State the effect on output voltage if we replace silicon diode with germanium diode.
2. If V_{dc} = 2 V, What will be the value of V_m ?

[Space for answers]

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XX References / Suggestions for further Reading

S. No	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S. Chand and Co., New Delhi 2008, ISBN 978-8121927833
2	Web References	-	http://nptel.ac.in/courses/117103063/4 http://www.electronicshub.org/tutorials/ http://www.electronics-tutorials.ws/

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10 %
2	Proper connection of wires for building circuit	20 %
3	Connect and select proper range of ammeter, voltmeter	20 %
4	Observe and plot Input / Output waveforms and measure V_m.	10 %
Product related(10 Marks)		**40%**
1	Interpretation of result	20 %
2	Conclusions	10 %
3	Practical related questions	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. …….
2. …….
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.7: Convert AC Signal into DC Signal Using Full Wave Rectifier.

I Practical Significance

Electrical energy is distributed as alternating current because AC voltage can be increased or decreased with the help of transformers. This allows power to be transmitted through power lines efficiently. AC voltage is represented as sine wave voltage. For certain electronic applications like computers, DC power supply is required. Rectifier is a circuit that converts AC to pulsating DC. In this experiment students will observe the working of full wave rectifier and can compare its performance with half wave rectifier.

II Relevant Program Outcomes (POs)

PO2. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.
PO3. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***:

i. Connect Circuits
ii. Record measurements.
iii. Analyze results
iv. Observe waveforms on CRO

IV Relevant Course Outcome(s)

- Use diodes in different applications

V Practical Outcome

Convert AC signal into DC signal using Full Wave Rectifier:

- Identify terminals of the component.
- Mount circuit components of full wave rectifier.
- Observe performance of full wave rectifier by Output DC voltage waveform
- Compare with half wave rectifier.

VI Relevant Affective domain related Outcome(s)

i. Handle equipments and components carefully
ii. Work in team

VII Minimum Theoretical Background

Rectifier is an electronic device used for converting AC into DC and this process is known as Rectification. Like the half wave circuit, a full wave rectifier circuit produces an output voltage or current which is pulsating DC or has some specified DC component. Full wave rectifier utilizes both the cycle of input AC voltage. Two diodes are used in full wave rectifier. Center Tapped Full wave rectifier using two diodes is shown in the following figure. Center tapped transformer is used in this full wave rectifier. During the positive cycle diode D_1 conducts and it is

available at the output. During negative cycle diode D_1 remains OFF but diode D_2 is in forward bias hence it conducts and negative cycle is available as a positive cycle at the output as shown in the following figure. Note that direction of current in the load resistance is same during both the cycles hence output is only positive cycles.

Ripple factor:

Ripple factor is defined as the ratio of the effective value of AC components to the average DC value. It is denoted by the symbol 'γ'.

$\gamma =$ ——

For Full Wave Rectifier (FWR),

Ripple factor = ——= 0.48

VIII Practical Circuit diagram:

(a) Sample

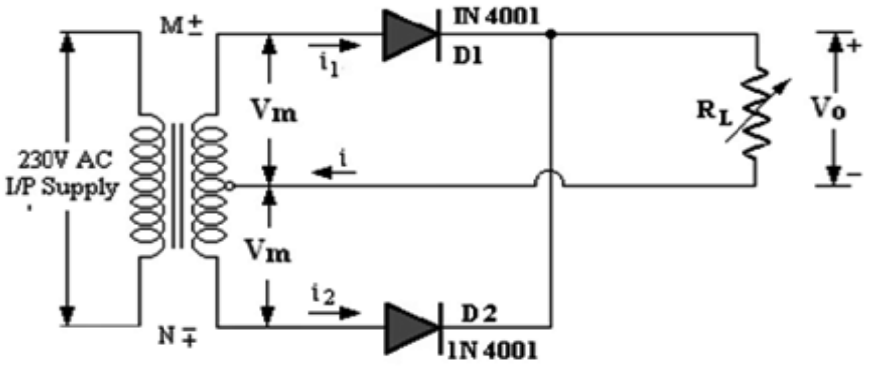


Figure 1: Full Wave Rectifier

(b) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Transformer (center tapped)	12-0-12 V AC, 500 mA	1 No.
2.	Resistor	1K Ω	1 No.
3.	Diode	Silicon Diode 1N4001/7	2 No.
4.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	1 No.
5.	Connecting wires	Single Strand	1 No.
6.	CRO	0-20 MHz(Dual Trace)	1 No.
7.	CRO Probes	-	2 No.

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode
3. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

XI Procedure

1. Connect the Electronic circuit for Center Tapped Full wave rectifier on bread board as shown in Fig 1.
2. Connect the primary side of the transformer to AC mains. Connect the CRO probe across the secondary and measure the V_{inp-p}appearing across diode. Now connect the probes across the resistance R_L.
3. Keep CRO in DC mode, adjust the zero dc level and measure accurately the peak value of output voltage (V_m).
4. Trace the waveforms.
5. Calculate the average or dc value of output voltage and frequency of the waveform
6. Using a DC voltmeter, measure the DC voltage at the load resistance (V_{dc})
7. Measure the AC voltage across the load resistance by setting multi-meter to AC mode (V_{ac}).
8. Calculate Ripple factor

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed

1. ……..……...
2. ……..……
3. ……..……
4. ……..…….
5. ……..…….
6. ……..…….

XIV Precautions

1. ……
2. ……

XV Observations and Calculations

A. Waveform at Secondary of the Transformer (V_m):

Waveform at the output Resistor R_L (V_O):

B.

Table 1

Load Resistance(R_L)	V_{ac}(V)	V_{dc}(V)	Ripple Factor = $\frac{V_{ac}}{V_{dc}}$	Input Signal		Output Signal	
				Vm p-p(V)	Frequency (Hz)	Vm p-p (V)	Frequency (Hz)

C. Calculations:

$V_{dc}=\frac{2V_m}{\pi}$= ……V

Ripple factor = $\frac{V_{ac}}{V_{dc}}$= …….

Theoretical Ripple factor =

XVI Results

V_{dc} calculated = ……..……. V

Ripple factor = ……

XVII Interpretation of results

……..

……

XVIII Conclusions

……..

……..

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Define ripple factor.
2. Compare half wave and Full wave rectifier based on output waveforms obtained in laboratory.

[Space for answers]

XX References / Suggestions for further Reading

S. No	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S.Chand and Co. , New Delhi, 2008 ISBN :978-8121927833
2	Basic Electronics	V.K.Mehta	S.Chand and co. Ram Nagar ,New Delhi-110055,11th Edition,2014.ISBN 978812192405
3	Web References	-	1.http://nptel.ac.in/courses/ 2.www.electronics-tutorials.ws› Diodes

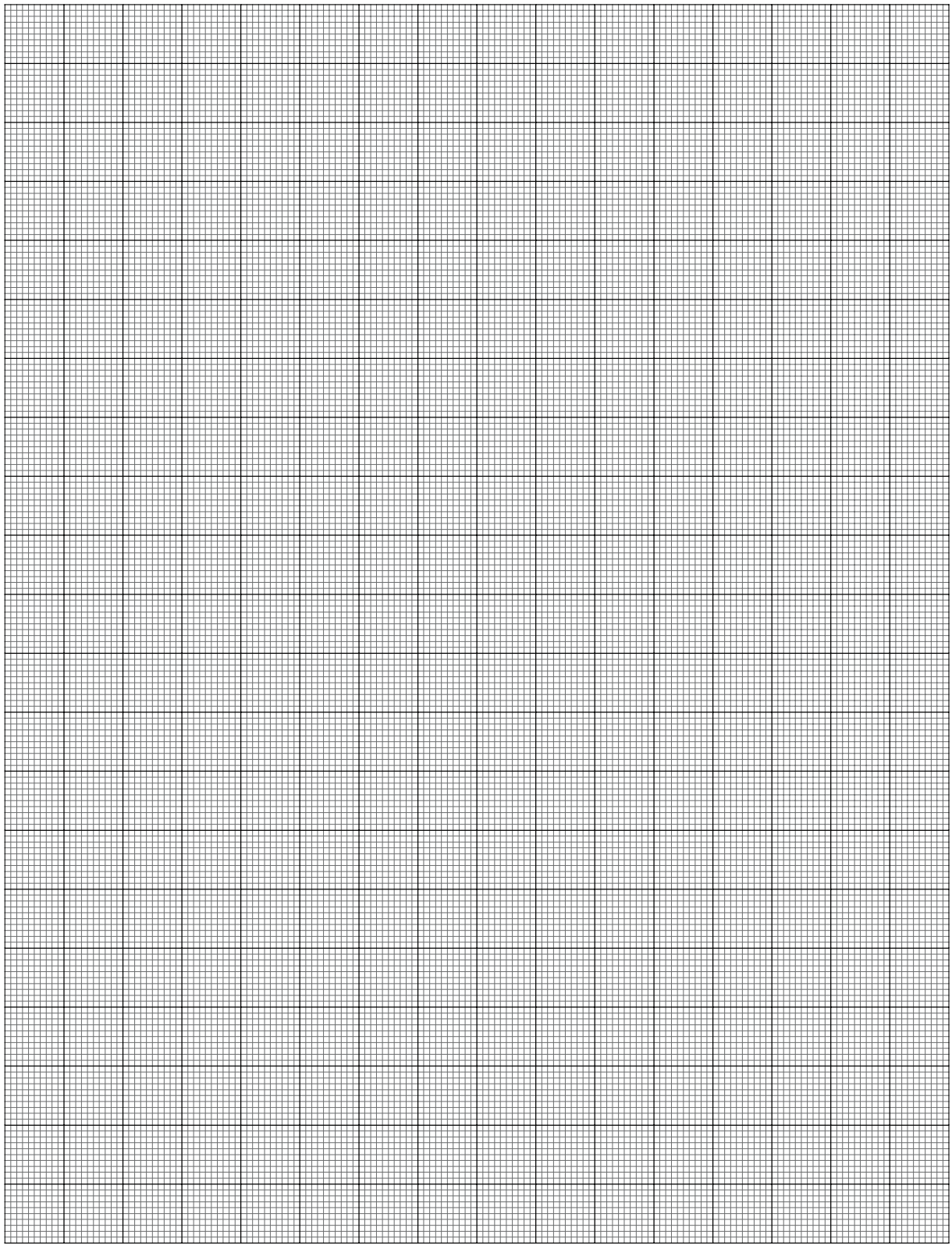
XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10%
2	Proper connection of wires for building circuit	10%
3	Connect and select proper range of ammeter, voltmeter	20%
4	Observe and plot Input / Output waveforms and measure V_m.	20%
Product related (10 Marks)		**40%**
1	Interpretation of result	20%
2	Conclusions	10%
3	Practical related questions	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. …….….
3. ……..…
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	



Practical No.8: Use Filters to Get Regulated DC

I Practical Significance

The devices which converts the pulsating DC into pure DC is called filter. Voltage regulator keeps the terminal voltage of the D.C. power supply constant, even if the a.c. input to the transformer varies or the load varies. The electronic reactive elements like capacitor and inductors are used to perform this function. In this experiment the student will be able to test the performance of L, C, LC and CLC filters.

II Relevant Program Outcomes (POs)

PO2. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO3. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use simple electronic circuits of computer system'***:

i. Connect Circuits
ii. Record measurements.
iii. Observe waveforms
iv. Analyze results

IV Relevant Course Outcome(s)

Use diodes in different applications

V Practical Outcome

Use filters to get regulated DC

(i) Identify terminals of the component.
(ii) Connect circuit Components of Half Wave Rectifier with filter
(iii) Connect circuit components of Full Wave Rectifier with filter .
(iv) Observe and compare performance of Half Wave Rectifier and Full Wave Rectifier with filters.

VI Relevant Affective domain related Outcome(s)

i. Handle the components with care
ii. Make Aesthetically clean connections
iii. Work in team
iv. Follow ethical practices

VII Minimum Theoretical Background

A rectifier is a circuit that converts a pure AC signal into pulsating DC signal or a signal that is a combination of AC and DC components. In DC supplies, a rectifier is followed by a filter circuit which converts the pulsating DC signal into pure DC signal by removing the AC component.

A filter circuit consists of passive components like resistor, inductor, capacitor and their combination. For example, an inductor allows DC to flow through it but blocks AC On the other hand, capacitor allows to flow AC through it, but blocks DC.

Therefore capacitor filter is always connected in parallel with the load. Whereas inductor filter is connected in series with the load.
Combination of L and C i.e. LC or CLC filters are also widely used for getting better filtered output.

VIII Practical Circuit diagram:

(a) Sample

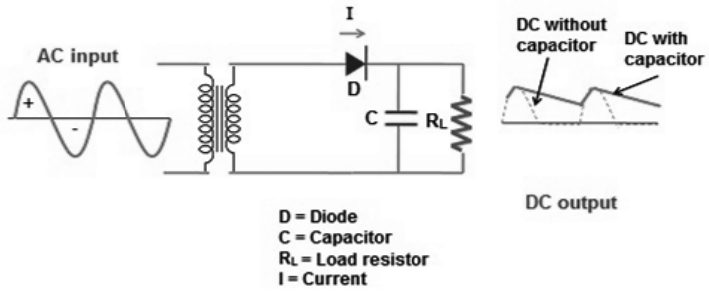


Figure1: Half wave rectifier with capacitor filter

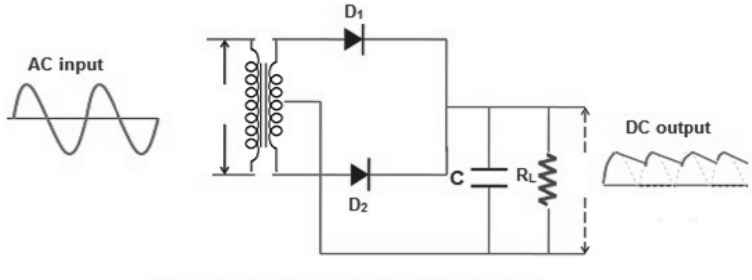


Figure 2: Full Wave rectifier with capacitor filter

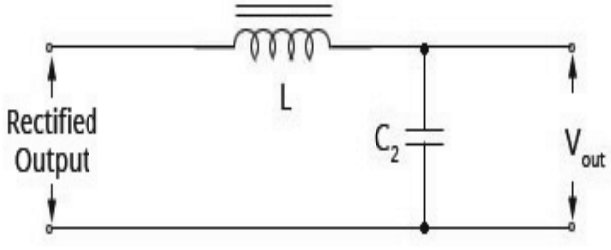


Figure 3: L-C Filter

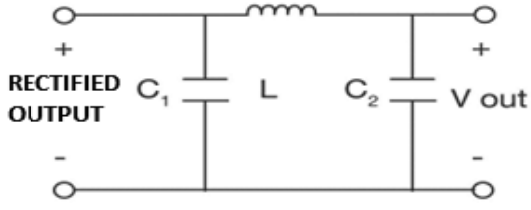


Figure4: C-L-C Filter

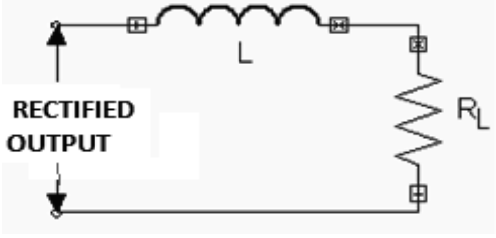


Figure 5: L Filter

(b) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Transformer (center tapped)	6-0-6 V AC, 500 mA	1 No.
2.	Resistor	1K Ω	1 No.
3.	Diode	Silicon Diode IN4007	2 No.
4.	Digital Multimeter	3 1/2 digit display.	1 No.
5.	Capacitor, Inductor	2.2μF, 720mH	1 No.
6.	C.R.O.	0-20 MHz(Dual trace)-	1 No.
7.	Connecting wires	Single Strand	1 No.
8.	Any other		

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode
3. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

XI Procedure

Part I

1. Connect the Electronic circuit for half wave rectifier on bread board as shown in Figure 1.
2. Connect the primary side of the transformer to AC mains and the secondary side to rectifier input.
3. Before switching on power supply, check the connection.
4. Switch ON the power supply and set CRO in DC mode adjust level accurately.
5. Observe the Waveforms across load resistance R_L for capacitor filter.
6. Connect the inductor as shown in Figure 5 and observe the waveform across load resistor

Part II

1. Connect the Electronic circuit for Full wave rectifier on bread board as shown in Figure 2.
2. Connect the primary side of the transformer to AC mains and the secondary side to rectifier input.
3. Before switching on power supply, check the connection.
4. Switch ON the power supply and set CRO in DC mode adjust level accurately.
5. Observe the Waveforms across load resistance R_L for capacitor filter.
6. Connect the inductor as shown in Figure 5 and observe the waveform across load resistor
7. Compare waveforms observed for half wave rectifier and full wave rectifier.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XIII Actual Procedure Followed

1. ……..……...
2. ……..……
3. ……..……
4. ……..……
5. ……..……
6. ……..……..……

XIV Precautions

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XV Observations and Calculations

Table 1

Type of Rectifier	Type of filter															
	C filter								L filter							
	Waveforms at R_L															
Half wave rectifier																
Full wave rectifier																

XVI Results

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……..……...
……..……...
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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions - (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Repeat the steps to find out DC output for LC and CLC filters for half wave as well as full wave rectifiers.
2. Compare output waveforms of LC and CLC filters for half wave as well as full wave rectifiers.

[Space for answers]

XX References / Suggestions for further Reading

S. No.	Title of Book / Website	Author	Publication
1	A text book of Applied Electronics	R.S.Sedha	S.Chand and Co., New Delhi 2008,ISBN 978-8121927833
2	Web References		a. http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/halfwaverectifierwithfilter.htmlhttp://nptel.ac.in/courses/117103063/4 b. https://www.elprocus.com/half-wave-rectifier-circuit-working-principle-and-characteristics-2/ c. http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/halfwaverectifierwithfilter.html

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10 %
2	Proper connection of wires for building circuit	20 %
3	Connect and select proper range of ammeter, voltmeter	10 %
4	Plot graph for input/output waveforms with and without filters for half wave and full wave rectifiers	20 %
Product related (10 Marks)		**40%**
1	Interpretation of result	20 %
2	Conclusions	10 %
3	Practical related questions	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. ……..
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 9: Convert AC Signal into DC Signal through Bridge Rectifier.

I Practical Significance

Half-wave rectifier circuit is unsuitable to applications which need a "steady and smooth" dc supply voltage since only alternate half cycles are rectified. One method to improve on this is to use every half-cycle of the input voltage instead of every other half-cycle. The circuit which allows us to do this is called a full wave rectifier. Here, unidirectional current flows in the output for both the cycles of input signal and rectifies it. In this experiment students will observe the working of full wave Bridge rectifier.

II Relevant Program Outcomes (POs)

PO2. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO3. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use simple electronic circuits of computer system***'

i. Connect Circuits
ii. Record measurements.
iii. Analyze results

IV Relevant Course Outcome(s)

Use diodes in different applications

V Practical Outcome

Convert AC into DC signal through Bridge Rectifier

i. Convert AC signal into DC signal through Bridge rectifier
ii. Identify terminals of the component.
iii. Connect circuit components of Bridge rectifier and label components.
iv. Usefunctions of CRO required for Bridge rectifier
v. Observe performance of full wave Bridge rectifier by Output DC voltage waveform
vi. Compare with half wave rectifier.

VI Relevant Affective domain related Outcome(s)

i. Handle components and instruments carefully.
ii. Work in a team

VII Minimum Theoretical Background

The circuit has four diodes connected to form a bridge. The ac inputvoltage is applied to the diagonally opposite ends of the bridge. The loadresistance is connected between the other two ends of the bridge.

For the positive half cycle of the input ac voltage, diodes D1 and D2 conduct, whereas diodes D3 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance R_L and hence the load current flows through R_L. For the negative half cycle of the input ac voltage, diodes D3 andD4 conduct whereas, D1 and D2 remain OFF. The conducting diodes D3and D4 will be in series with the load resistance R_L and hence the current flows through R_L in the same direction as in the previous half cycle. Thus abi-directional wave is converted into a unidirectional wave.

VIII Practical Circuit diagram:

(a) Sample

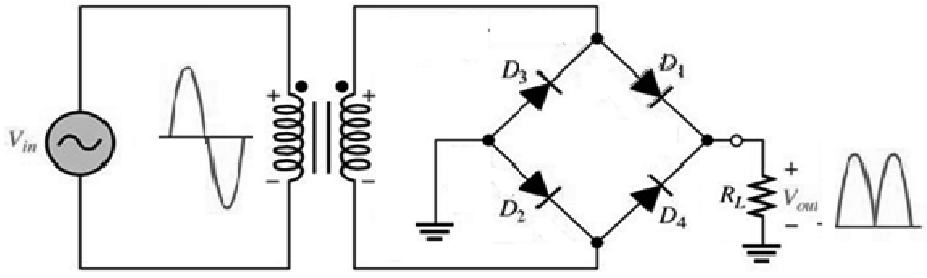

Figure. 1 Bridge Rectifier

(b) Actual Circuit used in laboratory

(c) Actual Experimental set-up used in laboratory

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Transformer	220V/12V V AC, 500 mA	1 No.
2.	Resistor	10K Ω	1 No.
3.	Diode	Silicon Diode IN4007	4 No.
4.	Digital Multimeter / CRO	3 1/2 digit display/ 0-20 MHz (Dual Trace).	1 No.
5.	Connecting wires	Single Strand	1 No.

X Precautions

1. Care should be taken while handling terminals of components.
2. Select proper mode for CRO.
3. Connect wires tightly while building circuit.
4. Show the connections to concerned teacher and then switch ON the power supply.

XI Procedure

Part I

1. Connect the Electronic circuit for Bridge rectifier on bread board / kit as shown in circuit diagram (Figure 1).
2. Connect the primary side of the transformer to AC mains and the secondary side to rectifier input.
3. Before switching on power supply, check the connection.
4. Switch ON the power supply and set CRO in DC mode and adjust level accurately.
5. Using a CRO, measure the maximum voltage V_m of the AC input voltage (at the anode) of the rectifier and AC voltage (at the cathode) at the output of the rectifier.
6. Using a DC voltmeter, measure the DC voltage at the load resistance.
7. Observe the Waveforms at the secondary windings of transformer and across load resistance.

Part II

1. Observe the input and output waveform on CRO.
2. Observe the difference between Center tapped wave rectifier output waveform and full wave Bridge output waveforms.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed

1. ……
2. ……

3. ……
4. ……
5. ……
6. ……

XIV Precautions

1. ……
2. ……

XV Observations and Calculations

Observe the input and output waveform on CRO.

Waveform at the secondary of the transformer														
Waveform at the load resistance														

1.Measure the d.c. component in the output(V_{dc})=…… V.

where$V_{dc}=\frac{2V_m}{\pi}$

XVI Results

……

……..

……..

……..

XVII Interpretation of results (Give meaning of the above obtained results)

……

…..……

……..

……

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……..

……..

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Calculate ripple factor for the circuit.
2. What is the difference in DC output voltage in half wave and full wave rectifier and Bridge for the same AC input?

[Space for answers]

XX References / Suggestions for further Reading

S. No	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S. Chand and Co. , New Delhi, 2008 ISBN :978-8121927833
2	Basic Electronics	V.K.Mehta	S. Chand and Co., Ram Nagar ,New Delhi-110055,11th Edition,2014.ISBN 978812192405
3	Web References		http://nptel.ac.in/courses/ http://www.circuitstoday.com/full-wave-bridge-rectifier. https://www.electrical4u.com/bridge-rectifiers/

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10%
2	Proper connection of wires for building circuit	10%
3	Connect and select proper range of ammeter, voltmeter	20%
4	Observe and plot Input / Output waveforms and measure V_m	20%
Product related (10 Marks)		**40%**
1	Practical related questions	10%
2	Interpretation of result	20%
3	Conclusions	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. ……..….
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

Practical No.10: Test the Performance of the given Bridge Rectifier Using Filter

I Practical Significance

Half -wave rectifier circuit is unsuitable to applications which need a "steady and smooth" dc supply voltage. One method to improve on this is to use every half-cycle of the input voltage instead of every other half-cycle. The circuit which allows us to do this is called a full wave rectifier. Here, unidirectional current flows in the output for both the half cycles of input signal and rectifies it. In this experiment students will observe the working of full wave Bridge rectifier and determine DC voltage with and without the use of filters.

II Relevant Program Outcomes (POs)

PO1. **Basic knowledge:** An ability to apply knowledge of basic mathematics, science and engineering to solve engineering problems.
PO2. **Discipline knowledge**: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.
PO3. **Experiments and practice:** An ability to plan and perform experiments and practices and to use the results to solve engineering problems.
PO4.**Engineering Tools:** Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use simple electronic circuits of computer system***'

i. Connect Circuits
ii. Record measurements.
iii. Analyze results

IV Relevant Course Outcome(s)

Use diodes in different applications

V Practical Outcome

Test the performance of the given Bridge rectifier using filter.

- Identify terminals of the component.
- Mount circuit components of Bridge wave rectifier.
- Observe functions of CRO required for Bridge wave rectifier
- Observe performance of Bridge wave rectifier by Output DC voltage waveform
- Compare with Bridge wave rectifier with filter and without filter.

VI Relevant Affective domain related Outcome(s):

i. Handle components and instruments with care.
ii. Work in a team
iii. Make aesthetically neat connections.

VII Minimum Theoretical Background

The filtered full wave rectifier is created from the Bridge rectifier by adding a capacitor across the output. The result of the addition of a capacitor is a smoothing of

the FWR output. The output is now a pulsating dc, with a peak to peak variation called ripple. The magnitude of the ripple depends on the input voltage magnitude and frequency, the filter capacitance, and the load resistance.

The circuit diagram of the bridge rectifier with filter capacitor is shown in the following figure 1. The smoothing capacitor converts the full-wave rippled output of the rectifier into a smooth dc output voltage.
When capacitor charges during the first cycle, surge current flows because initially capacitor acts like a short circuit. Thus, surge current is very large. If surge current exceeds rated current capacity of the diode it can damage the diode. To limit surge current surge resistance is used in series as shown in the figure. Similar surge resistance can be used in half wave as well as center-tapped full wave rectifier also.
Two important parameters to consider when choosing a suitable a capacitor are its working voltage, which must be higher than the no-load output value of the rectifier and its capacitance value, which determines the amount of ripple that will appear superimposed on top of the dc voltage.

Apart from rectification efficiency, the main advantages of a full-wave bridge rectifieris that it has a smaller ac ripple value for a given load and a smaller smoothing capacitor than an equivalent half-wave rectifier. The amount of ripple voltage that is superimposed on top of the dc supply voltage by the diodes can be virtually eliminated by adding other improved filters such as a pi-filter.

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VIII Practical Circuit diagram:

(a) Sample

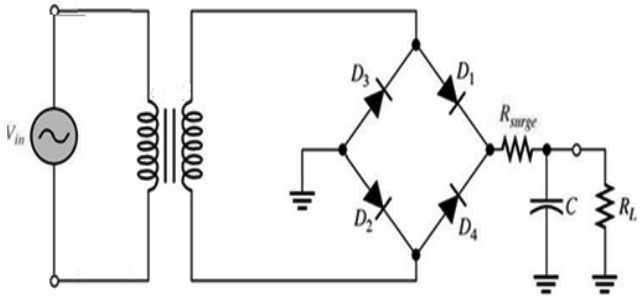

Figure No. 1 Bridge Rectifier with Capacitive filter

(b) Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Transformer	220V/12 V AC, 500 mA	1 No.
2.	Resistor	10K Ω	1 No.
3.	Diode	Silicon D1N4007	4 No.
4.	Digital Multimeter / LCR-Q meter / CRO	3 1/2 digit display.	1 No.
5.	Connecting wires	Single Strand	1 No.
6.	Capacitor	10μF/100μF	1

X Precautions

1. Care should be taken while handling terminals of components.
2. Select proper mode for CRO.
3. Connect wires tightly while building circuit.
4. Show the connections to concerned teacher and then switch ON the power supply.

XI Procedure

Part I

1. Connect the electronic circuit for Bridge rectifier with filter on bread board / kit as shown in circuit diagram.
2. Connect the primary side of the transformer to AC mains and the secondary side to rectifier input.
3. Before switching on power supply, check the connection.
4. Switch ON the power supply and set CRO in DC mode adjust level accurately.
5. Using a CRO, measure the maximum voltage V_m of the AC input voltage (at the anode) of the rectifier and AC voltage (at the cathode) at the output of the rectifier.
6. Using a DC voltmeter, measure the DC voltage at the load resistance.
7. Observe the Waveforms at the secondary windings of transformer and across load resistance.

Part II

1. Observe the input and output waveform on CRO.
2. Observe the difference between Center tapped wave rectifier output waveform and full wave Bridge output waveforms.
3. Observe the difference between Center tapped wave rectifier with filter output waveform and full wave Bridge rectifier with output waveforms.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

1. ……...
2. ……
3. ……
4. ……
5. ……
6. ……

XIV Precautions

1. ……
2. ……
3. ……

XV Observations and Calculations

1. Observe the input and output waveform on CRO.

Output Waveform Without filter														
Output Waveform With filter														

2. Measure the d.c. component in the output(V_{dc})=…… V(without filter)
3. Measure the d.c. component in the output(V_{dc})=…… V(with filter)
4. Theoretically calculate Vdc with and without filter using the formula

$V_{dc}=\frac{2V_m}{\pi}$

XVI Results

……..……
……..……

XVII Interpretation of result (Give meaning of the above obtained results)

……..……
……..……
……
……

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……
……
……
……

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. List applications of Full wave bridge rectifier.
2. What is the frequency of AC component at the output of Bridge rectifier? Give reason.
3. What is the difference in DC output voltage in half wave and full wave bridge rectifier with filter and withoutfilter for the same AC input?

[Space for answers]

XX References / Suggestions for further Reading

S. No.	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S.Chand and Co., New Delhi 2008,ISBN 978-8121927833
2	Web References		a. http://nptel.ac.in/courses/ b. http://www.circuitstoday.com/full-wave-bridge-rectifier. c. https://www.electrical4u.com/bridge-rectifiers/

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10%
2	Proper connection of wires for building circuit	10%
3	Connect and select proper range of ammeter, voltmeter	20%
4	Observe and plot Input / Output waveforms and measure V_m	20%
Product related (10 Marks)		**40%**
1	Practical related questions	10%
2	Interpretation of result	20%
3	Conclusions	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……....
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 11: Test Input/ Output Characteristics of NPN Transistor In CE Mode

I Practical Significance

Transistor is a basic building block of modern electronic circuits. Transistor is widely used in amplifier, oscillator, electronic switch and so many other electronic circuits for various applications. Nearly every electronic circuit contains at least one or more types of transistors. To understand operation of transistor, we use common emitter, common base and common collector configurations. In this experiment students will plot the characteristics of NPN transistor in input and output mode in CE configuration and calculate current amplification factor β.

II Relevant Program Outcomes (POs)

PO2.Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO3.Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

PO4.Engineering Tools: Apply relevant technologies and tools with an understanding of the limitations

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use simple electronic circuits of computer system'***:

i. Connect Circuits
ii. Record measurements.
iii. Analyze results

IV Relevant Course Outcomes (POs)

Interpret the working of junction transistor in the electronic circuits.

V Practical Outcome

Test input/output characteristics of NPN Transistor in CE Mode

- Identify terminals of given transistor.
- Measure input / output currents / voltages.
- Plot graph of base current verses base to emitter voltage for a constant collector to emitter voltage.
- Plot graph of collector current and collector to emitter voltage for a constant base current.
- Identify different regions of operation of transistor from the graph.
- Calculate current amplification factor β.

VI Relevant Affective domain related Outcome(s):

i. Handle the instruments and components with care.
ii. Work in team

VII Minimum Theoretical Background

Symbol:

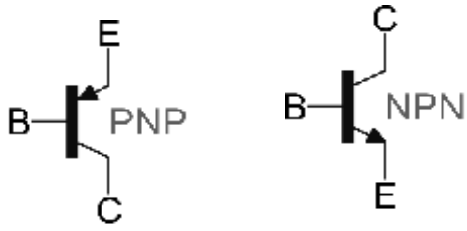

Figure 1: Symbol of BJT

BJT is called as Bipolar Junction transistor and it is a 3 terminal active device which has emitter, base and collector as its terminals. It is called bipolar device because the flow of current through it is due to two types of carriers i.e. majority and minority carriers.

A transistor can be in any of the three configurations namely common base common emitter and common collector.

The relation between of α, β, γ of CB, CE & CC are

$$\alpha = \frac{\beta}{1+\beta}$$

$$\beta = \frac{\alpha}{1-\alpha}$$

$$\gamma = 1+\beta = \frac{1}{1-\alpha}$$

In CE configuration base will be the input node and collector will be the output node. Emitter is common to both input and output and hence the name common Emitter Configuration. A transistor in CE configuration is used widely as an amplifier.

Input Characteristics:

This curve gives the relationship between input current (I_B) and input voltage (V_{BE}) for constant output voltage (V_{CE}). By varying V_{BE} for constant V_{CE} it may be noted that below knee voltage current is very small. Beyond knee voltage, the base current (I_B) increases with increase in V_{BE} for constant V_{CE}.

Input characteristics may be used to determine the value of common emitter transistor a.c. input resistance r_i. It is the ratio of change in base to emitter voltage (ΔV_{BE}) to resulting change in base current (I_B) at a constant collector to emitter voltage (V_{CE}).

$$r_i = \frac{\Delta V_{BE}}{\Delta I_B}$$

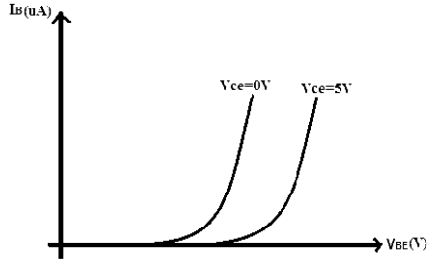

Figure 2: Input Characteristics of BJT in CE mode

Output Characteristics:

This curve gives the relationship between output current (I_c) and output voltage (V_{CE}) for a constant base current (I_B).

The output characteristics are divided into three regions:

Cut off region: Transistor act as OFF switch

Saturation Region: Transistor act as ON switch

Active Region: Transistor acts as amplifier.

Output characteristics may be used to determine the value of common emitter transistor a.c. Output resistance r_o. It is the ratio of change in collector to emitter voltage (ΔV_{CE}) to resulting change in Collector current (ΔI_C) at a constant base current (I_B).

$$r_o = \frac{\Delta V_{CE}}{\Delta I_C}$$

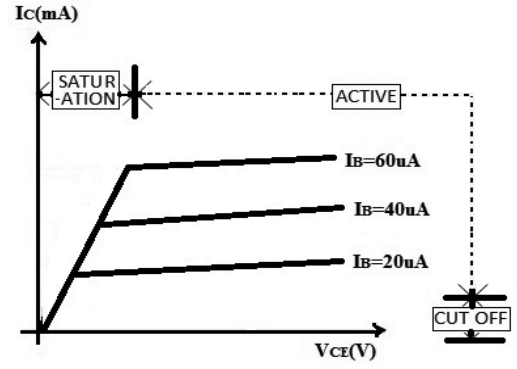

Figure 3: Output Characteristics of BJT in CE mode

VIII Practical Circuit diagram:

(a) Sample

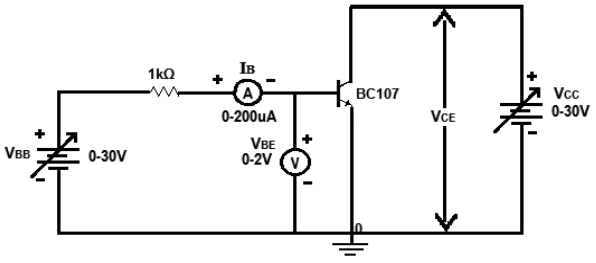

Figure: 3 Circuit diagram for Input Characteristics

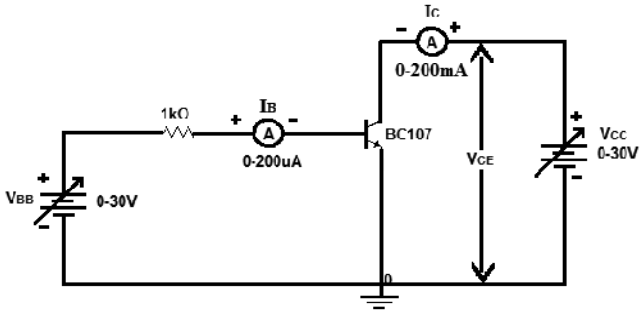

Figure 4: Circuit diagram for Output Characteristics

(b) Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	DC power supply	0-30 V	2 No.
2.	DC Voltmeter	(0-2V),(0-20V)	1 No.
3.	DC Ammeter	(0-50milliamps), (0-500μA)	1 No.
4.	Transistor	BC107	1 No.
5.	Resistors	1KΩ	1 No.
6.	Any other		

X Precautions

1. Care should be taken while handling terminals of components.
2. Select proper range & mode of ammeter and voltmeter.
3. Connect wires tightly while building circuit.
4. Show the connections to concerned teacher and then switch ON the power supply.

XI Procedure

Part I

Input characteristics:

1. Connect the electrical circuit as shown in Figure 3.
2. Select suitable range of milliammeter, voltmeter and power supply.
3. Switch on the power supply and adjust the voltage V_{CE} = 2V by varying V_{CC}
4. Vary the input voltage V_{BE} in steps of 0.1V and measure the current I_B for each step.
5. Repeat the steps 3 and 4 for V_{CE} values of 5V and 10V.
6. Tabulate the readings.

Part II

Output characteristics:

1. Connect micro ammeter and adjust base current I_B.
2. Select suitable range of milliammeter, voltmeter and power supply.
3. Switch on the power supply and apply a constant current I_B = 20 μA.
4. Vary V_{CE} from 0 to 10V is steps of 0.5 volts. Measure corresponding collective current I_C for each step.
5. Repeat steps 9 and 10 for various values of I_B = 30 μA and 40 μA.
6. Tabulate the readings.

Graph

Plot a graph of V_{BE}(V) (X-axis) versus I_B(μA) (Y-axis) for different V_{CE} voltages.
Plot a graph of V_{CE}(V) (X-axis) versus I_C(mA) (Y-axis) for different I_B (μA) currents.

Calculate dynamic input resistance using the formula given below

$$r_i = \left.\frac{\Delta V_{BE}}{\Delta I_B}\right|_{V_{CE}} = \text{----------}$$

Calculate dynamic output resistance using the formula given below

$$r_o = \left.\frac{\Delta V_{CE}}{\Delta I_C}\right|_{I_C} = \text{----------}$$

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

1. Connect the electrical circuit as per Circuit used in laboratory
2. ……
3. ……
4. ……
5. ……

XIV Precautions

1. ……
2. ……

XV Observations and Calculations

Calculation of input and Output resistance at any point-

$$r_i = \frac{\Delta V_{BE}}{\Delta I_B}$$

$$r_o = \frac{\Delta V_{CE}}{\Delta I_C}$$

$$\beta = \frac{I_C}{I_B}$$

Table 1: Input Characteristics

S.No.	V_{CE}=…...V		V_{CE}=…...v		V_{CE}=…….v	
	V_{BE} (V)	I_B(µA)	V_{BE} (V)	I_B(µA)	V_{BE} (V)	I_B(µA)
1						
2						
3						
4						
5						
6						

Table 2: Output Characteristics

S.No.	I_B=…….. µA		I_B=…… µA		I_B=……. µA	
	V_{CE} (V)	I_C(mA)	V_{CE} (V)	I_C(mA)	V_{CE} (V)	I_C(mA)
1						
2						
3						
4						
5						
6						

XVI Results

1. Input resistance r_i = …….…… Ω
2. Output resistance r_o = …….…… Ω
3. Current amplification factor β =……..……..

XVII Interpretation of results(Give meaning of the above obtained results)

……..

……..

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……..

……..

……...

……...

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Write the steps to identify emitter, base and collector terminals of given transistor.
2. State the range of ammeter and voltmeter selected.
3. The BJT has I_B = 10 μA, I_{C0} = 1 μA. what is collector current I_C? (Take value of β obtained from the graph)?

[Space for answers]

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XX References / Suggestions for further Reading

S. No.	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S. Chand and Co., New Delhi 2008,ISBN 978-8121927833
2	Principles of Electronics	V.K.Mehta.	S. Chand and Co., Ram Nagar ,New Delhi-110055,11th Edition,2014.ISBN 978812192405
3	Web References		a. https://www.electrical4u.com/transistor-characteristics/ b. http://nptel.ac.in/courses/117107095/10

XXI Assessment Scheme

The given performance indicators should serve as a guideline for assessment regarding process and product related marks:

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10 %
2	Proper connection of wires for building circuit	20 %
3	Connect and select proper range of ammeter, voltmeter	20 %
4	Measure V_{BE} and I_B by keeping V_{CE} constant voltage and plot graph	10 %
Product related (10 Marks)		**40%**
1	Interpretation of result	20 %
2	Conclusions	10 %
3	Practical related questions	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 12: Test Input/ Output Characteristics of NPN Transistor In CB Mode

I Practical Significance

Transistor is a basic building block of modern electronic circuits. Nearly every electronic circuit contains at least one or more types of transistors. A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. In this experiment students will plot the characteristics of NPN transistor in input and output mode for CB configuration and calculate current amplification factor α.

II Relevant Program Outcomes (POs)

PO2. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO3. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use simple electronic circuits of computer system'***:

i. Connect Circuits.
ii. Record measurements.
iii. Analyze results.

IV Relevant Course Outcome(s)

- Interpret the working of junction transistor in the electronic circuits.

V Practical Outcome

Test input/output characteristics of NPN Transistor in CB Mode

- Identify terminals of given transistor.
- Measure input / output currents / voltages
- Plot graph of Emitter current verses emitter to base voltage for constant collector to base voltage.
- Plot graph of collector current and collector to base voltage for constant emitter current.
- Identify different regions of operation of transistor from the graph.
- Calculate current amplification factor α.

VI Relevant Affective domain related Outcome(s)

i. Handle instruments & components with care.
ii. Work in team.

VII Minimum Theoretical Background

In common base configuration Emitter is the input terminal and collector is the output terminal and base is connected as a common terminal for both input and output. The CB configuration is used in applications where low input impedance is required.

Input Characteristics:

This curve gives the relationship between input current (I_E) and input voltage (V_{EB}) for constant output voltage (V_{CB}). By varying V_{EB} for constant V_{CB} it may be noted

that below knee voltage current is very small. Beyond knee voltage, the Emitter current (I_E) increases with small increase in emitter to base voltage V_{EB} for constant V_{CB}. As the collector to Base voltage is increased above 1V, the curve shifts upwards. Input characteristics may be used to determine the value of common base transistor a.c. input resistance r_i. It is the ratio of change in emitter to base voltage (ΔV_{EB}) to resulting change in emitter current (I_E) at a constant collector to base voltage (V_{CB}).

$$\Delta I_E V_{CB} = \frac{\Delta V_{EB}}{r_i} \Big|$$

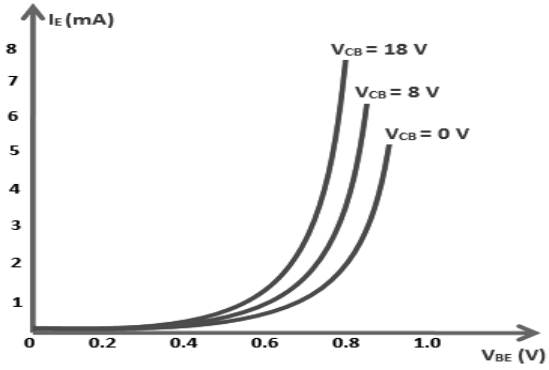


Figure: 1 Input Characteristics in CB mode

Output Characteristics:

This curve gives the relationship between output current (I_c) and output voltage (V_{CB}) for a constant emitter current (I_E).
The output characteristics are divided into three regions:
Cut off region: Transistor act as OFF switch
Saturation Region: Transistor act as ON switch
Active Region: Transistor acts as amplifier.
Output characteristics may be used to determine the value of common base transistor a.c. Output resistance r_o. It is the ratio of change in collector to base voltage (ΔV_{CB}) to resulting change in collector current (ΔI_C) at a constant emitter current (I_E).

$$\Delta I_C I_E = \frac{\Delta V_{CB}}{r_o} \Big|$$

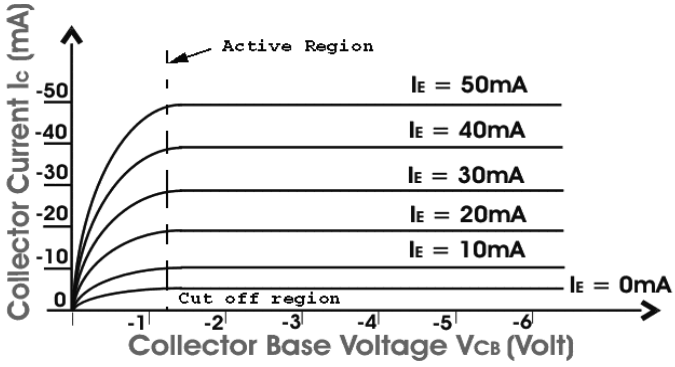


Figure: 2 Output Characteristics in CB mode

VIII Practical Circuit diagram:

(a) Sample

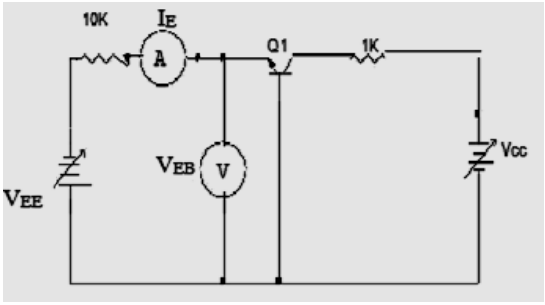


Figure: 3 Input Characteristics

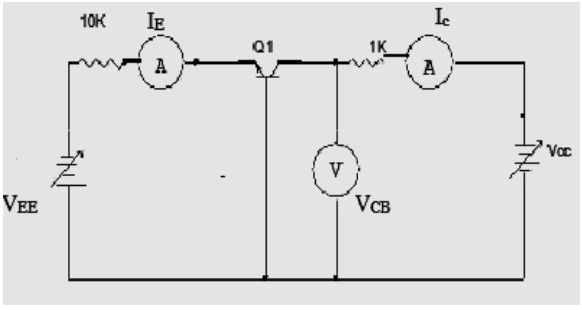


Figure: 4 Output Characteristics

(b)Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory

IX Resources required

Sr. No.	Name of Resource	Suggested Specification	Quantity
1.	D.C.Power Supply	0-30V	1 No.
2.	DC Voltmeter	0-20V	1 No.
3.	DC Ammeter	0-200 μA & 0-20 mA range	1 No.
4.	Transistor	BC107	1 No.
5.	Resistors	10KΩ, 1KΩ	1 No.
6.	Any other		

X Precautions

1. Care should be taken while handling terminals of components.
2. Select proper range & mode of ammeter and voltmeter.
3. Connect wires tightly while building circuit.
4. Show the connections to concerned teacher and then switch ON the power supply.

XI Procedure

Part I
Input characteristics:

1. Connect the electrical circuit as shown in Figure 3.
2. For plotting input characteristics, the output voltage V_{CB} is kept constant at 0V and for different values of V_{EB}note down values of I_E.
3. Repeat the above steps by keeping V_{CB}at 2V, 4V and 6V. Record I_E.
4. Draw input characteristics from the observation table.
5. At suitable operating point calculate input resistance (R_i).

Part II
Output characteristics:

1. Connect the electrical circuit as shown in Figure 1.
2. For plotting output characteristics, the input current $I_E$is kept constant at 10mA and for different values of V_{CB}note down values of I_C.
3. Repeat the above steps for the values of $I_E$at 20mA, 40mA and 60mA.Record I_C.
4. Draw output characteristics from the observation table.
5. At suitable operating point calculate output resistance (R_o).

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

1. Connect the electrical circuit as per Circuit used in laboratory.
2. ……
3. ……
4. ……
5. ……
6. ……

XIV Precautions

……..

……..

XV Observations and Calculations

Calculation of input and Output resistance at any point-

$$r_i = \frac{\Delta V_{EB}}{\Delta I_E}$$

$$r_o = \frac{\Delta V_{CB}}{\Delta I_C}$$

$$\alpha = \frac{I_C}{I_E}$$

Table 1: Input Characteristics

Sr.No.	V_{CB}=…….V		V_{CB} =……V		VCB =……V	
	V_{EB} (V)	I_E(mA)	V_{EB} (V)	I_E(mA)	V_{EB} (V)	I_E(mA)
1						
2						
3						
4						
5						
6						

Table 2: Output Characteristics

Sr.No.	I_E=…….. mA		I_E=……mA		I_E=……mA	
	V_{CB} (V)	I_C(mA)	V_{CB} (V)	V_{CB} (V)	I_C(mA)	V_{CB} (V)
1						
2						
3						
4						
5						
6						

XVI Results

1. Input resistance r_i= ……..……. Ω
2. Output resistance r_o= ……..……. Ω
3. Current amplification factor α =……..……..

XVII Interpretation of results (Give meaning of the above obtained results)

……...

……...

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

…….…….

……..

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Write the Part number of given transistor.
2. Write the steps to identify emitter, base and collector terminals of given transistor.
3. State the range of ammeter and voltmeter selected.

[Space for answers]

XX References / Suggestions for further Reading

S. No	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S.Chand and Co., New Delhi, 2008 ISBN :978-8121927833
2	Basic Electronics	V.K.Mehta	S.Chand and Co., Ram Nagar , New Delhi-110055, 11th Edition, 2014. ISBN 978812192405
3	Web References	-	https://www.electrical4u.com/transistor-characteristics/ http://nptel.ac.in/courses/117107095/11

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10%
2	Proper connection of wires for building circuit	10%
3	Connect and select proper range of ammeter, voltmeter	20%
4	Measure emitter current (I_E) and emitter to base voltage (V_{EB}) for constant collector to base voltage (V_{CB}) and plot graph.	20%
Product related (10 Marks)		**40%**
1.	Calculation of input and output resistance and current amplification factor α	10%
2.	Interpretation of result	20%
3.	Conclusions	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. ……..….
3. ……..…
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No.13: Test Input/output Characteristics of NPN Transistor in CC Mode

I Practical Significance

Transistor is a basic building block of modern electronic circuits. Nearly every electronic circuit contains at least one or more types of transistors. A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. In this experiment students will plot the input and output characteristics of NPN transistor in CC configuration and calculate current amplification factor γ.

II Relevant Program Outcomes (POs)

PO2.Discipline knowledge: Apply basic electronics engineering knowledge to solve broad-based Computer engineering related problems.

PO3. Experiments and practice: An ability to plan to perform experiments and practices to use the results to solve broad-based Computer engineering problems.

PO4. Engineering tools: Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***:

i. Connect circuits.
ii. Record Measurements.
iii. Analyze Circuits.

IV Relevant Course Outcome(s)

Interpret the working of junction transistor in the electronic circuits.

V Practical Outcome

Test input/output characteristics of NPN transistor in CC mode

- Measure current gain of CC amplifier.
- Measure Voltage gain of CC amplifier.
- Plot input and output characteristics in CC configuration

VI Relevant Affective domain related Outcome(s):

i. Handle instruments and components with care.
ii. Work in team

VII Minimum Theoretical Background

In common collector configuration, collector terminal is common between input and output. Input is applied between base and collector output is taken from emitter and collector. Voltage gain of CC configuration is less than unity gain. CC amplifier is used to provide current gain. It has very high input impedance and very low output impedance hence it is used to connect low impedance load to source which is having high output impedance. Hence it can be used as impedance matching. Emitter current is approximately equal to collector current, hence output characteristics of CC configuration is similar to CE configuration. However input characteristics of CE and CC are quite different.

VIII Circuit diagram

(a) Sample

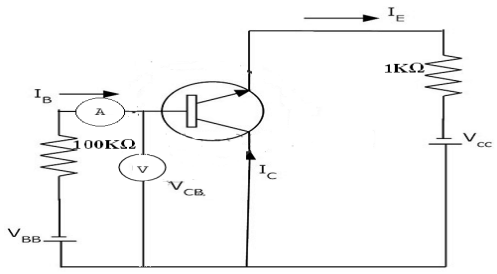


Figure 2: Input Characteristics in CC mode

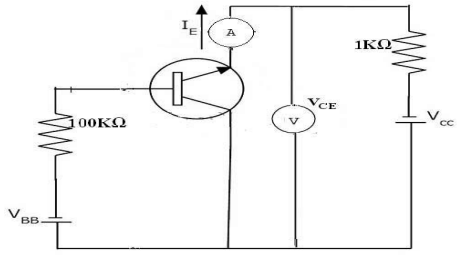


Figure 3: Output Characteristics in CC mode

(b) Actual Circuit used in laboratory

(c)Actual Experimental Set up used in laboratory: NA

IX Resources Required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Digital Multimeter	3 1/2 digit display.	1 No.
2.	DC Regulated power supply	Variable DC power supply 0-30V, 2A, SC protection, display for voltage and current.	1 No.
3.	DC Voltmeter	0-20 V	1 No.
4.	DC Ammeter	0 - 200 mA, 0 - 200 µA	1 No.
5.	Bread board		1 No.
6.	Transistor	BF494	1 No.
7.	Resistor	100KΩ,1KΩ(0.5watts/0.25watts)	1No.
8.	Connecting wires	Single strand	-
9.	Any other		

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode
3. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

XI Procedure

Input Characteristics

1. Connect the circuit as shown in the circuit diagram for input characteristics.
2. Connect variable power supply 0-30V (V_{BB}) at base-emitter circuit and another power supply 0-30V at collector emitter circuit.
3. Keep V_{CE}fixed at 0V (or do not connect V_{CC})
4. Increase $V_{BB}$from 0V to 20V, note down reading of base current I_B, collector to base voltage (V_{CB})in the observation table.
5. Repeat the procedure for V_{CE}=+1V and V_{CE}=+2V.

Output Characteristics

1. Connect the circuit as shown in the circuit diagram for output characteristics.
2. Connect variable power supply 0-30V at base circuit and collector circuit.
3. Keep base current fixed (initially at 0)
4. Increase V_{CC} from 0V to 30V, note down reading of emitter current I_E and collector to emitter voltage (V_{CE})in the observation table.
5. Repeat the procedure for base current I_B =10µA,50µA and 100µ A. Increase base current by increasing V_{BB}.

Graph:

Plot the graph by taking V_{CB} on the X axis and I_B on the Y axis for different values of V_{CE}

Plot a graph by taking V_{CE} on the X axis and I_E on the Y axis for different values of I_B

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

1. ……...
2. ……...
3. ……
4. ……...
5. ……..
6. ……...

XIV Precautions

1. ……..……
2. ……..……..

XV Observations and Calculations(use blank sheet provided if space not sufficient)

a. Input Characteristics

Transistor:-……

Table1:

Sr. No	V_{CE}= 0V		V_{CE}= +1V		V_{CE}= +2V	
	V_{CB}	I_B	V_{CB}	I_B	V_{CB}	I_B
1						
2						
3						
4						
5						
6						
7						
8						

b. Output Characteristics

Transistor:-……

Table1:

Sr. No	I_B=0μA		I_B= 10μA		I_B= 50μA		I_B= 100μA	
	V_{CE}	I_E	V_{CE}	I_E	V_{CE}	I_E	V_{CE}	I_E
1								
2								
3								
4								
5								
6								
7								

Graph:

Input Characteristics: Plot the graph by taking V_{CB} on the X axis and I_B on the Y axis for different values of V_{CE}

Output Characteristics: Plot a graph by taking V_{CE} on the X axis and I_E on the Y axis for different values of I_B

Calculations:

$\gamma = \frac{I_E}{I_B}$

XVI Results

Input resistance $r_i = \frac{\Delta V_{CB}}{\Delta I_B}$

Output resistance $r_o = \frac{\Delta V_{CE}}{\Delta I_E}$

Amplification Factor $\gamma = \frac{I_E}{I_B}$

XVII Interpretation of Results (Give meaning of the above obtained results)

……

……

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……

……

XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. State the relation betweenα, β&γ of a transistor.
2. State the voltage gain in common collector configuration circuit and compare it with the theoretical value.

[Space for answers]

……

……

……

……

……

……

……

……

……

XX References / Suggestions for Further Reading

S.No.	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S.Chand and Co.,New Delhi 2008,ISBN 978-8121927833
2	Web references		www.circuitglobe.com

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Selection of component. Proper connection of electrical circuit and Handling of the instrument	20%
2	Taking proper readings	20%
3	Connect and select proper range of ammeter, voltmeter	10%
4	Observe and plot Input / Output waveforms and measure V_m.	10%
Product related (10 Marks)		**40%**
1	Interpretation of result	20%
2	Conclusions	10%
3	Practical related questions	10%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. ……..
2. ……..….
3. …….
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 14: Determine Gain and Bandwidth of Single Stage RC Coupled Amplifier

I Practical Significance

Common emitter amplifiers are used to increase the strength of a weak AC signal. They provide high voltage gain, current gain and moderate.
Power gain: It has low input impedance and output impedance. These amplifiers are used in communication transmitters and receivers.

II Relevant Program Outcomes (POs)

PO2. Discipline knowledge: Apply basicelectronics engineering knowledge to solve broad-basedComputerengineering related problems.
PO3. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Computer engineering problems.
PO4. **Engineering tools:** Apply relevant technologies and tools with an understanding of the limitations.
PO10. Life- long learning: Engagein independent and life-long learning activities in the context of technological changes in the Computer Engineeringfield and allied industry.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***

i. Connect circuits with voltage sources and measuring instruments.
ii. Record measurements.
iii. Analyze the observations

IV Relevant Course Outcome(s)

Interpret the working of BJT in Electronic Circuits.

V Practical Outcome

Determine gain and bandwidth of single stage RC coupled amplifier:

- Make Connections as per required circuit diagram.
- Measure voltage and currents at various terminals.
- Plot the frequency versus Gain response.
- Calculate the cut off frequencies, Bandwidth and calculate its gain.

VI Relevant Affective domain related Outcome(s)

i. Handle components and instruments carefully.
ii. Make connections in an orderly manner

VII Minimum Theoretical Background

An amplifier is an electronic circuit that can increase the strength of a weak input signal without distorting its shape. The CE configuration is widely used as a basic amplifier as its both voltage and current amplification with 180^0 phase shift. The factor by which the input signal gets multiplied after passing through the amplifier is called the gain of the amplifier
It is given by,

Gain= Output voltage/Input voltage

The resistance R_1& R_2 provide the necessary bias condition and ensure that emitter base junction is operating in the active region. The Q point is placed at the middle of the DC load line. This will ensure that there is no clipping or distortion of the input signal.

VIII Practical Circuit Diagram

(a) Sample

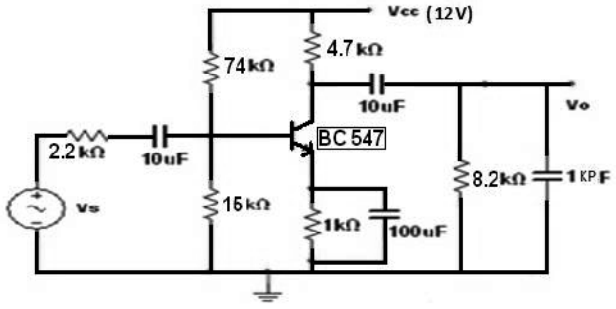


Figure 1: Single Stage RC Coupled Amplifier

(b) Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory: NA

IX Resources Required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	DC Regulated Power supply	Variable DC power supply 0-30V,2A display for current & voltage	1 No.
2.	Function Generator	0-1 MHz	01
3.	Transistor	BC 547	01
4.	Resistor	R_1-74KΩ, R_2-15KΩ , 2.2 KΩ, 4.7KΩ, 1KΩ, 8.2 KΩ	01 Each
5.	Capacitors	As per circuit diagram	01
6.	Connecting Wires		

X Precautions

1. Carefully handle the terminals of the components do not exceed the ratings of the transistor because this may damage the transistor.
2. Select proper range of time/division and volts/division on CRO.
3. Show the connection to the teacher before switching the power supply ON

XI Procedure

1. Connect the circuit as the circuit as shown in the figure. Set source voltage as $50mV_{p\text{-}p}$ at 1 kHz frequency using function generator/signal generator.
2. Keep the input voltage as constant. Vary the frequency from 50 Hz to 1MHz in regular steps and note down the corresponding p-p output voltage on CRO.
3. Plot the graph for frequency versus gain in (dB) in a semi-log graph sheet.
4. Calculate the bandwidth from the graph.

XII Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

1 ……

2……..

3……

4 ……..

5 ……

6……

XIV Precautions

1. ……..

2. ……

XV Observations and Calculations(use blank sheet provided if space not sufficient)

1. Input Voltage V_s at 1 kHz=
2. Supply Voltage $V_{cc=}$

Table: 1

Sr. No	Frequency	V_O (V)	Gain V_O / V_s	Gain in dB= 20 $\log_{10} V_O / V_s$

Graph:

Plot the graph on a semi log sheet with frequency on the X axis and Gain (dB) on Y axis. Mid band frequency range is defined as those frequencies at which the response has fallen to 3dB below the maximum gain.(|A| max). These are shown as F_L& F_H and are called as the 3 dB frequencies or the cut off frequencies respectively. The difference between F_L& F_H is referred to as the bandwidth (F_H- F_L)

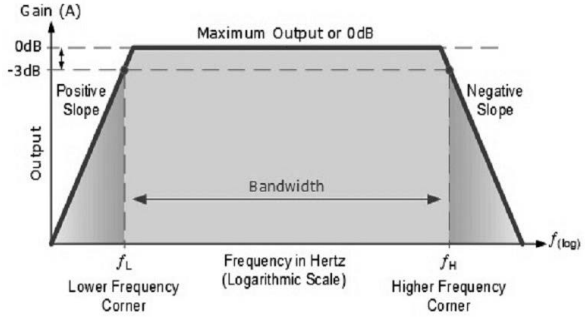


Figure 2: Frequency Response

XVI Results

1. Lower cutoff frequency F_L= ……..
2. Higher cutoff frequency F_H = ……
3. Bandwidth (F_H -F_L) = …..……

XVII Interpretation of Results (Give meaning of the above obtained results)

……

……

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……

……

XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. What is the gain of the amplifier when the input frequency is 1 kHz, 1 MHz?
2. How much is the Base Emitter Voltage (V_{BE}) of the transistor?

[Space for answers]

XX References / Suggestions for Further Reading

S. No.	Title of Book/ Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S.Chand and Co.,New Delhi 2008,ISBN 978-8121927833
2	Principles of Electronics	V.K.Mehta .	S.Chand and Co., Ram Nagar ,New Delhi-110055,11th Edition,2014.ISBN 978812192405
3	Websites		*https://www.youtube.com/watch?v=h19g_et19SY* *https://www.youtube.com/watch?v=DVLO4YBURS* *www.electronics-tutorials.ws › Amplifiers*

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Selection of component.Proper connection of electrical circuit and Handling of the instrument	20%
2	Taking proper readings	20%
3	Calculation of Cut off frequencies from graph	20%
Product related (10 Marks)		**40%**
1	Interpretation of result&Conclusions	20%
2	Practical related questions	10%
3	Submission of report in time	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. ……..….
3. …….
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No.15: Determine Gain and Bandwidth of 2-Stage RC Coupled Amplifier.

I Practical Significance

Single amplifier circuits, such as CE,CB & CC amplifiers are seldom found alone, as a single stage amplifier in any system. At least two or more than two stages are connected in cascade combination. The benefit of cascaded amplifier is to develop a larger output than the individual stages alone can develop. The individual stage gains are set relatively low to reduce signal distortion. RC coupling has the advantage of wide frequency response. The student will be able to plot the frequency response of the amplifier and calculate bandwidth.

II Relevant Program Outcomes (POs)

PO2. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO3. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

PO4.Engineering Tools: Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use Simple electronic circuits of electronics Circuits***'

i. Connect Circuits with Voltage sources and measuring instruments.
ii. Record measurements.
iii. Analyze the observations.

IV Relevant Course Outcome(s)

- Interpret the working of BJT in electronic circuits.

V Practical Outcomes

Determine gain and bandwidth of 2 Stage RC Coupled Amplifier.

- Make necessary connection.
- Measure Voltages and Currents at various terminals.
- Plot the frequency response.
- Calculate the cutoff frequencies, Bandwidth and gain.

VI Relevant Affective domain related outcome(s):

i. Handle Electronic equipments and components carefully
ii. Work in team

VII Minimum Theoretical Background

When an ac signal is applied to the base of the first transistor, it is amplified and developed across the output of the 1st stage. This amplified voltage is applied to the base of next stage of amplifier and reappears across the output of the second stage. Successive stages amplify the signal and the overall gain is raised to the desired level. RC Coupled amplifier is the most popular coupling since it is cheap and provides a constant amplification over a wide range of frequencies.

VIII Practical Circuit diagram

(a) Sample

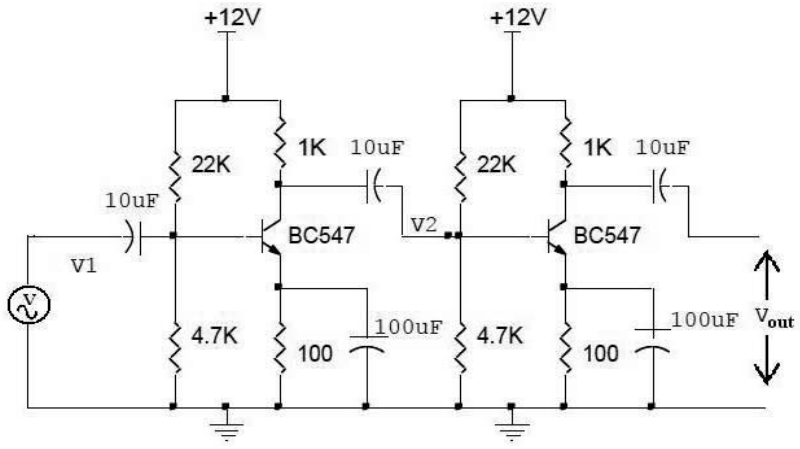


Figure1: 2 Stage RC coupled Amplifier

(b) Actual Circuit used in Lab.

(c)Actual Experimental setup used in Laboratory: NA

XIX Resources Required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Dual DC power supply	0-30 V Variable	1 No.
2.	Signal Generator	0-1 MHz	1 No.
3.	DMM (Voltmeter)	0-20 V	1 No.
4.	Transistor	BC 547	2 No.
5.	Resistors	22KΩ, 4.7 KΩ, 1KΩ	2 No. each
6.	Capacitors	10μF, 100 μF	2 No. each

X Precautions

1. Before connecting the input to the circuit, the input V is to measured and it should be less than 0.1 V.
2. The input voltage should be maintained at constant value throughout the experiment.
3. Select proper range of DMM for measurement of Voltage.
4. The connections are to be shown to the teacher before switching the power supply 'ON'.

XI Procedure

1. Connect the circuit as shown in the figure. Set source Voltage to 0.05v (50mV) at 500 Hz frequency. Keep this input Voltage constant throughout the experiment.
2. Set the input frequency at 100 Hz and vary upto 1 MHz in regular steps and note down the output voltage.
3. Calculate gain of the amplifier for each frequency.
4. Plot the graph between frequency (X-axis) and the gain in (dB) (Y-axis) in a semi-log graph sheet.
5. Calculate the Bandwidth from the graph.

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

1. ……...
2. ……...
3. ……...
4. ……...
5. ……...

XIV Precautions

1. ……...
2. ……...

XV Observations and Calculations (use blank sheet provided if space not sufficient)

Input Voltage V_{in} = _____V

Supply Voltage = _____V

S. No	Frequency (f) Hz	Output Voltage(V)	Gain (V_0/V_{in})	Gain in db= 20 log $_{10}V_o$/Vin

Graph:

Plot the graph on a semi log sheet with frequency on the X axis and Gain (dB) on Y axis. Mid band frequency range is defined as those frequencies at which the response has fallen to 3dB below the maximum gain.(|A| max) . These are shown as F_L& F_H and are called as the 3 dB frequencies or the cut off frequencies respectively. The difference between F_L& F_H is referred to as the bandwidth (F_H- F_L)

XVI Results

1. Lower Cut off frequency F_L =
2. Higher Cutoff frequency F_H =
3. Bandwidth $F_H - F_L$ =
4. Gain of the amplifier =

XVII Interpretation of Results (Give meaning of the above obtained results)

……..
……..
……...
……..

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……..
……..
……...
……..

XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. What is the gain of the amplifier's 1st stage?
2. What is the maximum input that can be given to the amplifier that has been built?

[Space for answers]

XX References / Suggestions for Further Reading

S. No.	Title of Book / Website	Author	Publication
1	Laboratory Manual for introductory electronics experiments	Maheshwari, L.K.; Anand, M.M.S.	New Age International Pvt. Ltd. New Delhi, ISBN:9780852265543
2	Applied Electronics	R.S.Sedha	S.Chand and Co. , New Delhi, 2008 ISBN :978-8121927833
3	Web references		*1.https://www.tutorialspoint.com › Amplifiers › RC Coupling Amplifier 2.https://www.elprocus.com/working-theory-of-an-rc-coupled-amplifier 3. https://www.youtube.com/watch?v=44UNkKddNdw*

XXIAssessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Selection of component.Proper connection of electrical circuit and Handling of the instrument	20%
2	Taking proper readings	20%
3	Calculation of Cut off frequencies from graph	20%
Product related (10 Marks)		**40%**
1	Interpretation of result&Conclusions	20%
2	Practical related questions	10%
3	Submission of report in time	10%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. …….
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 16: Test the Performance of the Given JFET

I Practical Significance

The field-effect transistor (FET) is a transistor that uses an electric field to control the electrical behavior of the circuit. JFETs are known as unipolar transistors since they involve single-carrier-type operation. Field effect transistors have a very high input impedance at low frequencies. In this experiment students will plot Drain and Gate /Transfer characteristics of JFET.

II Relevant Program Outcomes (POs)

PO2.Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.
PO3.Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system':***

i. Connect Circuits.
ii. Record measurements.
iii. Analyze results.

IV Relevant Course Outcome(s)

- Interpret the working of unipolar devices in the electronic circuits.

V Practical Outcome

Test the performance of the given JFET:

- Identify terminals of given JFET.
- Measure drain to source voltage V_{DS} , Gate to source voltage V_{GS} and drain current I_D
- Plot Drain and Gate characteristics of JFET.

VI Relevant Affective domain relevant outcome (s)

i.Handle all the instruments and components with care.
ii.Work in team

VII Minimum Theoretical Background

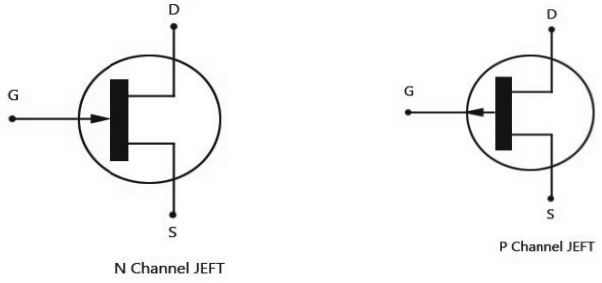


Figure 1: N Channel & P Channel JFET

Junction Field Effect Transistors are a type of transistors (high input impedance devices) which have three terminals namely Source (S), Gate (G) and Drain (D). These devices are also called voltage controlled devices as the voltage applied at the gate terminal determines the amount of current flowing in the drain and the source terminals.

N-Channel JFET

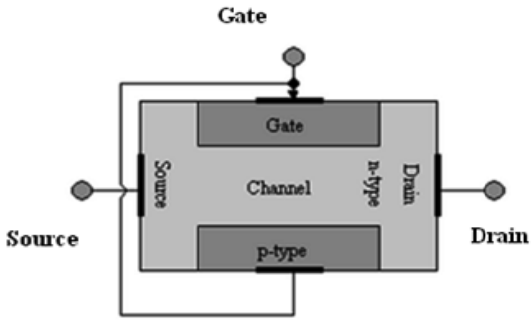


Figure 2: N-Channel JFET

N-channel JFET has its major portion made of n-type semiconductor. The mutually-opposite two faces of this bulk material from the source and the drain terminals. There are two relatively-small p-regions embedded into this substrate which are internally joined together to form the gate terminal. Thus, here, the source and the drain terminals are of n-type while the gate is of p-type.

P-Channel JFET

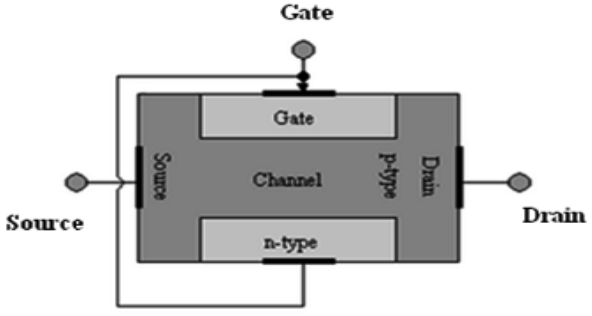


Figure 3: P-Channel JFET

P-channel JFET has its major portion made of p-type semiconductor. The mutually-opposite two faces of this bulk material from the source and the drain terminals. There are two relatively-small n-regions embedded into this substrate which are internally joined together to form the gate terminal. Thus, here, the source and the drain terminals are of p-type while the gate is of n-type.

Drain Characteristics:

The curve is divided into following regions:

Ohmic Region: In this region drain current increases linearly with the increase in drain to source voltage, obeying ohm's law.

In this region drain current increases at the inverse square law rate with the increase in drain to source voltage. It is because of fact that with increase in drain to source voltage, drain current increases. This is in turn increases reverse bias voltage across gate to source junction. As a result width of depletion region increases reducing effective width of channel.

Pinch off Region: In this region , drain current remains almost constant and at its maximum value.

Breakdown Region: In this region drain current increases rapidly as the drain to source voltage is also increased. It happens because breakdown of gate to source junction due to avalanche effect.

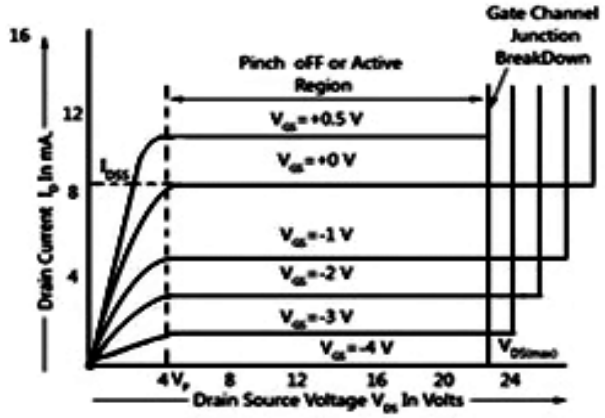


Figure 4: Drain Characteristics with External Bias

Gate/ Transfer Characteristics:

It gives relationship between drain current (I_D) and gate to source voltage for a constant value of drain to source voltage (V_{DS})

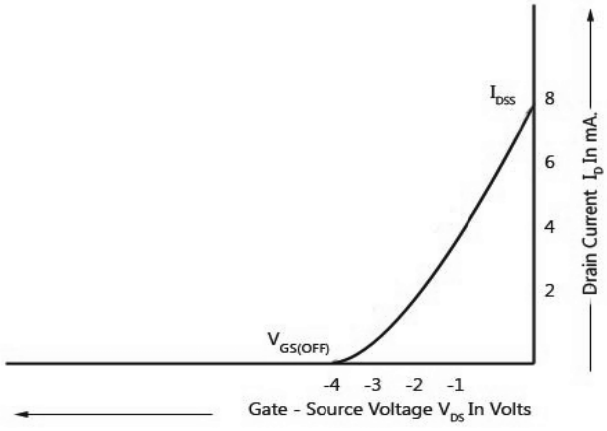


Figure 5: Gate /Transfer Characteristics

VIII Practical Circuit diagram:

(b) Sample

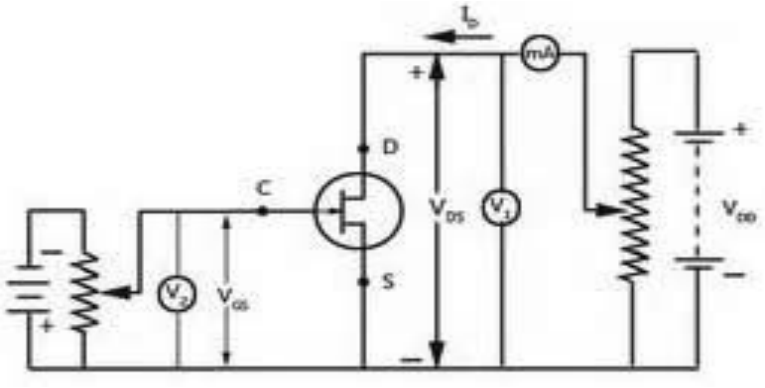


Figure 6: Input Output Characteristics of JFET

(c) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory:

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Power Supply	0-30V Dual power supply	1No.
2.	DC Voltmeter/DMM	0-20V	1 No.
3.	DC Ammeter	(0-50milliamps) (0-500μA)	1 No. each
4.	JFET	BFW 10/ BFW 11	1 No.
5.	Connecting wires / probes		
6.	Any other		

X Precautions

1. Care should be taken while handling terminals of components.
2. Select proper range & mode of ammeter and voltmeter.
3. Connect wires tightly while building circuit.
4. Show the connections to concerned teacher and then switch ON the power supply.

XI Procedure

Part I

Drain characteristics:

1. Connect the electrical circuit as shown in Figure 6.
2. Fix gate to source voltage (V_{GS}) at 0V.
3. Increase drain to source power supply and note down drain to source voltage (V_{DS}) and drain current (I_D).
4. Increase gate to source dc power supply so that voltmeter connected to gate and source terminal show 1V.
5. Now repeat above procedure and note down drain to source voltage and drain current by increasing drain power supply.
6. Take readings for 3 to 4 gate voltage values and tabulate it.

Part II

Transfer characteristics:

1. Connect the electrical circuit as shown in Figure 6.
2. Set drain to source voltage to 1V, vary gate to source voltage in steps and note down corresponding drain current (I_D).
3. Repeat the procedure for different set values of drain voltage and keep the record of gate to source voltage and drain current.

Graph

i. Plot a graph of drain to source voltage ($V_{DS)}$ on X axis verses Drain current ($I_{D)}$ on Y axis for various values of Gate to source voltage ($V_{GS).}$

ii. Plot a graph of gate to source voltage ($V_{GS)}$ verses drain current I_D for different set values of drain to source voltage (V_{DS}) .The graph will be in second quadrant as gate to source voltage is negative

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XIII Actual Procedure Followed

1. Connect the electrical circuit as per Circuit used in laboratory.
2. …….
3. …….
4. …….
5. …….
6. …….

XIV Precautions

1. …….
2. …….

XV Observations and Calculations

Table 1: Drain Characteristics

S.No.	V_{GS}=……V		V_{GS}=……V		V_{GS}=……V	
	V_{DS} (V)	I_D(mA)	V_{DS} (V)	I_D(mA)	V_{DS} (V)	I_D(mA)

Table 2: Transfer Characteristics

S.No.	V_{DS} =0V		V_{DS} =……V		V_{DS} =……V	
	V_{GS} (V)	I_D(mA)	V_{GS} (V)	I_D(mA)	V_{GS} (V)	I_D(mA)
1						
2						
3						
4						
5						
6						

Calculations:

Drain dynamic Resistance:

$r_d = \frac{\Delta V_{DS}}{\Delta I_D}$

Mutual Conductance:

$g_m = \frac{\Delta I_D}{\Delta V_{GS}}$

Amplification Factor:

$\mu = \frac{\Delta V_{DS}}{\Delta V_{GS}}$

XVI Results

a. Drain dynamic Resistance (r_d) =……..
b. Mutual Conductance (g_m) =……..
c. Amplification Factor (μ) =……..

XVII Interpretation of results (Give meaning of the above obtained results)

……
……
……

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……
……
……
……

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Write the Part number and manufacturer of given JFET.
2. Write the steps to identify terminals of given JFET.
3. The pinch off voltage for a n – channel JFET is 4 V, when VGS = 1 V, the pinch – off occurs for VDS equal to …….
   (a) 3 V (b)5 V (c) 4 V (d)1 V

[Space for answers]

XX References / Suggestions for further Reading

Sr. No.	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S. Chand and Co., New Delhi 2008, ISBN 978-8121927833
2	Principles of Electronics	V.K.Mehta.	S. Chand and Co., Ram Nagar ,New Delhi-110055,11th Edition, 2014. ISBN 978812192405
3	Web References		a. http://www.electronics-tutorials.ws/transistor/tran_5.html b. http://www.circuitstoday.com/characteristics-of-jfets c. www.nptel.ac.in/courses/117107095/lecturers/lecture_36/lecture36_page1.htm

XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the instrument and components	10 %
2	Proper connection of wires for building circuit	20 %
3	Connect and select proper range of ammeter, voltmeter	10 %
4	Identify three regions of operations	10 %
5	Measure V_{DS}, V_{GS}andI_D	10%
Product related (10 Marks)		**40%**
1	Calculation of Amplification Factor(μ), Mutual conductance (Gm), Drain dynamic resistance (rd)	10 %
2	Interpretation of result	20 %
3	Conclusions	5 %
4	Practical related questions	5%
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

Practical No. 17: Measure Temperature of the given Liquid Using Thermocouple Sensor

I Practical Significance

The thermocouple has become standard in industry as a cost effective method for measuring temperature. Several types of thermocouple are available and different types are designated by capital letters. They are constituted by two different metals. It is used to control the temperature of the furnace, water heater, and the kitchen oven; in the automobile, it is used to monitor coolant and oil temperature, and even to control the air conditioner. Thermocouple is used to measure very high temperature. The student will be able to study the variation of thermo-emf with temperature.

II Relevant Program Outcomes (POs)

PO1. **Basic knowledge**: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.
PO2.Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems
PO4. E**ngineering Tools:** Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use simple electronic circuits of computer system'***:

i. Identify electronic components.
ii. Circuit mounting.
iii. Record voltages.
iv. Analyse results

IV Relevant Course Outcome(s)

- Use sensors and transducers.

V Practical Outcome

Measure temperature of the given liquid using thermocouple

- Ability to make the connection and perform experiment.
- Ability to measure temperatures and the thermo-emf using voltmeter.
- To calculate the sensitivity of thermocouple from the graph.

VI Relevant Affective domain related Outcome(s):

1. Handle the instruments and components with care.
2. Work in team

VII Minimum Theoretical Background

Thermocouple is an arrangement in which two dissimilar metals are joined together so as to form two junctions and a closed circuit. Seebeck effect is the phenomenon in which emf is produced when junctions of a thermocouple are kept at two different temperatures. This emf is known as thermo emf and current is called thermo electric current.
Thermo emf in the thermocouple change due to change in differences of temperature in the two junctions, using the following equation.

$e = At + Bt^2$

where, e- Thermo emf

t- difference of temperature between two junctions.
A & B are constant that depend on the metals forming the thermocouple.

VIII Practical Circuit Diagram

(a) Sample

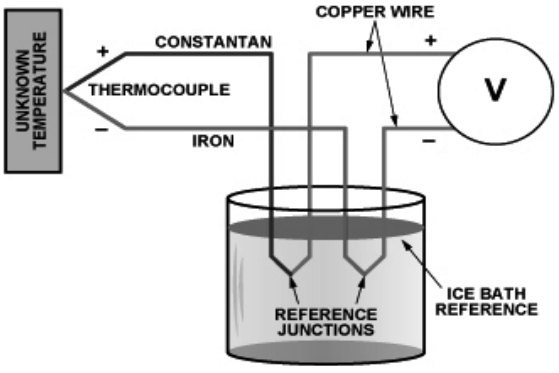


Figure 1:

(b) Actual Circuit used in laboratory

Figure 2: Experimental Setup

(c) Actual Experimental set up used in laboratory:

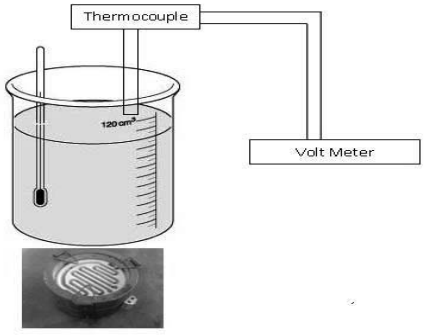


Figure 2: Experimental Setup

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Thermometer	Mercury -38° to +55°C	01
2.	Thermocouple	Iron /constantan	01
3.	Heater		01
4.	Voltmeter	0-10V	01
5.	Any other		

X Precautions

1. Care should be taken while handling thermocouple and other instruments.
2. Select proper range & mode of voltmeter.
3. Connect probes of measuring instrument tightly to terminals of a component.

XI Procedure

1. Connect the circuit diagram as per the experimental setup.
2. Insert the thermocouple into water.
3. Switch ON heater.
4. Observe the reading on milli voltmeter for temperature from 30^0Cup to 100^0 C at intervals of 10^0C .
5. Note down the changes in thermo emf of thermocouple with temperature in the table.
6. Calculate the sensitivity of the thermocouple from the graph by using formula.

Sensitivity of thermocouple= $\frac{\Delta V}{\Delta T}$

Graph:

Plot the graph of Temperature on X axis verses thermo-emf on Y axis

XII Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					

XIII Actual Procedure Followed

1. Select the electronic componentavailable in the laboratory.
2. ……
3. ……...
4. ……...
5. ……...
6. ……..

XIV Precautions

1. …….
2. …….
3. …….

XV Observations and Calculations(use blank sheet provided if space not sufficient)

Table 1:

S.No	Temperature ^{0}C	Thermo emf (*m*V)

Calculations

Sensitivity= $\frac{\Delta V}{\Delta T}$

XVI Results

……

……

XVII Interpretation of results (Give meaning of the above obtained results)

……..

……..

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……..

……..

XIX Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. At what temperature does the thermo emf start increasing?
2. What is the maximum temperature that can be measured with the given thermocouple?

[Space for answers]

XX References / Suggestions for further Reading

S. No	Title of Book/ Websites	Author	Publication
1	Web references		www.thermocoupleinfo.com www.brighthubengineering.com https://books.google.co.in › Technology & Engineering › Sensors
2	Sensors and Transducers	Dr. D. Patranabi	PHI Learning Pvt. Ltd

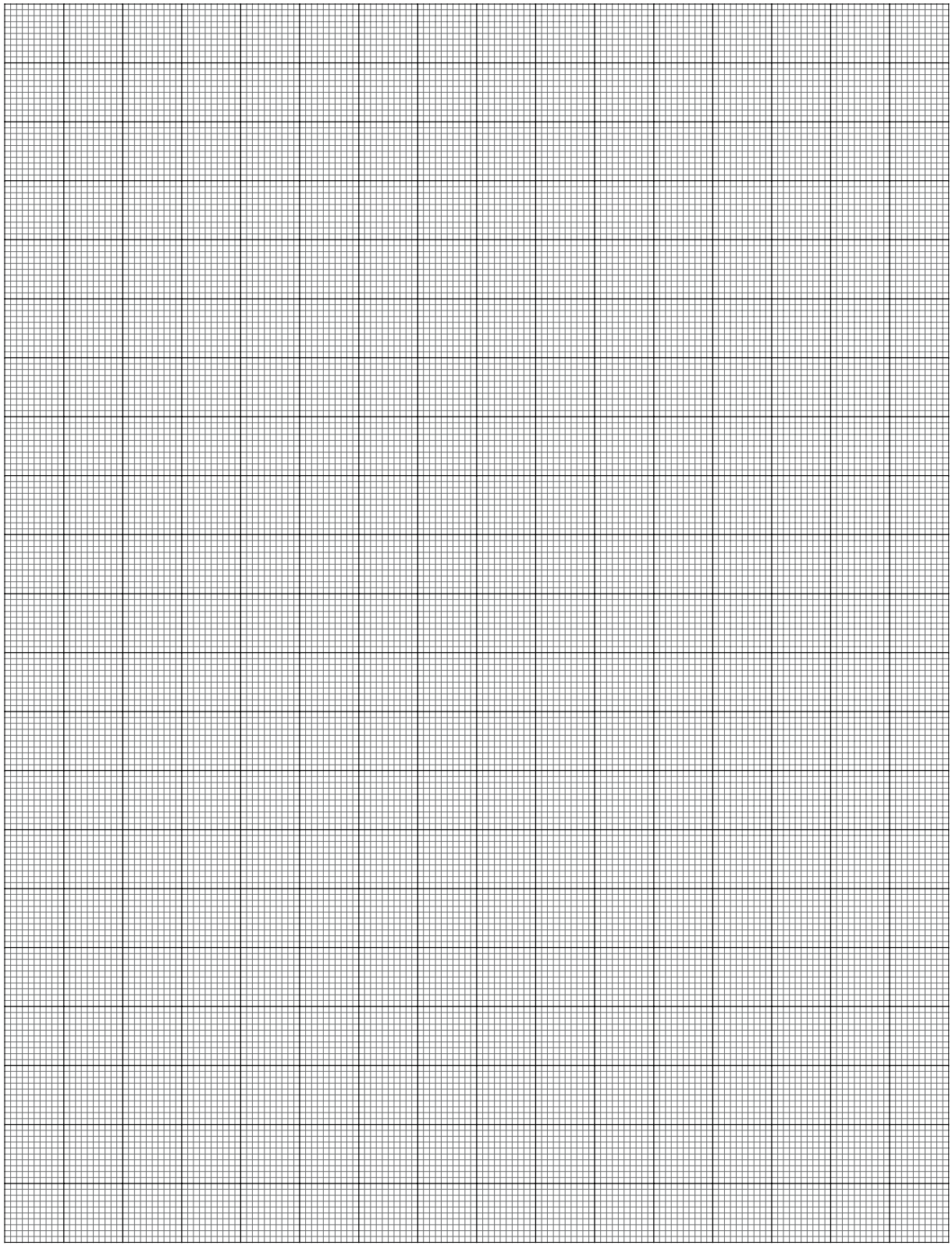
XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the equipment	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
1	Interpretation of result	20 %
2	Conclusions	10 %
3	Practical related questions	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……..
2. ……..
3. ……
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	



Practical No.18: Test the Performance of the Given Circuit Consisting of Photoelectric Sensor

I Practical Significance:

In industry, photodiodes involve in applications similar to photo detectors like charge-coupled devices, photoconductors, and photomultiplier tubes. These diodes are used in consumer electronics devices like smoke detectors, compact disc players, and televisions and remote controls in VCRs. Photodiodes are frequently used for exact measurement of the intensity of light in science & industry. Generally, they have an enhanced, more linear response than photoconductors. Photodiodes are also widely used in numerous medical applications like instruments to analyze samples, detectors for computed tomography and also used in blood gas monitors.

These diodes are much faster & more complex than normal PN junction diodes and hence are frequently used for lighting regulation and in optical communications. The students will be able to plot the VI characteristics of the given photodiode

II Relevant Program Outcomes (POs)

PO2.Discipline knowledge: Apply basic electronics engineering knowledge to solve broad-based Computer engineering related problems.
PO3.Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Computer engineering problems.
PO4.Engineering tools: Apply relevant technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency '***Use simple electronic circuits of computer system':***

i. Connect circuits.
ii. Record Measurements.
iii. Analyze Circuits.

IV Relevant Course Outcomes

- Use sensors and transducers

V Practical Outcome

Test the performance of the given circuit consisting of photoelectric sensor

- Measure photo current of a given diode.
- Measure Dark current of a given diode.

VI Relevant Affective domain related outcome(s):

i. Handle Electronic equipments and components carefully
ii. Work in team.

VII Minimum Theoretical Background

A photodiode is a two terminal PN-junction diode that consumes light energy to produce electric current. It is also called as photo-detector, a light detector, and photo-sensor. These diodes are designed to work in **reverse bias** condition, it means that the

P-side of the photodiode is associated with the negative terminal of the battery and n-side is connected to the positive terminal of the battery. This diode is very sensitive to light so when light falls on the diode it changes light into electric current.

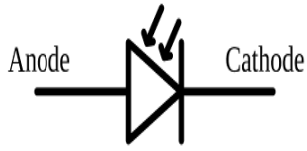


Figure 1: Symbol of Photo Diode

Figure 2: Photo Diode

When photons of energy greater than 1.1 eV hit the diode, electron-hole pairs are created. The intensity of photon absorption depends on the energy of photons – the lower the energy of photons, the deeper the absorption is. This process is known as the inner photoelectric effect.

If the absorption occurs in the depletion region of the p-n junction, these whole pairs are swept from the junction - due to the built-in electric field of the depletion region. As a result, the holes move toward the anode and the electrons move toward the cathode, thereby producing photocurrent.

Photo Current (I_λ): It is the reverse current produced due to thermally generated electron-hole pairs in depletion region due to incident light.Photo current is proportional to light intensity as light intensity increases photocurrent increases.

Dark Current: It is a reverse current that flows when no light is incident on the device.

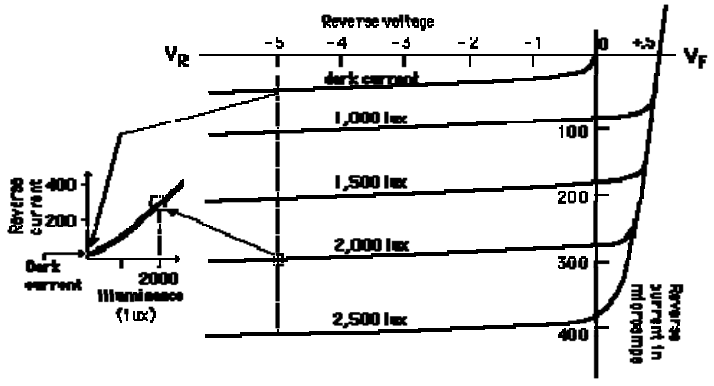


Figure 3: Reverse Characteristics

VIII Practical Circuit Diagram

(a) Sample

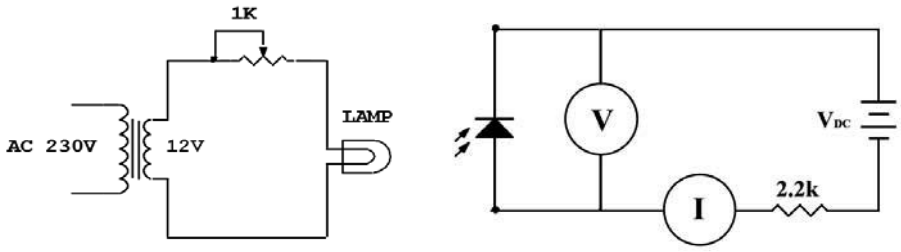


Figure 4: Circuit diagram of Photo diode in Reverse bias

(b) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory:

IX Resources required

S. No.	Name of Resource	Suggested Specification	Quantity
1.	Experimental kit/ breadboard	840 -1000 contact points: Positive and Negative power rails on opposite side of the board	1
2.	Photo diode	Silicon Photodiode	1
3.	Connecting wires		
4.	Resistor	2.2KΩ	1
5.	Digital Multimeter	3 1/2 digit display Voltmeter -0-25 V, Ammeter -0-10 μA	1
6.	DC Power supply	0-30V,2A,SC protection, display for voltage and current	1
7.	Luxmeter/Optical power meter,	3000 Lumen, Battery operated hand held type	1
8.	Light source.	Lamp	1

X Procedure

1. Select the component as per circuit diagram.
2. Make the connections as per circuit diagram.
3. Apply the reverse voltage, and measure the current when light is not incident.
4. Increase the reverse voltage and light intensity in step and note down the photocurrent.
5. Change the light source and repeat the steps.

Graph

Plot the graph of reverse voltage (negative X-Axis) versus reverse photo current (negative Y-Axis) for various light intensity.

XI Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the experiment do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode.
3. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

XII Resources used (with major specifications)

……..

……..

XIII Actual procedure followed

……..

……..

XIV Precautions

……..

……...

……...

……...

……..

……...

XV Observations and Calculations:

Table 1: Measurement of Photodiode current

Light Intensity	Position I No light Condition		Position II Low Light Condition		Position III Medium Light Condition		Position IV High Light condition	
SR No.	V_R Volts	I_R (µA)	V_R Volts	I_R (µA)	V_R Volts	I_R (µA)	V_R Volts	I_R (µA)
1	2							
2	4							
3	6							
4	8							
5	10							
6	12							
7	14							
8	16							

XXII Results

Dark Current: …….A

XVII Interpretation of results (Give meaning of the above obtained results)

……

……

XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

……

……

XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questionsso as to ensure the achievement of identified CO.

1. Identify anode and cathode of a Photodiode.
2. Draw Symbol of Photodiode.
3. Define Dark current of photodiode.
4. Write application of Photodiode.
5. State operating Principle of photodiode.

[Space for answers]

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XX References / Suggestions for further Reading

S. No.	Title of Book / Website	Author	Publication
1	Applied Electronics	R.S.Sedha	S.Chand and Co.,New Delhi 2008,ISBN 978-8121927833
2	Principles of Electronics	V.K.Mehta .	S.Chand and Co., Ram Nagar ,New Delhi-110055,11th Edition,2014.ISBN 978812192405
3	Web Reference		1. https://www.youtube.com/watch?v=SFc673lEyQA 2. https://www.youtube.com/watch?v=yMmXHg0hRok 3. https://www.youtube.com/watch?v=BtQ7qY-uqs8 4. https://www.electronics-notes.com/articles/electronic_components/diode/photodiode-detector-technology.php 5. http://silas.psfc.mit.edu/22.071j/photodiode.pdf http://www.osioptoelectronics.com/application-notes/an-photodiode-parameters-characteristics.pdf

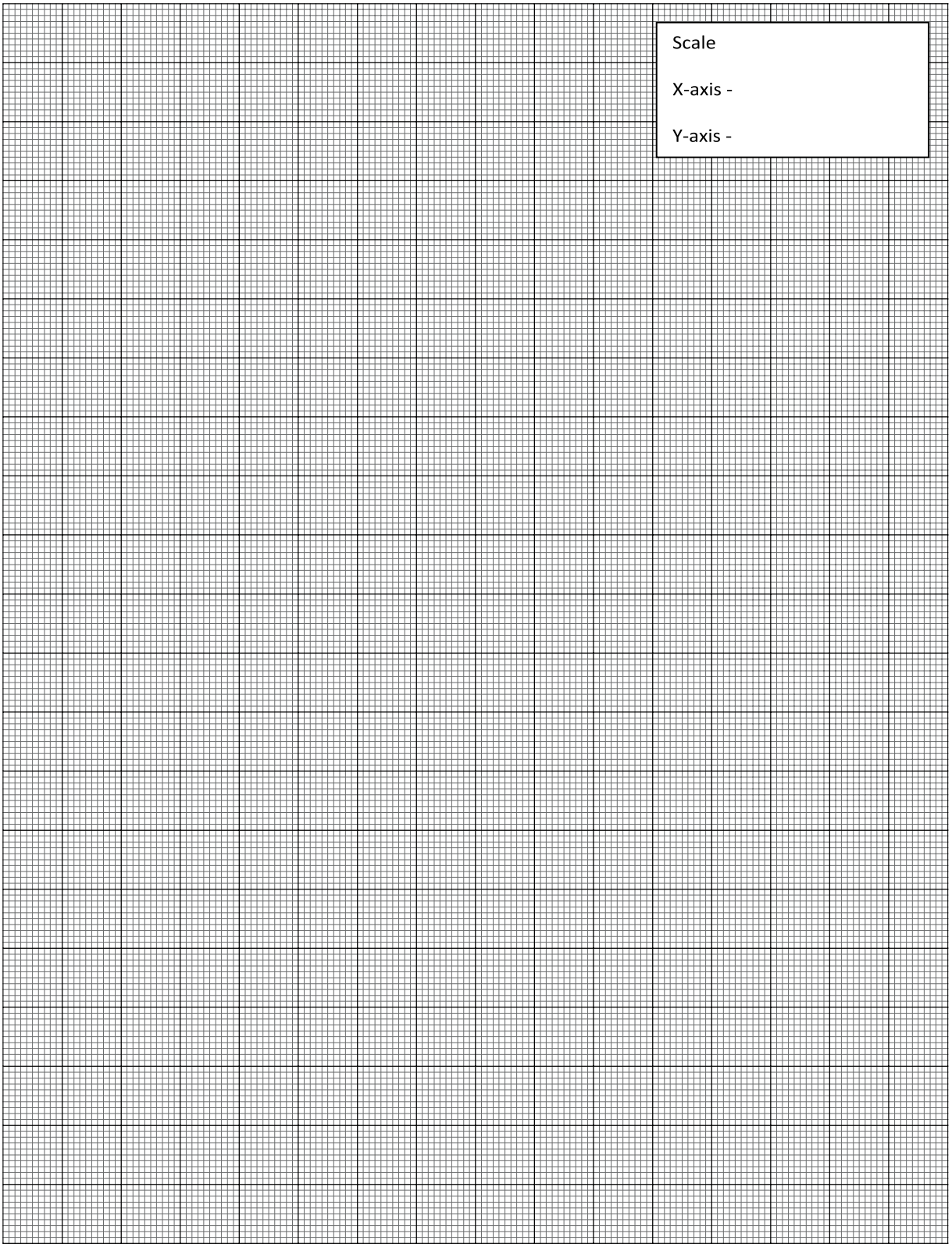
XXI Assessment Scheme

Performance Indicators		Weightage
Process related (15 Marks)		**60%**
1	Selection of component.Proper connection of electrical circuit and Handling of the instrument	20%
2	Taking proper readings	20%
3	Calculation of static and dynamic resistance from graph.	20%
Product related (10 Marks)		**40%**
1	Interpretation of result	20%
2	Conclusions	10%
3	Practical related questions	10%
	Total (25 Marks)	**100%**

Names of student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	


Scale
X-axis -
Y-axis -

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101W
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	'C' programming Language	22218
15	Basic Electronics	22225
16	Programming in "C"	22226
17	Fundamentals of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemicals	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurements	22420
12	Digital Electronics And Microcontroller Applications	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048
20	Guidelines & Assessment Manual for Micro Projects & Industrial Training	22049

Fifth Semester:

1	Network Management & Administration	17061
2	Solid Modeling	17063
3	CNC Machines	17064
4	Behavioral Science(Hand Book)	17075
5	Behavioral Science (Assignment Book)	17075
6	Windows Programming using VC++	17076
7	Estimation and Costing	17501
8	Public Health Engineering	17503
9	Concrete Technology	17504
10	Design of Steel Structures	17505
11	Switchgear and Protection	17508
12	Microprocessor & Application	17509
13	A.C. Machines	17511
14	Operating System	17512
15	Java Programming	17515
16	System Programming	17517
17	Communication Technology	17519
18	Hydraulic & Pneumatics	17522
19	Advanced Automobile Engines	17523
20	Basic Electrical & Electronics	17524
21	Measurement and Control	17528
22	Power Engineering	17529
23	Metrology & Quality Control	17530
24	Computer Hardware & Networking	17533
25	Microcontroller	17534
26	Digital Communication	17535
27	Control System & PLC	17536
28	Audio Video Engineering	17537
29	Control System	17538
30	Industrial Electronics and applications	17541
31	Heat Transfer Operations	17560
32	Chemical Process Instrumentation & control	17561

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

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