I

Name _____

Roll No. _____ Year 20____ 20____

Exam Seat No. _____

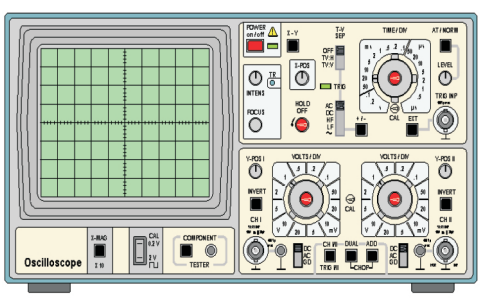
ELECTRONICS GROUP | SEMESTER - II | DIPLOMA IN ENGINEERING AND TECHNOLOGY

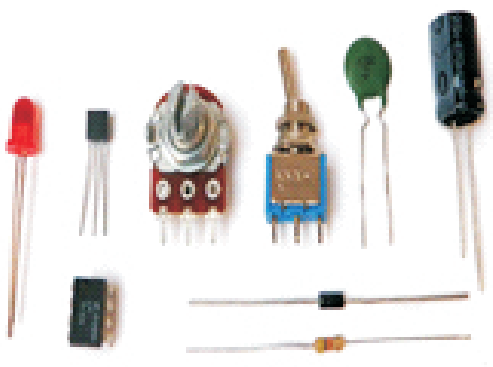
A LABORATORY MANUAL

FOR

BASIC ELECTRONICS

(22216)





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

(22216)

Semester-II

(EJ/EX/EN/ET/EQ/DE/IS/IC/IE)

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,
Bandra (East), Mumbai - 400051.
(Printed on December, 2017)

MAHARASHTRA STATE

BOARD OF TECHNICAL EDUCATION

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 (22216)** 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.

Basic Electronics courseprovides a platform for students to understand working of active devices such as Diode, BJT, MOSFET, JFET and circuits like rectifier regulators and wave shaping circuit. It is one of the foundation course, which is required for students to understand working of complex electronic circuits and systems. It also gives information about rectifiers, filters, different wave shaping circuits and voltage regulator with their applications for effective functioning in the field of electronic service industry.

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 Practical of this Course

Following programme outcomes are expected to be achieved through the practical of the course :

PO1. Basic knowledge: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electronics related problems.

PO2. Discipline knowledge: Apply Electronics and Telecommunication engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems

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

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

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

PO6. Environment and sustainability: Apply Electronics and Telecommunication engineering solutions also for sustainable development practices in social and environmental contexts

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

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

PO9. 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 also in the Electronics and Telecommunication engineering and allied industry.

Practical- Course Outcome matrix

Course Outcomes (COs):

- **a.** Use relevant diode in different electronics circuits.
- **b.** Maintain rectifiers comprising of diodes.
- **c.** Use BJT in electronics circuits.
- **d.** Use FET in electronics circuits.
- **e.** Maintain DC regulated power supply.

Sr. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.
1.	Test the performance of PN junction diode.	√	-	-	-	-
2.	Test the performance of Zener diode.	√	-	-	-	-
3.	Test the performance of photo diode by varying the light intensity as well as distance of the light source.	√	-	-	-	-
4.	Build/test half wave rectifier on breadboard.	-	√	-	-	-
5.	Build/test half wave rectifier on bread board with filter-Part I	-	√	-	-	-
6.	Build/test half wave rectifier on bread board with filter- Part II	-	√	-	-	-
7.	Build/test full wave rectifier on breadboard using two diodes.-Part I	-	√	-	-	-
8.	Build/test full wave rectifier on breadboard using two diodes-Part II	-	√	-	-	-
9.	Build/test full wave bridge rectifier on breadboard.	-	√	-	-	-
10.	Use LC with fullwave rectifier to measure ripple factor.	-	√	-	-	-
11.	Use π filter with bridge rectifier to measure ripple factor.	-	√	-	-	-
12.	Assemble positive clipper circuit on breadboard and test the performances.	√	-	-	-	-
13.	Assemble Negative clipper circuit on breadboard and test the performances.	√	-	-	-	-
14.	Build the combinational Clipper on breadboard and test the performance.-Part I	√	-	-	-	-
15.	Build the combinational Clipper on breadboard and test the performance.-Part II	√	-	-	-	-
16.	Build positive clamper on breadboard and test the performance.-Part I	√	-	-	-	-
17.	Build positive clamper on breadboard and test the performance. –Part II	√	-	-	-	-
18.	Build negative clamper on breadboard and test the performance.	√	-	-	-	-

19.	Identify the terminals of the PNP and NPN transistor using Cathode Ray Oscilloscope-Part I	-	-	√	-	-
20.	Identify the terminals of the PNP and NPN transistor using multimeter -Part II	-	-	√	-	-
21.	Find specifications of a given transistor using data sheets.	-	-	√	-	-
22.	Test the performance of BJT operated in CE mode.	-	-	√	-	-
23.	Test the performance of BJT working on CB Mode.	-	-	√	-	-
24.	Test the assembled BJT voltage divider bias circuit for given input.-Part I	-	-	√	-	-
25.	Test the assembled BJT voltage divider bias circuit for given input-Part II	-	-	√	-	-
26.	Test the performance of FET drain characteristics, transfer characteristics and calculate trans-conductance.-Part I	-	-	-	√	-
27.	Test the performance of FET drain characteristics, transfer characteristics and calculate trans-conductance.-Part II	-	-	-	√	-
28.	Build /test Zener voltage regulator for the given voltage.	-	-	-	-	√
29.	Test the performance of the transistorized series voltage regulator for the given load regulation.	-	-	-	-	√
30.	Test the performance of the transistorized shunt voltage regulator for the given load regulation.	-	-	-	-	√
31.	Test the various blocks of regulated DC power supply.	-	-	-	-	√
32.	Find out faults at different stages of regulated DC power supply.	-	-	-	-	√
33.	Troubleshoot given DC regulated power supply.-Part I	-	-	-	-	√
34.	Troubleshoot given DC regulated power supply .-Part II	-	-	-	-	√

List of Industry Relevant Skills

The following industry relevant skills of the competency "Maintain electronic circuits comprising of discrete electronic components" are expected to be developed in the student by undertaking the practical of this laboratory manual.

1.Identify the electronic component.
2. Test electronic component
3. Select the electronic component of proper value as per the requirement.
4. Mount the electronic component on breadboard as per circuit diagram.
5. Test the circuit for the given application.
6. Compare the observed output with the expected output.
7.Find faults and trouble shoot the given circuit.

Guidelines to Teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each practical
3. Involve students in performance of each experiment.
4. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.
9. If practical is in two parts -Part I and Part II it should be conducted in two weeks.
10. Teacher is expected to refer complete curriculum document and followguidelines for implementation

Instructions for Students

1. Listen carefully the lecture given by teacher about course, curriculum, learning structure, skills to be developed.
2. Organize the work in the group and make record of all observations.
3. Students shall develop maintenance skill as expected by industries.
4. Student shall attempt to develop related hand-on skills and gain confidence.
5. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual
6. Student shall refer technical magazines, IS codes and data books.
7. Student should develop habit to submit the practical on date and time.
8. Student should well prepare while submitting write-up of exercise.

Content Page

List of Practicals and Progressive Assessment Sheet

S. No	Practical no.	Practical Outcome	Page No.	Date of perfor mance	Date of submi ssion	Assess ment marks (25)	Dated sign. of teacher	Remarks (if any)
1.	1	Test the performance of PN junction diode.	1					
2.	2	Test the performance of zener diode.	9					
3.	3	Test the performance of photo diode by varying the light intensity as well as distance of the light source.	17					
4.	4	Build and test half wave rectifier on breadboard.	26					
5.	5 and 6	Build/test half wave rectifier on bread board with filter-Part I, Part-II	33					
6.	7 and 8	Build/test full wave rectifier on breadboard using two diodes.-Part I, Part-II	42					
7.	9	Build/test full wave bridge rectifier on breadboard	51					
8.	10	Use LC with full wave rectifier to measure ripple factor.	58					
9.	11	Use π filter with bridge rectifier to measure ripple factor.	65					
10.	12	Assemble positive clipper circuit on breadboard and test the performances.	72					
11.	13	Assemble Negative clipper circuit on breadboard and test the performances.	79					
12.	14 and 15	Build the combinational Clipper on breadboard and test the performance.-Part I, Part-II	86					
13.	16 and 17	Build positive clamper on breadboard and test the performance.-Part I, Part-II	93					
14.	18	Build negative clamper on breadboard and test the performance.	101					
15.	19 and 20	Identify the terminals of the PNP and NPN transistor using Cathode Ray Oscilloscope-Part I, Part-II	109					
16.	21	Find specifications of a given transistor using data sheets.	118					

S. No	Practical no.	Practical Outcome	Page No.	Date of performance	Date of submission	Assessment marks (25)	Dated sign. of teacher	Remarks (if any)
17.	22	Test the performance of BJT operated in CE mode.	124					
18.	23	Test the performance of BJT working on CB Mode.	134					
19.	24 and 25	Test the assembled BJT voltage divider bias circuit for given input.-Part I, Part-II	144					
20.	26 and 27	Test the performance of FET drain characteristics, transfer characteristics and calculate trans-conductance.-Part I, Part-II	150					
21.	28	Build and test Zener voltage regulator for the given voltage.	160					
22.	29	Test the performance of the transistorized series voltage regulator for the given load regulation.	169					
23.	30	Test the performance of the transistorized shunt voltage regulator for the given load regulation.	178					
24.	31	Test the various blocks of regulated DC power supply.	187					
25.	32	Find out faults at different stages of regulated DC power supply.	195					
26.	33 and 34	Troubleshoot given DC regulated power supply.-Part I, Part-II	202					
Total								

* To be transferred to proforma of CIAAN 2017.

Practical No.1:Test the Performance of PN Junction Diode.

I Practical Significance:

PN Junction diode is used in industries as well as in domestic applications such asdetector circuits,wave shaping circuits and in rectifier 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 diode behavior with respect to change in voltage.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunicationsengineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunicationsengineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

III Competency and Practical Skills

This practical isexpected to develop the following skills for the industry-identified competency: **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use DC Power supply to give different voltages.
4. Use Digital multimeter to measure the voltages and currents.

IV Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V PracticalOutcome

Test V-I characteristics of PN Junction diode to:

1. Measure static resistance of a given diode.
2. Measure dynamic resistance of a given diode.
3. Determine knee voltage of a given diode.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Follow safety precautions.

VII Minimum Theoretical Background

A PN Junction Diode is one of the simplest semiconductor devices, and it has the characteristic of passing current in one direction only. If a suitable positivevoltage (forward bias) is applied between the two ends of the PN junction, it can supply free electrons and holes with the extra energy they require to cross the junction, as the width of the depletion layer around the PN junction is decreased.

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

$R_{static} = V_F/I_F \Omega$

Dynamic resistance ($R_{dynamic}$) of a PN junction diode is a ratio of small change in forward voltage (ΔV_F) to small change in forward current (ΔI_F).

$$R_{dynamic} = \Delta V_F / \Delta I_F \ \Omega$$

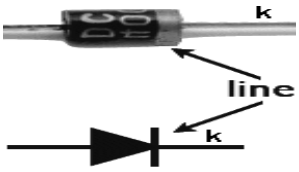


Figure 1: Diode and its symbol

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

VIII Practical Circuit Diagram :

a) Sample

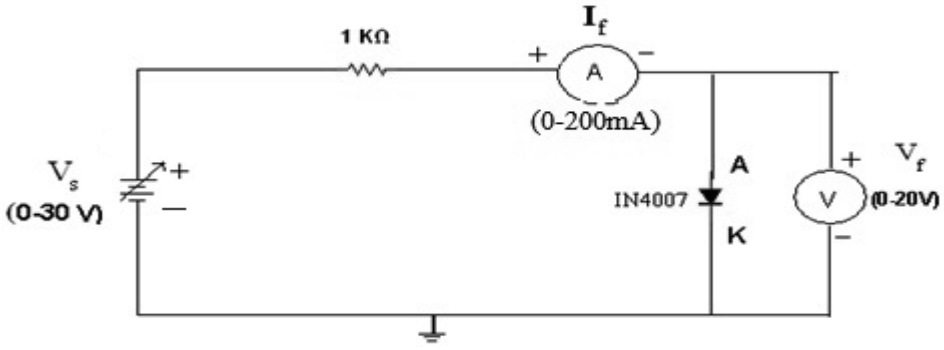


Figure 2: Circuit diagram of diode in forward bias

b) Actual Circuit used in laboratory

c) Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	2	1. Digital Multimeterwith diode testing facilities will be preferred. 2. In place of Digital Multimeter, DC Voltmeter and DC ammeter can be used.
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1	-
3.	Voltmeter	0-20 V	1	-
4.	Ammeter	0 - 200 mA, 0 - 200 μA	1	-
5.	Bread board	5.5 CM X 17CM	1	-
6.	Diode	IN4001 (or any other equivalent diode)	1	-
7.	Resistor	1KΩ(0.5watts/0.25watts)	1	-
8.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	-

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 with correct polarities as shown in the circuit diagram.

XI Procedure

1. Connect the electrical circuit as in figure 2.
2. Switch ON the power supply.
3. Increase the input voltage in step of 0.1 V
4. Record the voltage V_F and current I_F in the observation table
5. Repeat steps 4 to 5 till 1 V is reached.
6. Plot the graph for the forward bias characteristics of diode bytaking V_F on X- axis and I_F on Y- axis.
7. Calculate the static resistance at a particular point, on the characteristics.
8. Considering two points on the plotted graph, calculate dynamic resistance.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……...……...
……..…….
……..

XIV Precautions followed

……..
……..
……..

XV Observations and Calculations:

Table 1: Measurement of V_F and I_F

S.No.	$V_{F(volts)}$	$I_{F(mA)}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Calculations:

Calculate static resistance at particular point

$$R_{static} = V_F \ / \ I_F \Omega$$

Calculate dynamic resistance:

$$R_{dynamic} = \Delta V_F \ / \ \Delta I_F \Omega$$

XVI Results

1. Static resistance of given diode = ……..……. Ω
2. Dynamic Resistance of given diode = ……. Ω
3. Knee Voltage of given diode= …… V

XVII Interpretation of results

…..……..
……

XVIII Conclusions

……
…….....

XIX Practical related Questions

1. Repeat the above experiment for germanium diode and find its knee voltage.

[Space for answers]

……

……

XX References / Suggestions for further Reading

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

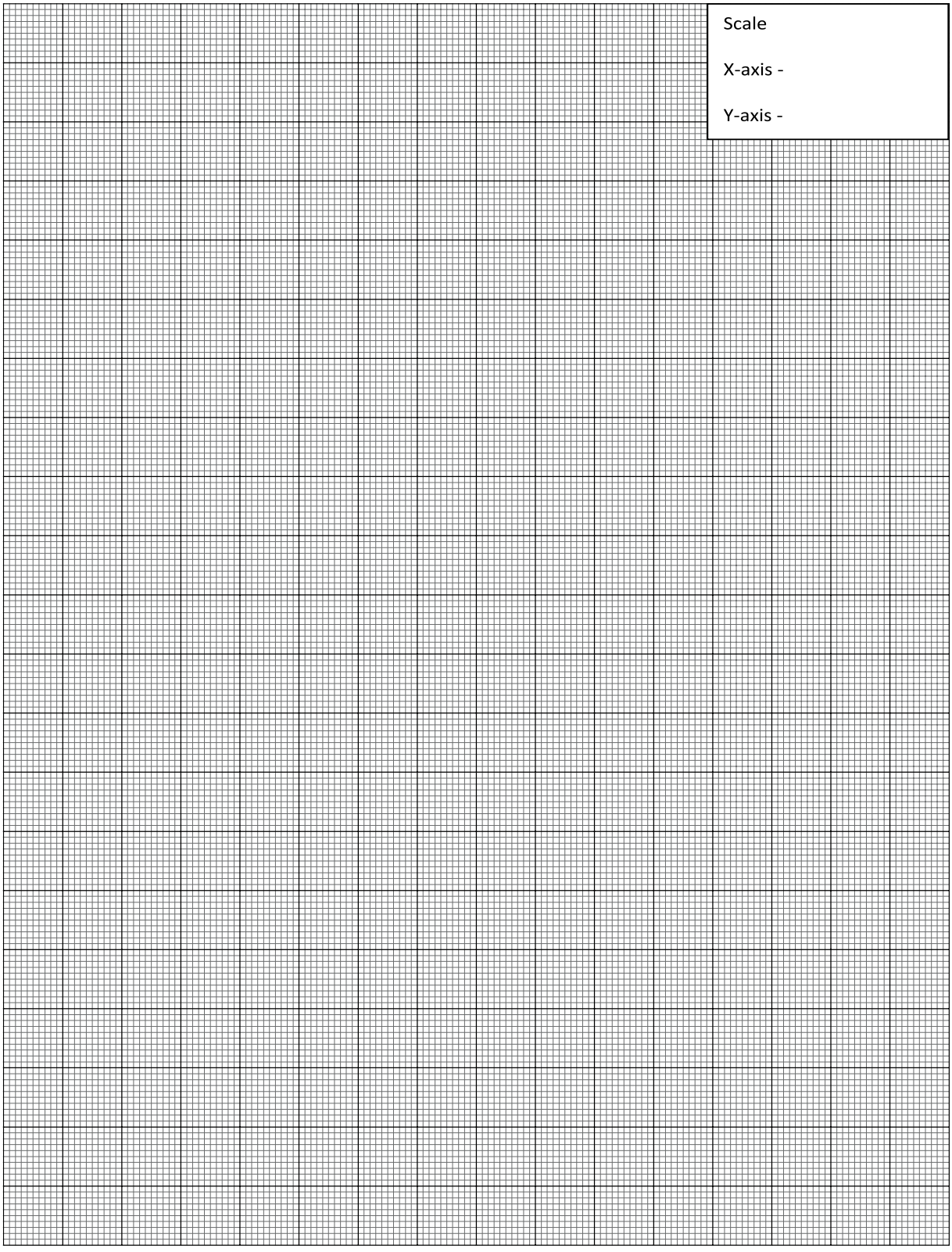
XXI Assessment Scheme

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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. 2: Test the Performance of Zener Diode.

I Practical Significance:

In industries, Zener diodes are widely used as voltage references and as shunt regulators to regulate the voltage across circuits. Zener diodes are also used in over voltage protection circuits and switching applications. Zener diodes are suitable for surge suppression circuits, for device protection, for clipping, clamping circuits and especially as peak clippers.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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: **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use DC Power supply to give different voltages.
4. Use Digital multimeter to measure the voltages and currents.

IV Relevant Course Outcomes

Use relevant diode in different electronic circuits.

V Practical Outcome

Test V-I characteristics of Zener diode to:

1. Measure breakdown voltage of Zener diode.
2. Measure forward resistance of Zener diode.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully
- Follow safety precautions.

VII Minimum Theoretical Background

Zener diode is formed by combining highly doped P and N semiconductor materials. It works on the principle of Zener breakdown and is normally operated in reverse breakdown region. In reverse breakdown region, high current flow through the diode leading to high power dissipation.

The Zener breakdown occurs when the electric field across the junction produced due to the reverse voltage is sufficiently high, this breaks covalent bonds. Thus a large numbers of carriers are generated which causes a more current to flow. This mechanism is called as Zener breakdown. After Zener breakdown the reverse current increases sharply.

Zener resistance of a Zener diode is a ratio of reverse Zener voltage to the reverse Zener current.

Figure 1: Symbol of Zener diode

VIII Practical Circuit Diagram :

a) Sample

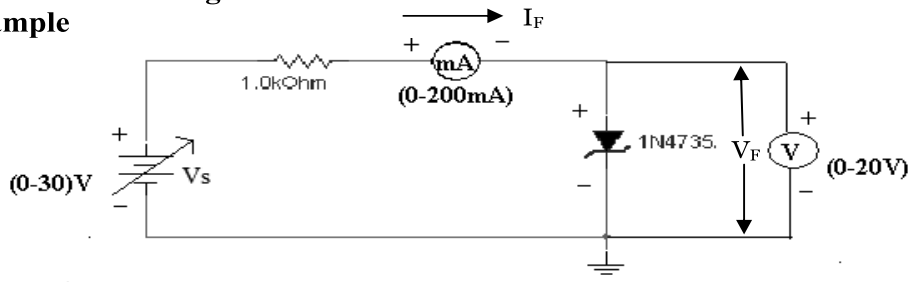


Figure 2: Zener diode in forward bias

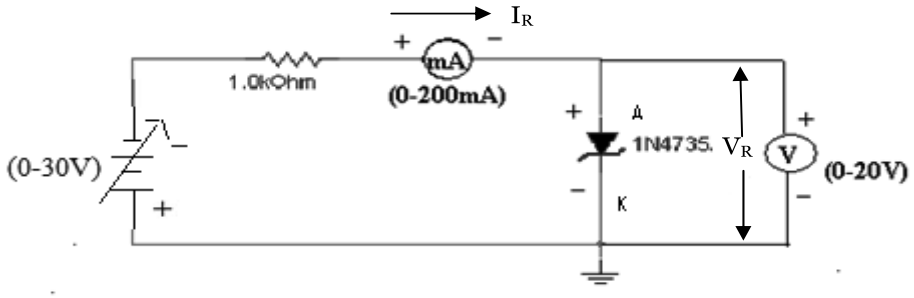


Figure 3: Zener diode in reverse bias

b) Actual Circuit used in laboratory

c) Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3	2	1. Digital Multimeter with diode testing facilities will be preferred. 2. In place of Digital Multimeter, DC Voltmeter and DC ammeter can be used.
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1.	
3.	Voltmeter	0-20 V	1	
4.	Ammeter	(0 - 200 mA, 0 - 200 μA)	1	
5.	Bread board	5.5 CM X 17CM	1	
6.	Zener Diode	IN4735 (or any other equivalent diode)	1	
7.	Resistor	1KΩ(0.5watts/0.25watts)	1	
8.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

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 Zener 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 circuit as shown in figure 2.
2. Switch ON the power supply.
3. Record the voltage V_F and current I_F in the observation table no1.
4. Increase the input voltage in step of 0.1 V
5. Record the voltage V_F and current I_F in the observation table no1.
6. Repeat steps 4 to 5 till 1 V is reached.
7. Plot the graph for the forward bias characteristics of Zener diode by taking V_F on X-axis and I_F on Y-axis.
8. Connect the circuit as shown in figure 3.
9. Vary input voltage gradually in steps of 1V up to 12V.
10. Record the corresponding readings of V_R and I_R in the observation table no2.
11. Plot the graph for the reverse bias characteristics of Zener diode by taking V_R on X-axis and I_R on Y-axis.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……

……

……

XIV Precautions followed

……

……

……

XV Observations and Calculations:

Table 1: Measurement of V_F and I_F

S.No.	$V_{F(V)}$	$I_{F(mA)}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Table 2: Measurement of V_R and I_R

S.No.	$V_{R(V)}$	$I_{R(mA)}$
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Calculations:

$$R_Z = V_F / I_F \Omega$$

$$R_Z = V_R / I_R \quad \Omega$$

XVI Results

1.Zener breakdown voltage = …….V

2. Forward resistance of zener diode = ……..….Ω

XVII Interpretation of result

……..

……..

XVIII Conclusions

……

..……...

XVIII Practical related Questions

1. What is the value of zener voltage for given zener diode?
2. What is the maximum value of reverse current for given zener diode.
3. What is the effect on voltage across zener diode and current flowing through it, when reverse voltage across it is more than breakdown voltage?
4. What portion of zener diode characteristics is most useful for voltage regulator applications?

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XIX References / Suggestions for further Reading

https://www.youtube.com/watch?v=itzPT3UbCII

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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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. 3:Test the Performance of Photo Diode by Varying the Light Intensity as Well as Distance of the Lightsource.

I Practical Significance:

In industry and domestic applications, photodiodes are used in applications of photo detectors like charge-coupled devices, photoconductors, and photomultiplier tubes. These diodes are used in consumer electronics applications like smoke detectors, compact disc players, and televisions remotecontrols. Photodiodes are frequently used for exact measurement of the intensity of light in scientific and industry applications. Generally, they have an enhanced, more linear response than photoconductors. These diodes are much faster and more complex than normal PN junction diodes and hence are frequently used for lighting regulation and in optical communications.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use DC Power supply to give different voltages.
4. Use Digital multimeter to measure the voltages.

IV Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V Practical Outcome

Test the performance of Photodiode by varying the light intensity and distance of the light source.

VI Relevant Affective domain related Outcome(s)

1. Handle components and equipment carefully.
2. Select instruments of required range and specification.

VII Minimum Theoretical Background

A photodiode is a two terminal PN-junction diode that is operated by first reverse biasing the junction and then illuminating it by light energy to produce electric current. It is also called as photo-detector/light detector/photo-sensor. These diodes are designed to work in **reverse bias** condition, it means that the P-side of the photodiode is connected 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

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: A reverse current flows when no light is incident on the device.

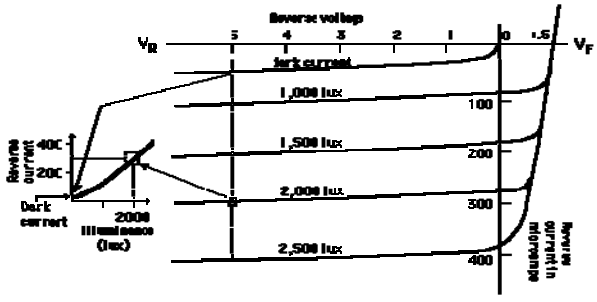


Figure 3: Plot of V_R versus V_F

VIII Practical Circuit Diagram :

a. Sample

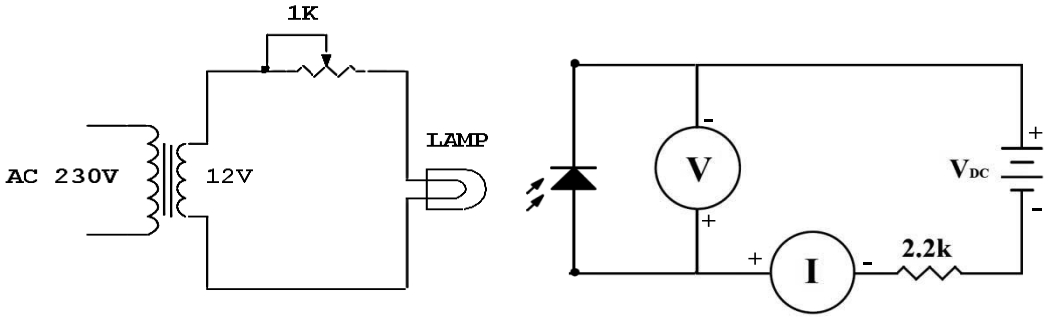


Figure 4: Experimental setup

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Experimental kit/ breadboard	840 -1000 contact points: Positive and Negative power rails on opposite side of the board 5.5 CM X 17CM	1	
2.	Photo diode	BPW 34 or equivalent any other photodiode	1	
3.	Connecting wires	Single strand Teflon coating(0.6mm diameter)		
4.	Resistor	2.2KΩ, 0.5Watt	1	
5.	Digital Multimeter	3 1/2 digit display, 9999 counts digital multimeter measures: Vac, Vdc (1000V max) , Adc, Aac (10 amp max), Resistance (0 - 100 MΩ) ,	1	Voltmeter (0-25) V, Ammeter (0-10μ) A
6.	DC Power supply	0-30V,2A,SC protection, display for voltage and current	1	
7.	Lux meter/Optical power meter,	3000 Lumen, Battery operated hand held type	1	
8.	Light source.	Portable Lamp mounted on stand	1	

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

Test performance of photo diode by varying the light intensity.

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 intensity and repeat the steps.
6. Plot the graph of reverse voltage (negative X-Axis) V_S reverse photo current (negative Y-Axis) for various light intensity.

Test performance of photo diode by varying distance of the light source.

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. Keep the input voltage constant at which we get sufficient light intensity and vary the distance of light source from photo diode in step and note down the photocurrent.
5. Plot the graph of reverse voltage (negative X-Axis) V_S reverse photo current (negative Y-Axis) for various light intensity.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……...
……...
……...
……...
……...

XIV Precautions followed

……..…….
……..…….
……..…….

XV Observations and Calculations:

Table 1: Measurement of Photodiode current when light intensity is varied

Light Intensity	No light Condition(Lux meter reading ----)		Low Light Condition(Lux meter reading ----)		High Light condition(Lux meter reading ----)	
SR No.	V_R Volts	Ip (µA)	V_R Volts	Ip (µA)	V_R Volts	Ip (µA)
1	2					
2	4					
3	6					
4	8					
5	10					
6	12					
7	14					
8	16					

Table 2 : Measurement of Photodiode current when distance is varied

Light Intensity	Position I No light condition (Distance of light source in cm ----)		Position II (Distance of light source in cm ----)		Position III (Distance of light source in cm ----)	
SR No.	V_R Volts	Ip (µA)	V_R Volts	Ip (µA)	V_R Volts	Ip (µA)
1	2					
2	4					
3	6					
4	8					
5	10					
6	12					
7	14					
8	16					

Calculations:

XVI Results

Dark Current: …….

XVII Interpretation of results

……

……

XVIII Conclusions

……

……

XIX Practical related Questions

1. Write specification of photodiode used in above performance.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

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
6. http://www.osioptoelectronics.com/application-notes/an-photodiode-parameters-characteristics.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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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: Build and Test Half Wave Rectifier on Breadboard.

I Practical Significance:

AC power is more efficiently and economically transmitted. The majority of electronic equipment, devices work on DC power. It becomes necessary to convert AC power into DC power. In half wave rectifier single diode is used. The current flows in only one direction through diode. So it is unidirectional device.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry-identified competency **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use CRO to observe input output waveforms.
4. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V Practical Outcome

Test half wave rectifier on Breadboard:

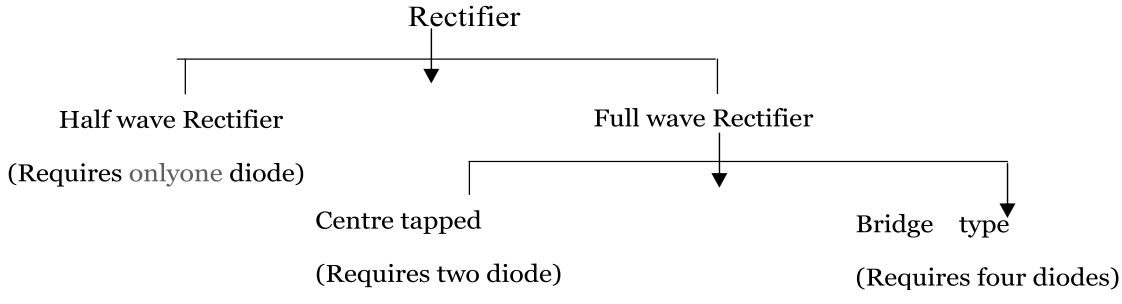
1. Observe output Waveform on CRO.
2. Use of DMM to measure the output voltage.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Follow all safety precautions.

VII Minimum Theoretical Background

Rectifier: - It is a circuit, which converts AC supply into the Pulsating DC supply.



Half wave Rectifier: DC or average output voltage of half wave rectifier is Vm/π as the output current flows only for half the cycle of input signal.

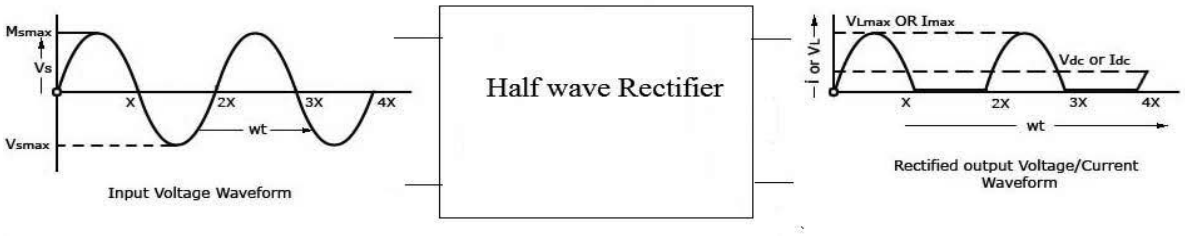


Figure 1: Half Wave rectifier.

Courtesy: (*www.Circuit.Today.com)*

VIII Practical Circuit Diagram :

a. Sample

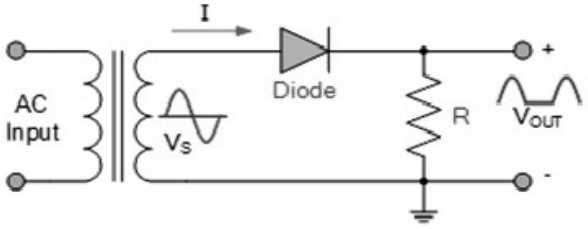


Figure 2: Circuit diagram of Half Wave rectifier.

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Transformer	Step down 9-0-9 V 500mA	1	
2.	Digital Multimeter	Digital Multimeter: 3 1/2-digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred.
3.	CRO	25 MHz ,dual scope	1	
4.	Bread board	5.5 CM X 17CM	1	
5.	Diode	IN4007 (or any other equivalent diode)	1	
6.	Resistor	1KΩ/10KΩ(0.5watts/0.25watts)	1	
7.	Connecting wires	Single strand Teflon coating(0.6mm diameter)	L.S.	

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.

XI Procedure

1. Make the connection as per the circuit diagram shown in figure2.
2. Connect the CRO probe across the Secondary and measure the Vp-p appearing across the diodes.
3. Now connect the CRO probes across the resistance R_L and measure the peak value of output voltage (Vm).
4. Observe the waveform on CRO and draw it on graph paper.
5. From the measured peak value of output voltage (Vm), calculate the average or dc value of output voltage (V_{dc}).
6. Connect the DMM across the R_L and measure the dc voltage.
7. Compare the value calculated in step 5 with the value measured in step 6.
8. Tabulate the readings in Table1.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……

……

……

XIV Precautions followed

……

……

XV Observations and Calculations:

Table 1

Type of rectifier	Rectifier Output on CRO (V_m)	V_{dc} Calculated (using Formula $V_{dc} = (V_m/\pi)$	V_{dc} Measured (using DMM)	Comment

Calculations: Calculate V_{dc} using Formula:

$$V_{dc} = (V_m / \pi)$$

XVI Results

DC output voltage of Half wave rectifier

1. Calculated V_{dc} (CRO)= …… V
2. Measured V_{dc} (DMM)= …….. .V

XVII Interpretation of results

……

……

XVIII Conclusions

……

……

XIX Practical related Questions

1. Repeat the above experiment for silicon diode of different specification.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=_vKeaPHXF9U
2. https://www.youtube.com/watch?v=7U8NzRAvy
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

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 components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Calculation of theoretical values	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 and 6: Build and Test Half Wave Rectifier On Breadboard with Filter (PART-I and II)

I Practical Significance

Electric power is usually transmitted in AC form. However certain applications needs DC power supply such as electronic appliances. Hence, AC mains need to be rectified using rectifier when DC power is required.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry-identified competency:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Digital multimeter to measure the voltages.

IV Relevant Course Outcome(s)

Use diodes in different applications.

V Practical Outcome

Convert AC signal into DC signal using Half wave rectifier:

1. Build the circuit of Half Wave Rectifier on bread board.
2. Observe the waveform of Half Wave Rectifier on CRO at various test points.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Follow safety precautions.

VII Minimum Theoretical Background

Rectifier is an electronic circuit used for converting AC into Pulsating DC and this process is known as **Rectification**. In half wave rectifier, during the positive half cycles of the input wave, the diode will be forward biased and during the negative half cycles of input wave, the diode will be reverse biased. The rectifier conducts current during positive half Cycle of A.C. input and no current through it during negative half cycle of AC input. This is called **half wave rectification.**

Rectifier performance is based on efficient DC output. The pulsating Direct Current (DC) is not constant. It fluctuates with respect to time. When this fluctuating Direct Current (DC) is applied to any electronic device, the device may not work properly. Sometimes the device may also be damaged. So the fluctuating Direct Current (DC) is not useful in most of the applications. Therefore, it needs a Direct Current (DC) that does not fluctuate with respect to time. The only solution for this is smoothing the fluctuating Direct Current (DC). This can be achieved by using a circuit called filter. The filter is made up of a combination of components such as capacitors, resistors, and inductors. The capacitor allows the AC component and blocks the DC component. The inductor allows the DC component and blocks the AC component.

VIII Circuit diagram:

a. Sample

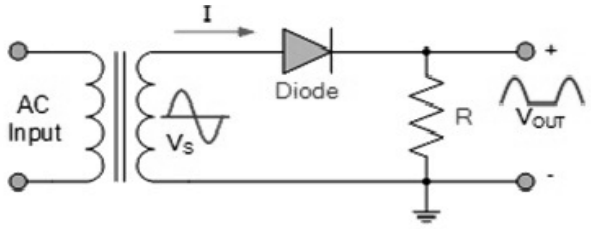
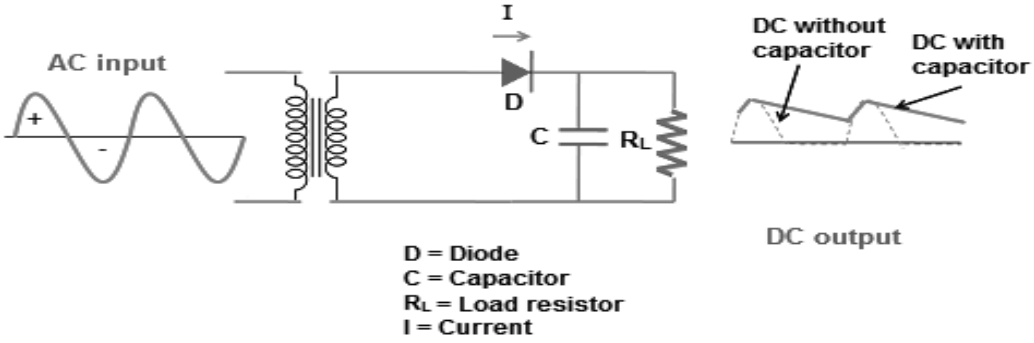


Figure 1. Half wave rectifier without filter.



(Courtesy http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/halfwaverectifierwithfilter.html)

Figure 2. Half wave rectifier with filter

b. Actual Circuit used in laboratory

c. Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Object	Specification	Quantity
1.	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	2
2.	Voltmeter	0-20 V	1
3.	CRO	25MHz	1
4.	Ammeter	(0 - 200 mA, 0 - 200 μA)	1
5.	Bread board	5.5 CM X 17CM	1
6.	Transformer	12-0-12 V AC, 500 mA	1
7.	Diode	IN4001(or any other equivalent diode)	1
8.	Resistor	1KΩ(0.5watts/0.25watts)	1
9.	Capacitor	10μf/ 24 V	1
10.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement

X Precautions to be Followed

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.

XI Procedure

1. Connect the Electronic circuit for half wave rectifier with Capacitor filter on breadboard as shown in Figure 2.
2. Connect the primary side of the transformer to AC mains. Connect the CRO probe across the secondary and measure the Vs_{p-p} appearing across diode. Now connect the probes across the resistance R_L.
3. Measure the peak value of output voltage (Vm) using CRO. From measured peak value of output voltage (Vm) calculate the average or DC value of output voltage.
4. Draw the input/output waveforms of rectifier on graph paper.
5. Using a DMM measure the DC voltage across the load resistance.

XII Resources Used

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

XIII Actual Procedure Followed

……...……..

……

..……...

XIV Precautions Followed

……

……

XV Observations and Calculations

Table 1

S.No.	Rectified output (V_m)	V_{dc} (V) measured without filter on CRO	V_{dc} (V) measured without filter on DMM	V_{dc} (V) measured with filter on CRO	V_{dc} (V) measured with filter on DMM
1					

Calculations:

$$V_{dc}=V_m/\pi$$

XVI Results

V_{dc} calculated = ….....V

XVII Interpretation of results

……...……..

…….

XVIII Conclusions

…….

…….

XIX Practical related Questions

1. State the effect on output voltage if we replace the filter capacitor of different specification.

2. Attach the data sheet of capacitor used in Q1 of XIX .Refer second website given in XX.

[Space for answers]

…….

…….

…….

…….

…….

…….

…….

XX References / Suggestions for further Reading

1. http://nptel.ac.in/courses/117103063/4
2. http://eecs.oregonstate.edu/education/docs/datasheets/XC-600178.pdf

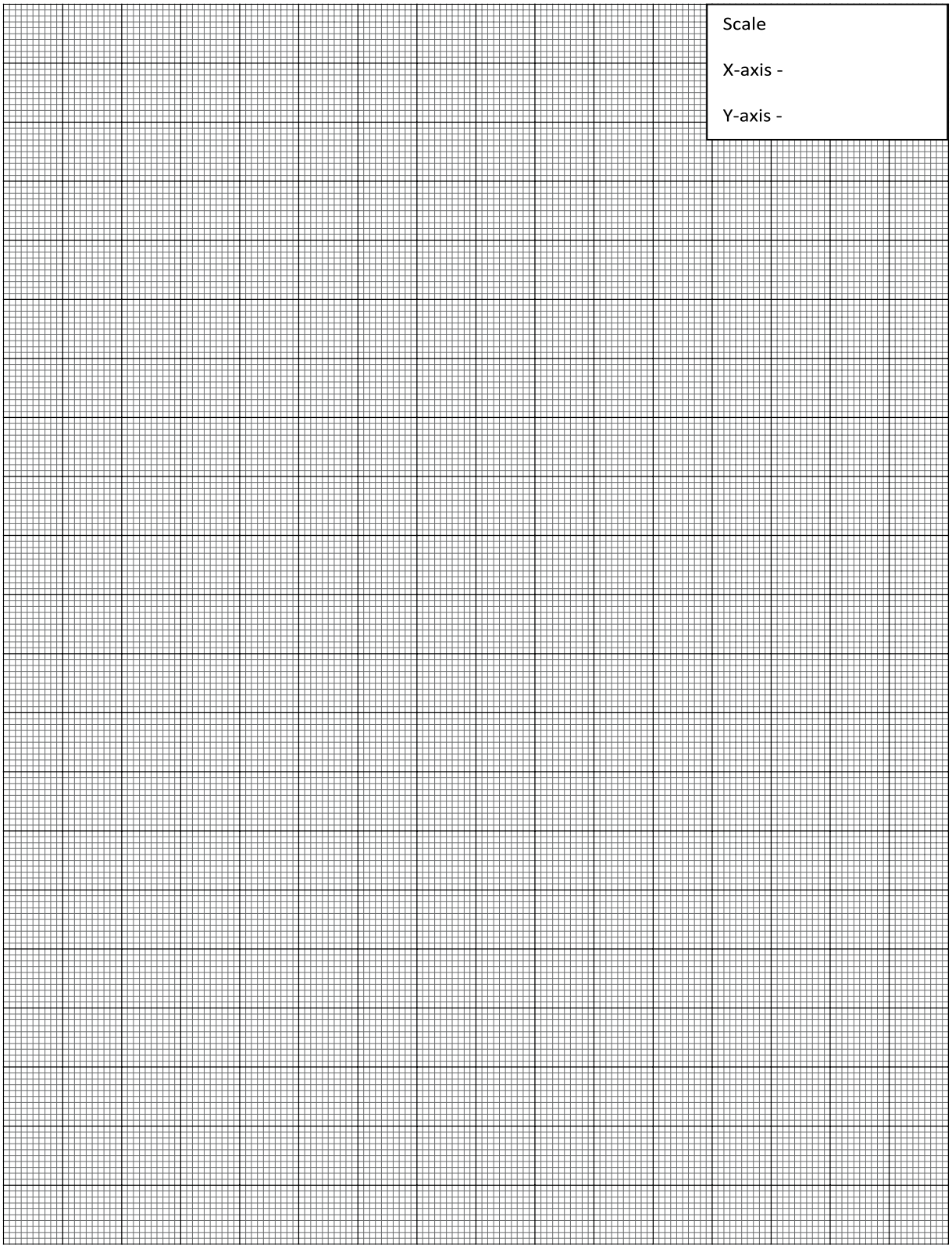
XXI Assessment Scheme

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 -

1N4001 - 1N4007
General-Purpose Rectifiers

Features

- Low Forward Voltage Drop
- High Surge Current Capability

DO-41
COLOR BAND DENOTES CATHODE

Ordering Information

Part Number	Top Mark	Package	Packing Method
1N4001	1N4001	DO-204AL (DO-41)	Tape and Reel
1N4002	1N4002	DO-204AL (DO-41)	Tape and Reel
1N4003	1N4003	DO-204AL (DO-41)	Tape and Reel
1N4004	1N4004	DO-204AL (DO-41)	Tape and Reel
1N4005	1N4005	DO-204AL (DO-41)	Tape and Reel
1N4006	1N4006	DO-204AL (DO-41)	Tape and Reel
1N4007	1N4007	DO-204AL (DO-41)	Tape and Reel

Practical No. 7 and 8: Build/ Test Full Wave Rectifier on Breadboard Using Two Diodes (PART- I and II)

I Practical Significance

Electric power is usually transmitted in AC form. However certain applications needs DC power supply such as electronic appliances. Hence, AC mains need to be rectified using rectifier when DC power is required.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V Practical Outcome

Convert AC signal into DC signal using Half wave rectifier:

1. Sketch circuit diagram of Half Wave Rectifier and label components.
2. Observe the waveform of Half Wave Rectifier on CRO at various test points.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Follow all safety precautions.

VII Minimum Theoretical Background

Rectifier is an electronic device used for converting AC into pulsating 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. Full wave rectifier utilizes both the cycle of input AC voltage. Two diodes are used in full wave centre tapped rectifier. Center Tapped Full wave rectifier using two diodes is shown in the figure no. 1. Center tapped transformer is used in this full wave rectifier. During the positive cycle diode D1 conducts and D2 remains OFF. During negative cycle diode D1 remains OFF but diode D2 is ON. Note that direction of current in the load resistance is same during both the cycles hence output consists of only positive cycles.

VIII Circuit diagram:

(a) Sample

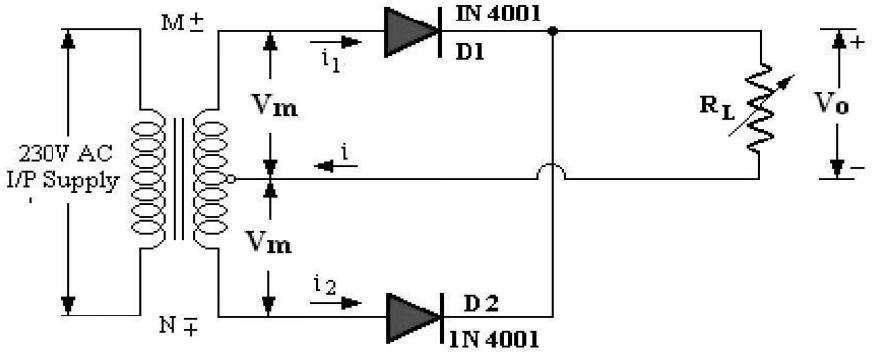


Figure 1:Full wave rectifier without filter.

(b) Actual Circuit used in laboratory

(c) Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Object	Specification	Quantity
1.	Transformer (center tapped)	12-0-12 V AC, 500 mA	1
2.	Resistor	10K Ω,0.5 Watt	1
3.	Diode	Silicon 1N4001	2
4.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	1
5.	Bread board	5.5 CM X 17CM	1
6.	CRO	25 MHz Dual trace	1
7.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	1

X Precautions to be Followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the practical do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode.

XI Procedure

1. Connect the circuit for Center Tapped Full wave rectifier on breadboard 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 Vs_{p-p} appearing across diode.
3. Measure the peak value of output voltage (V_m) across the resistance R_L.
4. Draw input and output waveforms of full wave rectifier.
5. Calculate the average or dc value of output voltage.
6. Using DMM measure the DC voltage at the load resistance R_L.
7. Compare the value calculated in step 5 with the value measured in step 6.
8. Tabulate the readings in Table1.

XII Resources Used

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

XIII Actual Procedure Followed

……

……

XIV Precautions Followed

……

……

XV Observations and Calculations

Table 1.

Type of rectifier	Rectifier Output on CRO (V_m)	V_{dc} Calculated (using Formula $V_{dc} = (2V_{m/\pi})$	V_{dc} Measured (using DMM)	Comment

Calculations:

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

XVI Results

V_{dc} calculated = ……..……. V

XVII Interpretation of results

……

…..……...

XVIII Conclusions

……

……

XIX Practical related Questions

1. Calculate frequency of waveform obtained at the output of full wave rectifier.

2. Compare half wave and Full wave rectifier based on output waveforms obtained in Laboratory.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

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 components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 -

1N4001 - 1N4007
General-Purpose Rectifiers

Features

- Low Forward Voltage Drop
- High Surge Current Capability

DO-41
COLOR BAND DENOTES CATHODE

Ordering Information

Part Number	Top Mark	Package	Packing Method
1N4001	1N4001	DO-204AL (DO-41)	Tape and Reel
1N4002	1N4002	DO-204AL (DO-41)	Tape and Reel
1N4003	1N4003	DO-204AL (DO-41)	Tape and Reel
1N4004	1N4004	DO-204AL (DO-41)	Tape and Reel
1N4005	1N4005	DO-204AL (DO-41)	Tape and Reel
1N4006	1N4006	DO-204AL (DO-41)	Tape and Reel
1N4007	1N4007	DO-204AL (DO-41)	Tape and Reel

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Value							Unit
		1N 4001	1N 4002	1N 4003	1N 4004	1N 4005	1N 4006	1N 4007	
V_{RRM}	Peak Repetitive Reverse Voltage	50	100	200	400	600	800	1000	V
$I_{F(AV)}$	Average Rectified Forward Current .375 " Lead Length at T_A = 75°C	1.0							A
I_{FSM}	Non-Repetitive Peak Forward Surge Current 8.3 ms Single Half-Sine-Wave	30							A
I^2t	Rating for Fusing (t < 8.3 ms)	3.7							A^2sec
T_{STG}	Storage Temperature Range	-55 to +175							°C
T_J	Operating Junction Temperature	-55 to +175							°C

Thermal Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Value	Unit
P_D	Power Dissipation	3.0	W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	50	°C/W

Electrical Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Conditions	Value	Unit
V_F	Forward Voltage	I_F = 1.0 A	1.1	V
I_{rr}	Maximum Full Load Reverse Current, Full Cycle	T_A = 75°C	30	µA
I_R	Reverse Current at Rated V_R	T_A = 25°C	5.0	µA
		T_A = 100°C	50	
C_T	Total Capacitance	V_R = 4.0 V, f = 1.0 MHz	15	pF

Practical No. 9: Build and Test Full Wave Bridge Rectifier on Breadboard.

I Practical Significance

A bridge rectifier is an arrangement of four diodes in a bridge configuration, which provides the same output polarity for either input polarity. It is used for converting an alternating current (AC) input into a direct current (DC) output. Bridge rectifier is widely used in power supply circuit.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Digital multimeter to measure the voltages.

IV Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V Practical Outcome

Convert AC signal into DC signal using Full wave rectifier:

1. Build circuit of Full Wave bridge Rectifier on breadboard.
2. Observe the waveform of Full Wave Rectifier on CRO at various test points.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Follow all safety precautions.

VII Minimum Theoretical Background

The circuit diagram of the full wave bridge rectifier is shown in figure 1. During positive half cycle diode D1 and D4 becomes forward bias and diode D2 and D3 becomes Reverse bias. Currents starts flowing through D1 and D4 which produces output voltage across Load Resistor R.

During negative half cycle diode D2 and D3 becomes forward bias and diode D1 and D4 becomes Reverse bias. Currents starts flowing through D2 and D3 which produces output voltage across Load Resistor R.

VIII Circuit diagram:

(a) Sample

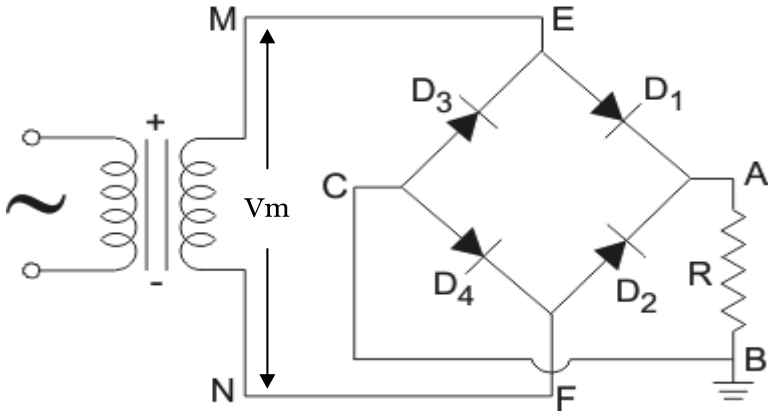


Figure 1.Full wave bridge rectifier

(b) Actual Circuit used in laboratory

(c) Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Object	Specification	Quantity
1.	Transformer	9-0-9VAC, 500 mA	1
2.	Resistor	10KΩ 0.5 Watt	1
3.	Diode	Silicon 1N4007	4
4.	CRO	25MHz	1
5.	Bread board	5.5 CM X 17CM	
6.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	L.S

X Precautions to be Followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the practical do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode

XI Procedure

1. Connect the circuit for full wave bridge rectifier on bread board 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 connections.
4. Switch ON the power supply and connect the CRO to the load resistor.
5. Measure the peak voltage V_m (peak voltage) across load resistor.

XII Resources Used

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

XIII Actual Procedure Followed

……
……

XIV Precautions Followed

……...
……

XV Observations and Calculations

Table 1

S. No.	Rectified output across R (V_m)
1	

Calculations: NA

XVI Results

…...……...
……...……...

XVII Interpretation of results

…...……...
……...……...

XVIII Conclusions

……

……

XIX Practical related Questions

Sketch DC output voltage of Half wave, Centre tapped Full wave Rectifier and Full wave Bridge rectifier for the same AC input and comment on it.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. http://nptel.ac.in/courses/
2. http://www.circuitstoday.com/full-wave-bridge-rectifier.
3. https://www.electrical4u.com/bridge-rectifiers/

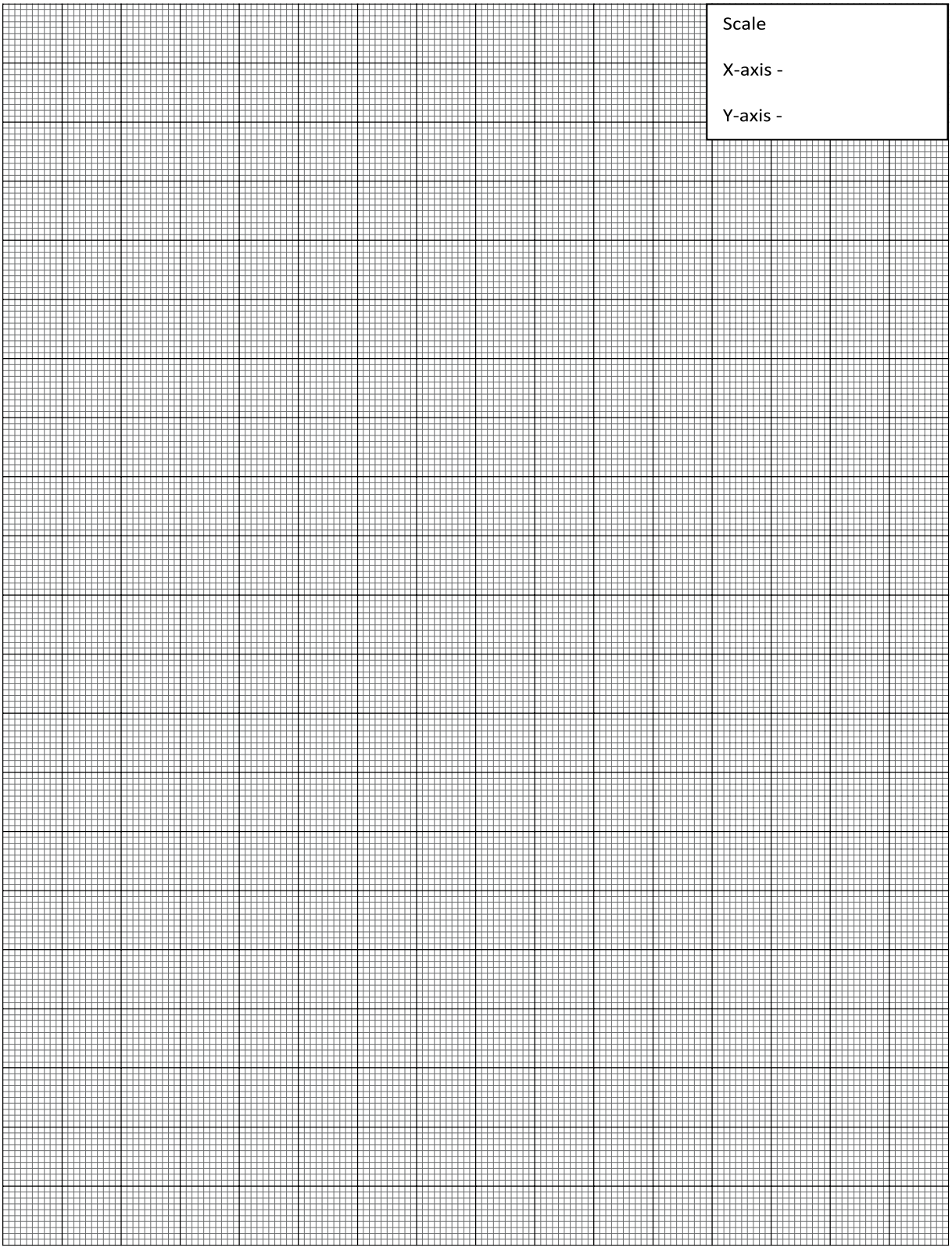
XXI Assessment Scheme

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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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.10: Use LC Filter with Full Wave Rectifier to Measure Ripple Factor.

I Practical Significance

The filter converts the pulsating DC into pure DC. The electronic reactive elements like capacitor and inductors are used for filtering.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V Practical Outcome

Use LC filter to remove the ripples at the output of full wave rectifier:

1. Build circuit of Full Wave Rectifier with LC filter on bread board.
2. Observe the waveform at output of Full Wave Rectifier and LC filter.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Follow all safety precautions.

VII Minimum Theoretical Background

The capacitor used in "C" filter reduces the ripple voltage, but causes the diode current to increase .This large current may damage the diode and will further cause heating problem and decrease the efficiency of the filter. On the other hand, a simple series inductor reduces both the peak and effective values of the output current and output voltage. So the combination of both the filter (L and C), forms a new filter called the L-C filter which will have a good efficiency, with controlled diode current and enough ripple removal factor . The voltage stabilizing action of shunt capacitor and the current smoothing action of series inductor filter can be combined to form a perfect practical filter circuit.

VIII Circuit diagram:

a. Sample

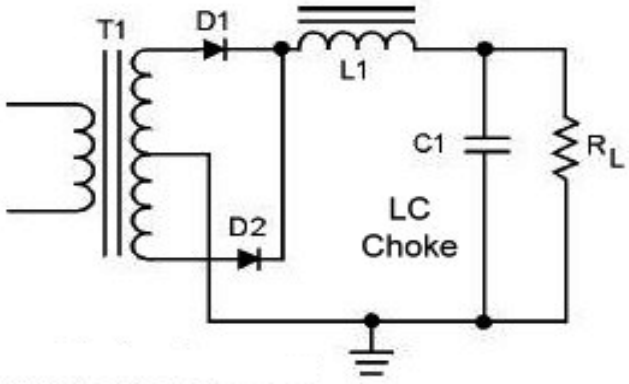


Figure 1:Full wave rectifier with LC filter.

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Object	Specification	Quantity
1.	Transformer (center tapped)	12-0-12 V AC, 500 mA	1
2.	Resistor	10K Ω, 0.5 Watt.	1
3.	Diode	Silicon 1N4007	2
4.	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	1
5.	Capacitor, Inductor	Suitable rating	1
6.	C.R.O.	25MHz	1
7.	Bread board	5.5 CM X 17CM	
8.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement

X Precautions to be Followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the practical do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode.

XI Procedure

1. Connect the circuit of rectifier with LC Filter 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. Record peak voltage across load resistor using CRO.
5. Calculate the DC output voltage and peak to peak ripple voltage.
6. Calculate the ripple factor.
7. Observe and draw the waveforms across LC filter on graph paper.

XII Resources Used

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

XIII Actual Procedure Followed

……

……

XIV Precautions Followed

……

……..…..

XV Observations and Calculations

Table 1

Type of Rectifier	Peak Voltage Vm (volts)	Vdc= 2Vm/π (volts)	Peak to peak ripple voltage Vr(volts)	Ripple factor= Vr/Vdc
Full wave rectifier				

XVI Results

……

……...

XVII Interpretation of results

……..

……

XVIII Conclusions

……..

……..……...

XIX Practical related Questions

1. Repeat the above experiment using C filter and comment on ripple factor.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/halfwaverectifierwithfilter.htmlhttp://nptel.ac.in/courses/117103063/4
2. https://www.elprocus.com/half-wave-rectifier-circuit-working-principle-and-characteristics-2/
3. http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/halfwaverectifierwithfilter.html

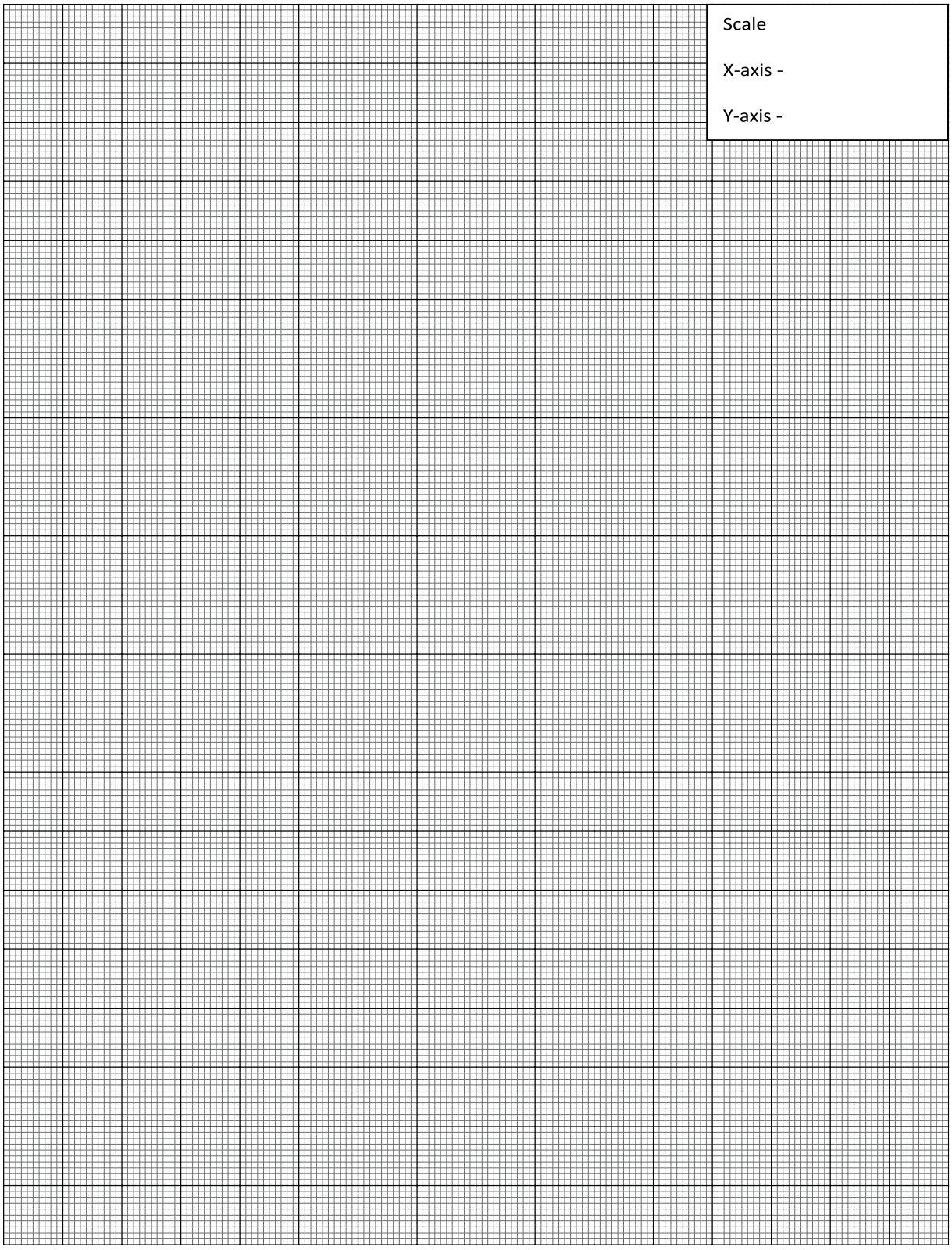
XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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. 11: Use π Filter With Bridge Rectifier To Measure Ripple Factor.

I Practical Significance

The filter converts the pulsating DC into pure DC. The electronic reactive elements like capacitor and inductors are used for filtering.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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 :**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Digital multimeter to measure the voltages.

IV Relevant Course Outcomes

- Use relevant diode in different electronics circuits.

V Practical Outcome

Use **π** filter to remove the ripples at the output of bridge rectifier:

1. Build the circuit of bridge rectifier with π filter.
2. Observe the waveform at output of bridge rectifier with π filter.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Follow all safety precautions.

VII Minimum Theoretical Background

This filter is basically a capacitor filter followed by an LC filter. Since its shape (C-L-C) is like the letter π it is called π filter. It is also called capacitor input filter because the rectifier feeds directly into the capacitor C. Here the first capacitor C offers a low reactance to AC component of rectifier output but provide more reactance to DC components. Therefore most of the AC components will bypass through C and the DC component flows through chock L. The choke offers very high reactance to the AC component. Thus it blocks AC components while pass the DC. The capacitor C_f bypasses any other AC component appears across the load.

VIII Circuit diagram:

a. Sample

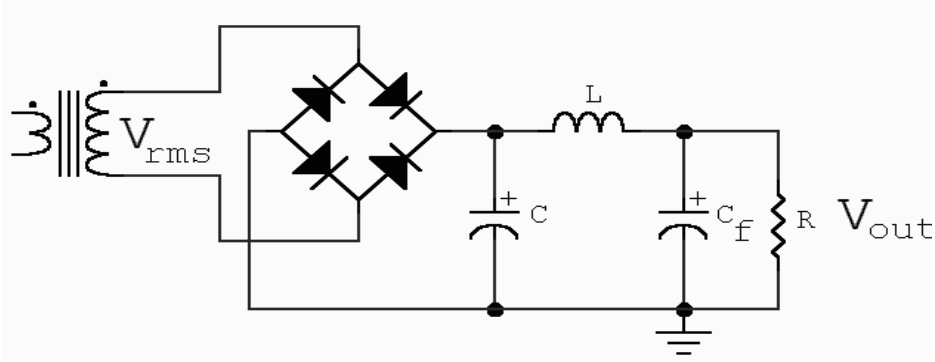


Figure1 :Full wave bridge rectifier with π filter

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Object	Specification	Quantity
1.	Transformer	0-12 V AC, 500 mA	1
2.	Resistor	10K Ω 0.5 Watt	1
3.	Diode	Silicon Diode 1N4007	4
4.	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	1
5.	Capacitor, inductor	Suitable rating	2 Capacitors 1 Inductor
6.	C.R.O.	20MHz	1
7.	Bread board	5.5 CM X 17CM	
8.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement

X Precautions to be Followed

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. While doing the practical do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode

XI Procedure

1. Connect the circuit of rectifier with π Filter 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. Record peak voltage across load resistor using CRO.
5. Calculate the DC output voltage and peak to peak ripple voltage.
6. Calculate the ripple factor.
7. Observe and draw the waveforms across π filter on graph paper.

XII Resources Used

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

XIII Actual Procedure Followed

……

……

XIV Precautions Followed

……

……

XV Observations and Calculations

Table 1

Type of Rectifier	Peak Voltage Vm (volts)	Vdc= 2Vm/π (volts)	Peak to peak ripple voltage Vr(volts)	Ripple factor= Vr/Vdc
Full wave rectifier				

Calculations:

XVI Results

……

……

XVII Interpretation of results

……

……

XVIII Conclusions

……

……

XIX Practical related Questions

1. Repeat the above experiment using different value of $C_{f.}$

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/halfwaverectifierwithfilter.htmlhttp://nptel.ac.in/courses/117103063/4
2. https://www.elprocus.com/full-wave-rectifier-circuit-working-principle-and-characteristics-2/
3. http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/full waverectifierwithfilter.html

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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. 12: Assemble Positive Clipper Circuit on Breadboard and Test The Performances

I Practical Significance

In electronics, a clipper is a circuit designed to prevent the output of a circuit from exceeding a predetermined voltage level without distorting the remaining part of the applied input waveform.

Clippers are used for the separation of synchronizing signals from the composite picture signals. The excessive noise spikes above a certain level can be limited or clipped in FM transmitters by using the series clippers. The typical application of diode clipper is for the protection of transistor from transients. Clippers can be used as voltage limiters and amplitude selectors. Clipping circuits are also called slicers or amplitude selectors.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency. :**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Function generator to give input waveform.
4. Use CRO to observe input and output waveform.

IV Relevant Course Outcome(s)

- Use relevant diode in different electronics circuits.

V Practical Outcome

Assemble positive clipper on bread board and test its performance.

1. Select the required component for positive clipper circuit.
2. Connect circuit as positive clipper circuit.
3. Apply input to the circuit and observe the output.

VI Relevant Affective domain related Outcome(s)

1.Handle components and equipment carefully.

2.Select instruments of required range and specifications.

VII Minimum Theoretical Background

A clipping circuit consists of linear elements like resistors and non-linear elements like junction diodes or transistors, but it does not contain energy-storage elements like capacitors. Clipping circuits are used to select for purposes of transmission, that part of a signal wave form which appears above or below a certain reference voltage level.

Thus a clipper circuit can remove certain portions of an arbitrary waveform near the positive or negative peaks. Clipping may be achieved either at one level or two levels.

Clipper has two types:
1. **Series Clipper**: In this configuration the diode is connected in series with the load.
2. **Parallel Clipper**: In this configuration the diode is connected in parallel with the load.

VIII Practical circuit diagram:

a. Sample

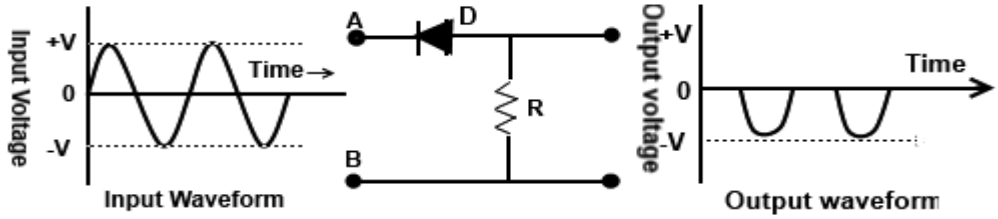


Figure1: Circuit diagram of positive clipper.

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred.
2.	CRO	25 MHz, Dual trace CRO.	1	
3.	Function Generator	1MHz, Sine, Triangle, Square, Ramp, Pulse, TTL (Sync) and DC Outputs	1	
4.	Bread board	5.5 CM X 17CM	1	
5.	Diode	IN4007 (or any other equivalent diode)	1	
6.	Resistor	1KΩ(0.5watts/0.25watts)	1	
7.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

X Precautions to be Followed

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.

XI Procedure

1. Make the connections on breadboard as per circuit diagram as shown in figure no.1.
2. Connect the function generator at the input and apply sine wave to the input of circuit (8Vp-p).
3. Observe the input and output waveforms on CRO and sketch it on the graph paper.

XII Resources Used

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

XIII Actual Procedure Followed

……

……

……

……

XIV Precautions Followed

……
……
……
……

XV Observations and Calculations

Table 1: Measurement of V_{in} and V_{out}

S.No.	Input Voltage $V_{in(VOLTS)}$	Output Voltage $V_{out(VOLTS)}$	Comments
1			

Calculations: Not applicable

XVI Results

……
……

XVII Interpretation of results

……
……

XVIII Conclusions

……
……

XIX Practical related Questions

1. Repeat the above experiment for $V_i = 3V_{pp}$.
2. Repeat the above experiment for $Vi = 3V_{pp}$ but different value of R.
3. Repeat the above experiment for $Vi = 7V_{pp}$ but same value of R as in XIX [2]

[Space for answers]

……
……
……
……
……
……
……
……
……
……
……
……

XX References / Suggestions for further Reading

1. https://en.wikipedia.org/wiki/Clipper_(electronics)
2. http://www.circuitstoday.com/diode-clippers
3. https://www.youtube.com/watch?v=ve-8HKOnCk0

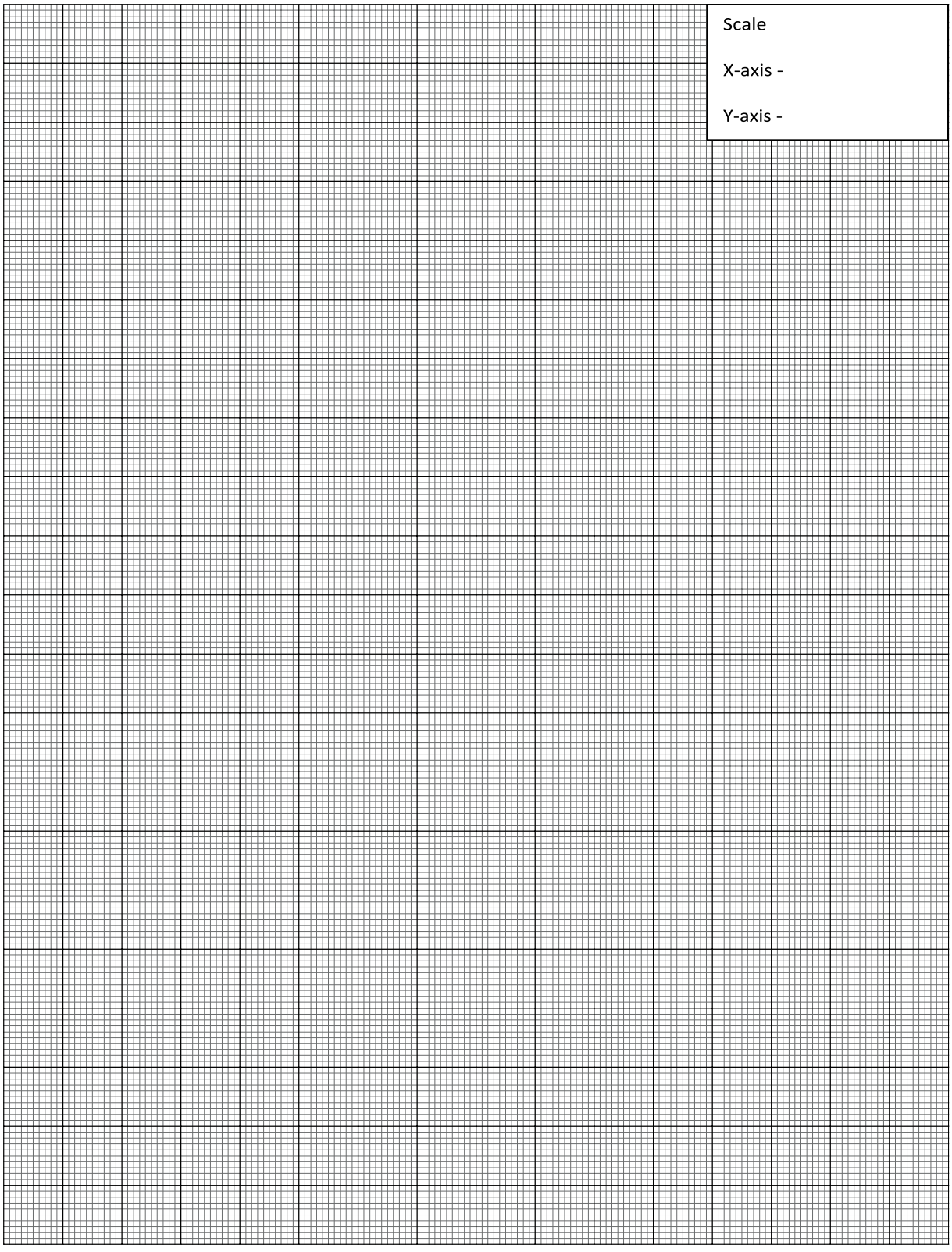
XXI Assessment Scheme

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	10%
7	Conclusions	05 %
8	Practical related questions	10%
9	Submitting the journal 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. 13: Assemble Negative Clipper Circuit on Breadboard and Test the Performance

I Practical Significance:

In electronics, a clipper is a circuit designed to prevent the output of a circuit from exceeding a predetermined voltage level without distorting the remaining part of the applied input waveform.

Clippers are used for the separation of synchronizing signals from the composite picture signals. The excessive noise spikes above a certain level can be limited or clipped in FM transmitters by using the series clippers. The typical application of diode clipper is for the protection of transistor from transients. Clippers can be used as voltage limiters and amplitude selectors.

Clipping circuits are also called slicers or amplitude selectors.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Function generator to give input waveform.
4. Use CRO to observe input and output waveform.

IV Relevant Course Outcome(s)

- Use relevant diode in different electronics circuits.

V Practical Outcome

Build negative clipper on breadboard and test its performance.

1. Select the required component for negative clipper circuit.
2. Connect circuit as negative clipper circuit.
3. Apply input to the circuit and observe the output.

VI Relevant Affective domain related Outcome(s)

1. Handle components and equipment carefully.
2. Select instruments of required range and specifications.

VII Minimum Theoretical Background

A clipping circuit consists of linear elements like resistors and non-linear elements like junction diodes or transistors, but it does not contain energy-storage elements

like capacitors. Clipping circuits are used to select for purposes of transmission, that part of a signal wave form which lies above or below a certain reference voltage level.

Thus a clipper circuit can remove certain portions of an arbitrary waveform near the positive or negative peaks. Clipping may be achieved either at one level or two levels.

Clipper has two types:

1. **Series Clipper**: In this configuration the diode is connected in series with the load.
2. **Parallel Clipper**: In this configuration the diode is connected in parallel with the load.

Clipper is used to clip off or remove portion of input signal without distorting the remaining part of wave form.

The negative clipping circuit is almost same as the positive clipping circuit only one difference that is diode polarity.

During the positive half cycle of the input, the diode is forward biased and so the positive half cycle appears across the output.

During the negative half cycle of the input waveform, the diode 'D' is reverse biased, which maintains the output voltage at 0 Volts. Thus causes the negative half cycle to be clipped off.

VIII Practical Circuit Diagram :

a) Sample

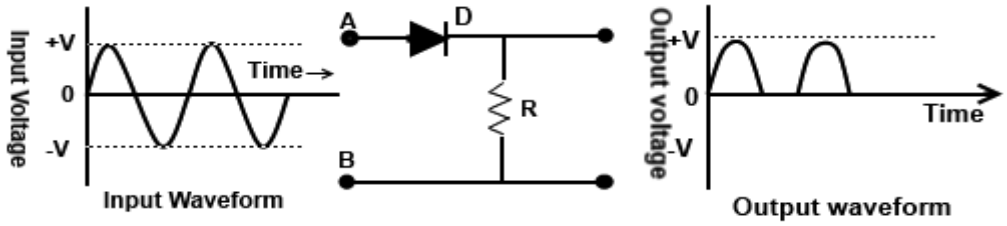


Figure 1: Circuit diagram of Negative clipper.

b) Actual Circuit used in laboratory

c) Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred
2.	CRO	25 MHz, Dual trace CRO.	1	
3.	Function Generator	1MHz, Sine, Triangle, Square, Ramp, Pulse, TTL (Sync) & DC Outputs	1	
4.	Bread board	5.5 CM X 17CM	1	
5.	Diode	IN4007 (or any other equivalent diode)	1	
6.	Resistor	1KΩ(0.5watts/0.25watts)	1	
7.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

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 practical do not exceed the input voltage of the diode beyond the rated voltage of diode. This may lead to damaging of the diode.

XI Procedure

1. Make the connections on breadboard as per circuit diagram as shown in figure no. 1.
2. Connect the function generator at the input and apply sine wave to the input of circuit (8Vp-p).
3. Observe the input and output waveforms on CRO and draw it on the graph paper.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……
……
……

XIV Precautions followed

……
……

XV Observations and Calculations:

Table 1: Measurement of V_{in} and V_{out}

S.No.	Input voltage $V_{in(VOLTS)}$	Output Voltage $V_{out\ (VOLTS))}$	Comments
1			

Calculations: Not Applicable

XVI Results

……

……

XVII Interpretation of results

……

……

XVIII Conclusions

……

……

XIX Practical related Questions

1. Repeat the above experiment for 4 Vp-p square wave input.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. https://en.wikipedia.org/wiki/Clipper_(electronics)
2. http://www.circuitstoday.com/diode-clippers
3. https://www.youtube.com/watch?v=ZmZ6U9DU8O4

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	10%
7	Conclusions	05 %
8	Practical related questions	10%
9	Submitting the journal 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. 14 and 15: Build the Combinational Clipper On Breadboard and Test the Performance. (Part I and II)

I Practical Significance:

The combinational clipper is the combination of positive and negative clipper. It means a portion of both positive and negative of each half cycle of the input voltage is to be clipped or removed. Diode clipping circuits is used in voltage limiting applications.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics and Telecommunications engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Function generator to give input waveform.
4. Use CRO to observe input and output waveforms.

IV Relevant Course Outcome(s)

- Use relevant diode in different electronics circuits.

V Practical Outcome

Assemble combinational clipper on breadboard and test its performance.

1. Select the required component for positive clipper circuit.
2. Connect circuit as combinational clipper circuit.
3. Apply input to the circuit and observe the output.

VI Relevant Affective domain related Outcome(s)

1.Handle components and equipment carefully.
2.Select instruments of required range and specifications.

VII Minimum Theoretical Background

When a portion of both positive and negative of each half cycle of the input voltage is to be clipped, combinational clipper is used. The circuit for such a clipper is given in the figure no.1.

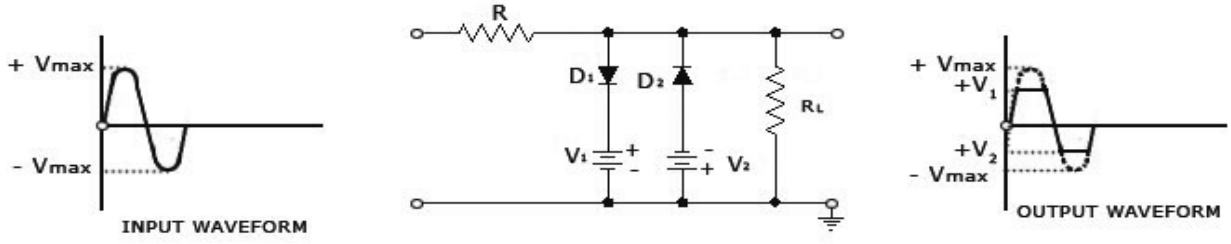


Figure 1: Combinational clipper circuit.

During positive input voltage signal when input voltage exceeds battery voltage '+ V_1'diode D_1 conducts heavily while diode 'D_2'is reversed biased and so voltage '+ V_1'appears across the output. This output voltage '+ V_1'stays as long as the input signal voltage exceeds '+ V_1'

On the other hand for the negative input voltage signal, the diode 'D_1' remains reverse biased and diode 'D_2' conducts heavily only when input voltage exceeds battery voltage 'V_2' in magnitude. Thus during the negative half cycle the output stays at '- V_2'so long as the input signal voltage is greater than '-V_2'.

VIII Practical Circuit Diagram :

a) Sample

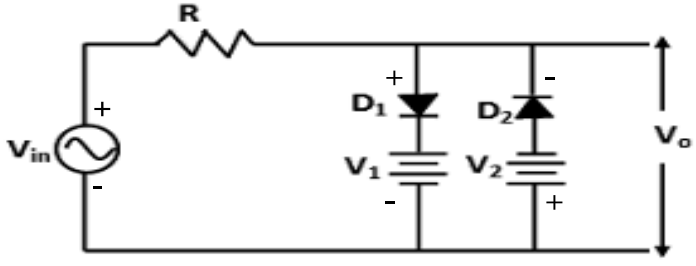


Figure 2: Circuit diagram of Combinational clipper.

b) Actual Circuit used in laboratory

c) Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred
2.	Dual DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1	
3.	CRO	25 MHz, Dual trace CRO.	1	
4.	Function Generator	1MHz, Sine, Triangle, Square, Ramp, Pulse, TTL (Sync) and DC Outputs	1	
5.	Bread board	5.5 CM X 17CM	1	
6.	Diode	IN4007 (or any other equivalent diode)	2	
7.	Resistor	1KΩ(0.5watts/0.25watts)	1	
8.	Connecting wires	Single strand Teflon coating (0.6mm diameter)	As per requirement	

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.

XI Procedure

1. Make the connections on breadboard as per circuit diagram as shown in figure no.
2. Apply sine wave as a input 8V p-p from function generator to the circuit.
3. Adjust V_1 and V_2 less than 4 volts.
4. Observe and draw the input and output waveforms from CRO.

XII Resources used (with major specifications)

S. No.	Instrument/Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……

……

……

XIV Precautions followed

……

……

XV Observations and Calculations:

Table 1: Measurement of V_{in} and V_{out}

S.No.	Input voltage $V_{in(VOLTS)}$	Output Voltage $V_{out(VOLTS)}$	Comment
1	$V_{in} \leq V_1$		
2	$V_1 < V_{in} < V_2$		
3	$V_{in} \geq V_2$		

Calculations: Not Applicable

XVI Results

……

……

XVII Interpretation of results

……

……

XVIII Conclusions

……

……

XIX Practical related Questions

1. Repeat the above experiment by changing V_{in} and reference voltage V_1 and V_2.
2. Find out the difference between input and output voltage.
3. Draw the input and output waveforms.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. http://www.expertsmind.com/learning/combination-clipper-assignment-help-
2. 7342873667.aspx
3. https://www.youtube.com/watch?v=Mvmfqg28ZnY
4. https://www.youtube.com/watch?v=VMquoQBbjFQ

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	10%
7	Conclusions	05 %
8	Practical related questions	10%
9	Submitting the journal 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. 16 & 17: Build Positive Clamper on Breadboard and Test The Performance. (Part I And II)

I Practical Significance

A clamper is an electronic circuit that shifts either the positive or the negative peak excursions of a signal to a predefined value by shifting its DC value. The clamper does not restrict the peak-to-peak excursion of the signal, it moves the whole signal up or down so as to place the peaks at the reference level.

A clamping circuit (also known as a clamper) will bind the upper or lower extreme of a waveform to a fixed DC voltage level. These circuits are also known as DC voltage restorers.

Clampers can be constructed in both positive and negative polarities. Clamper essentially adds a DC level to the AC output signal, clampers are commonly used in analog TV receivers.

Clamper circuits are categorized by their operation as negative or positive clamper.

A positive clamper circuit (negative peak clamper) outputs a purely positive waveform from an input signal; it offsets the input signal so that all of the waveform is greater than 0 V.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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 **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use CRO to observe input output waveforms.
4. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

- Use relevant diode in different electronics circuits.

V Practical Outcome

Test performance of negative clamper on breadboard:

1. Observe output Waveform on CRO.
2. Use of DMM to measure the output voltage.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.

VII Minimum Theoretical Background

The positive clamper is made up of a voltage source V_i, capacitor C, diode D, and load resistor R_L as shown in figure 1. In this the diode is connected in parallel with the output load. So the positive clamper passes the input signal to the output load when the diode is reverse biased and blocks the input signal when the diode is forward biased.

During the negative half cycle of the input AC signal, the diode is forward biased and hence no signal appears at the output. In forward biased condition, the diode allows electric current through it. This current will flow through the capacitor and charges it to the peak value of input voltage V_m. The capacitor is charged in inverse polarity (positive) with the input voltage. As input current or voltage decreases after attaining its maximum value $-V_m$, the capacitor holds the charge until the diode remains forward biased.

During the positive half cycle of the input AC signal, the diode is reverse biased and hence the signal appears at the output. In reverse biased condition, the diode does not allow electric current through it. So the input current directly flows towards the output.

When the positive half cycle begins, the diode is in the non-conducting state and the charge stored in the capacitor is discharged (released). Therefore, the voltage appeared at the output is equal to the sum of the voltage stored in the capacitor (V_m) and the input voltage (V_m)

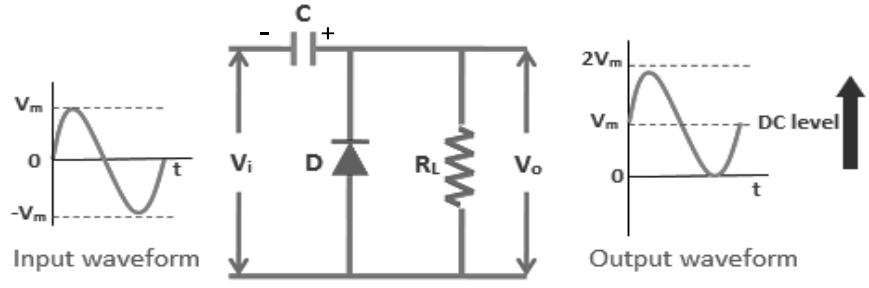
i.e. $V_o = V_m + V_m = 2V_m$

Which have the same polarity with each other. As a result, the signal is shifted upwards.

The peak to peak amplitude of the input signal is $2V_m$, similarly the peak to peak amplitude of the output signal is also $2V_m$. Therefore, the total swing of the output is same as the total swing of the input.

VIII Practical Circuit diagram:

a. **Sample**



Courtesy: *http://www.physics-and-radio-electronics.com/electronic-devices-and-circuits/rectifier/clampercircuits.html*

Figure 1: Positive clamper.

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	25MHzz, Dual scope	1
1	Function Generator	1MHz, Multi waveform output	1
2	Diode	IN4007 (or any other equivalent diode)	1
3	Resistors	1KΩ (0.5watts/0.25watts	1
4	Capacitor	1μf (or any other capacitor value)	1
5	Bread Board	5.5 CM X 17CM	
6	Connecting wires	Single strand Teflon coating 0.6mm	As per requirement

X Precautions to be Followed

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.

XI Procedure

1. Make the connections on breadboard as per circuit diagram as shown in figure no. 1.
2. Apply sine wave as input of 8V peak to peak to the circuit.
3. Observe and draw the input and output waveforms from CRO.

XII Resources Used

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

XIII Actual Procedure Followed

……..……...

……..……...

XIV Precautions Followed

……...……..

……...……..

XV Observations and Calculations

Table 1: Measurement of V_{in} and V_{out}

S.No.	Input voltage $V_{in(VOLTS)}$	Output Voltage $V_{out(VOLTS)}$	Comments
1			

Calculation: Not applicable.

XVI Results

……

……

XVII Interpretation of results

……

……

XVIII Conclusions

……

……

XIX Practical related Questions

1. Repeat the above experiment for 4 volt peak to peak and observe output and input.
2. Repeat the above experiment for different value of capacitor and observe output and input.

[Space for answers]

XX References / Suggestions for further Reading

1. http://www.expertsmind.com/learning/combination-clipper-assignment-help-7342873667.aspx
2. https://www.youtube.com/watch?v=Mvmfqg28ZnY
3. https://www.youtube.com/watch?v=VMquoQBbjFQ

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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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. 18: Build Negative Clamper on Breadboard and Test The Performances.

I. Practical Significance

A clamper is an electronic circuit that fixes either the positive or the negative peak excursions of a signal to a defined value by shifting its DC value. The clamper does not restrict the peak-to-peak excursion of the signal, it moves the whole signal up or down so as to place the peaks at the reference level.

A clamping circuit (also known as a clamper) will bind the upper or lower extreme of a waveform to a fixed DC voltage level. These circuits are also known as DC voltage restorers.

Clampers can be constructed in both positive and negative polarities. Clamper essentially adds DC level to the AC signal. Clampers are commonly used in analog TV receivers.

Clamper circuits are categorized by their operation as negative or positive clamper.

A negative clamper is the opposite of positive clamper, It outputs a purely negative waveform from an input signal. A bias voltage between the diode and ground offsets the output voltage by that amount.

II. Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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: **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use CRO to observe input output waveforms.
4. Use Digital multimeter to measure the voltage and current.

IV. Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V. Practical Outcome

Test performance of negative clamper on breadboard:

1. Observe output Waveform on CRO.
2. Use of DMM to measure the output voltage.

VI. Relevant Affective domain related Outcome(s)

Handle components and equipment carefully.

VII. Minimum Theoretical Background

The negative clamper is made up of a voltage source V, capacitor C, diode D, and load resistor Ras shown in figure 1. In this the diode is connected in parallel with the output load

In negative unbiased clamper, in the positive cycle of the input AC signal, the diode is forward biased and conducts, charging the capacitor to the peak positive value of V_{IN}. During the negative cycle, the diode is reverse biased and thus does not conduct.

$$V_{OUT} = V_{IN} - V_{INpeak}.$$

VIII. Practical Circuit diagram:

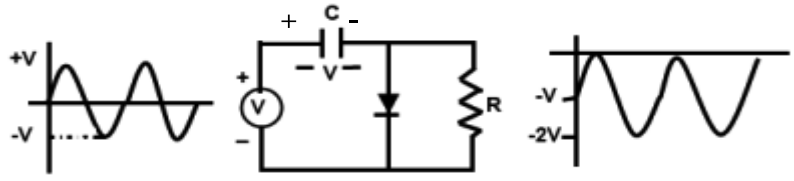


Figure 1: Negative Clamper

VII Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1	Digital Multimeter	Digital Multimeter: 3 1/2 digit display.	1	1. Digital Multimeter with diode testing facilities will be preferred
2	DC Regulated power supply	Variable DC power supply 0-30V, 2 A, SC protection, display for voltage and current.	2	
3	Function generator	1MHz Multi signal output	1	
4	Bread board	5.5 CM X 17CM	1	
5	Diode	IN4007 (or any other equivalent diode)	1	
6	Resistor	1KΩ(0.5watts/0.25watts)	1	
7	Connecting wires	Single strand Teflon coating 0.6mm diameter	As per requirement	

VIII Procedure

1. Connect the circuit as shown in Figure 1.
2. Switch ON the power supply.
3. Apply 4V peak to peak sine wave from function generator to the input of negative clamper circuit.
4. Connect the CRO at output of negative clamper circuit.
5. Observe the output waveform on CRO and measure the output Voltage.

IX 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.

X Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XI Actual procedure followed

……

……

XII Precautions followed

……..…

……..……..

XIII Observations and Calculations:

Table 1

S.No.	Vin (volts)	V_{out} (volts)	Output Waveform	Comment
1				

Calculations: Not applicable

XIV Results

……..…

……

XV Interpretation of results

……

……

XVI Conclusions

……

……

XVII Practical related Questions

Repeat the above experiment for input voltage 6 volt peak to peak and 2volt peak to peak.

[Space for answers]

XVIII References / Suggestions for further Reading

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

XIX Assessment Scheme

Process related with Weightage (Criteria considered:60%)

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 -

1N4001 - 1N4007
General-Purpose Rectifiers

Features

- Low Forward Voltage Drop
- High Surge Current Capability

DO-41
COLOR BAND DENOTES CATHODE

Ordering Information

Part Number	Top Mark	Package	Packing Method
1N4001	1N4001	DO-204AL (DO-41)	Tape and Reel
1N4002	1N4002	DO-204AL (DO-41)	Tape and Reel
1N4003	1N4003	DO-204AL (DO-41)	Tape and Reel
1N4004	1N4004	DO-204AL (DO-41)	Tape and Reel
1N4005	1N4005	DO-204AL (DO-41)	Tape and Reel
1N4006	1N4006	DO-204AL (DO-41)	Tape and Reel
1N4007	1N4007	DO-204AL (DO-41)	Tape and Reel

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Value							Unit
		1N 4001	1N 4002	1N 4003	1N 4004	1N 4005	1N 4006	1N 4007	
V_{RRM}	Peak Repetitive Reverse Voltage	50	100	200	400	600	800	1000	V
$I_{F(AV)}$	Average Rectified Forward Current .375 " Lead Length at T_A = 75°C	1.0							A
I_{FSM}	Non-Repetitive Peak Forward Surge Current 8.3 ms Single Half-Sine-Wave	30							A
I^2t	Rating for Fusing (t < 8.3 ms)	3.7							A^2sec
T_{STG}	Storage Temperature Range	-55 to +175							°C
T_J	Operating Junction Temperature	-55 to +175							°C

Thermal Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Value	Unit
P_D	Power Dissipation	3.0	W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	50	°C/W

Electrical Characteristics

Values are at T_A = 25°C unless otherwise noted.

Symbol	Parameter	Conditions	Value	Unit
V_F	Forward Voltage	I_F = 1.0 A	1.1	V
I_{rr}	Maximum Full Load Reverse Current, Full Cycle	T_A = 75°C	30	µA
I_R	Reverse Current at Rated V_R	T_A = 25°C	5.0	µA
		T_A = 100°C	50	
C_T	Total Capacitance	V_R = 4.0 V, f = 1.0 MHz	15	pF

Practical No. 19 and 20: Identify the Terminals of the PNP and NPN Using CRO and Multimeter. (PART-I and II)

I Practical Significance

In industry, transistor has wide range of applications. Transistors are semiconductor devices used for applications like amplification of voltages, current and are also used in oscillator circuits and switches. In digital circuits they are used as switches. It is used in electronic equipment, computers, televisions, mobile phones, audio amplifiers, industrial control, and radio transmitters.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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 :**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Testing of transistor
2. Identifications of terminals of BJT

IV Relevant Course Outcomes

Use BJT in electronics circuits.

V Practical Outcome

Identify the terminals of the PNP and NPN transistor using Digital Multimeter and CRO

1. Measure the resistance between base and emitter.
2. Measure the resistance between base and collector.
3. Measure the resistance between emitter and collector.
4. Operate CRO in component testing mode.

VI Practical Skills

1. Identify type of transistor.
2. Test Different terminals of transistor.
3. Measurement Skills.

VII Relevant Affective domain related Outcomes

1. Handle components and equipment carefully.
2. Select instruments of required range.

VIII Minimum Theoretical Background

A transistor has two PN junctions (a combination of two diodes connected back to back), one junction is forward biased and the other is reverse biased. The forward biased junction has a low resistance path whereas a reverse biased junction has a high

resistance path. The weak signal is introduced in the low resistance circuit and output is taken from the high resistance circuit. Transistor has two junctions and 3 terminals, made of three layers of N and P type materials. The three regions are emitter, base and collector. There are 2 types of BJT (i) PNP and (ii) NPN.

An NPN transistor is composed of two N-type semiconductors separated by a thin section of P type .However, a PNP transistor is formed by two P-sections separated by a thin section of N-type as shown in Figure 1.

.

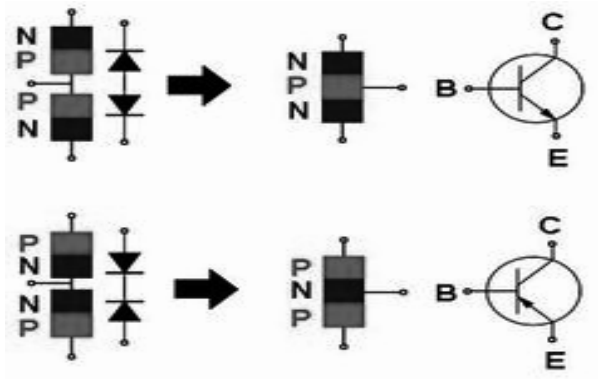


Figure 1: NPN,PNP Transistor construction and symbol

Identifying Transistor Terminals:

The transistors are available with various packages in the market. Consider about the TO-92 package. Keep the transistor such that the flat surface is facing towards you as shown in the below figure:

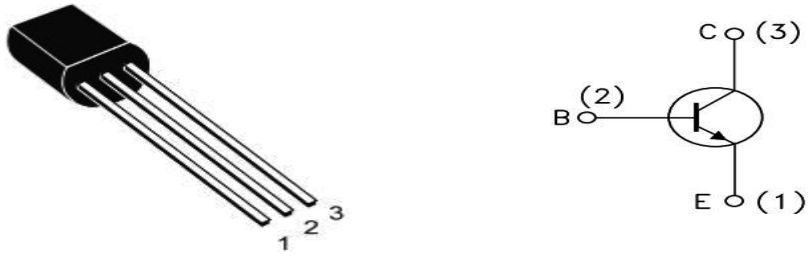


Figure 2: TO-92 package of transistor and its terminals

Now starting from left, mark like 1, 2 and 3. They are respectively

1. Emitter (E)
2. Base (B)
3. Collector(C)

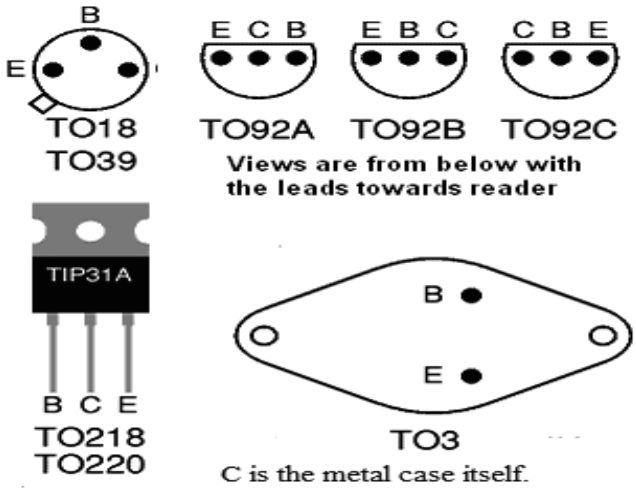


Figure 3: Emitter, base and collector leads for some case styles.

Both NPN and PNP transistor looks similar in physical appearance. We cannot differentiate by seeing them. We need a multimeter or CRO to identify the type of BJT.

Remember the following points:

1. The transistor internally has two diodes (NPN ≡ N - P - N ≡ NP Junction + PN Junction and PNP ≡ P - N - P ≡ PN Junction + NP Junction) i.e, Emitter to base is one PN junction (diode) and Base to collector another PN junction (diode).
2. In the diode mode, the multimeter will show the voltage when we connect the positive probe of the multimeter to the anode of the diode and negative probe to the cathode.
3. If the multimeter positive probe is connected to the cathode of the diode and the negative probe to the anode, then it will not give any voltage (showing zero).

Steps to identify the PNP type transistor using DMM:

1. Keep the DMM in the resistance mode.
2. Keep the positive probe to the pin-1 (Emitter) of the transistor and connect the negative probe to the center pin (Base). You will see some resistance in the DMM.
3. Similarly connect the negative probe to the center pin (Base) with respect to the pin-3 (collector). You will see some resistance in the DMM.
4. It will ensure that it is a PNP transistor. The logic behind this is, in PNP transistor Emitter (E) - P type material - Equivalent to anode of the diode Base (B) - N type material - Equivalent to cathode of the diode Collector(C) - P type material - Equivalent to anode of the diode
5. If the multimeter positive probe is connected to anode and negative probe is connected to cathode, then it will show resistance. If the connections are interchanged it will not show any value.

Steps to identify the PNP type transistor using CRO

1. By operating CRO in component testing mode.
2. Keep the knob on xy mode of CRO and observe the patterns on CRO screen.

3. If the pattern is as given in text box  The transistor terminals are in forward bias(low resistance).
4. If the pattern is as given in text box  The transistor terminals are in reverse bias (high resistance)

IX Circuit diagram

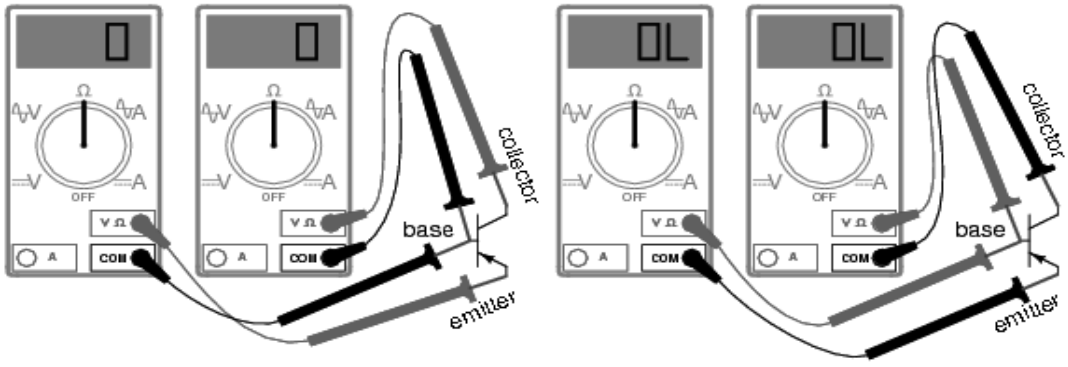


Figure 4: PNP transistor meter check: (a) forward B-E, B-C, resistance is low;
(b) Reverse B-E, B-C, resistance is ∞.

X Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	3 1/2 digit display, 9999 counts digital multimeter measures: Vac, Vdc (1000V max), Adc, Aac (10 amp max), Resistance (0 - 100 M□)	1	
2.	CRO	20 MHz with component testing facility	1	
3.	Transistors	Small Signal Transistor (TO-92 Package) BC547(NPN) BC557(PNP)	1 of each type	
4.	Transistors	Power Transistors 2N2955(NPN) 2N3055(PNP)	1 of each type	

XI Procedure

Using Multimeter

1. Set the multimeter to its ohms range.
2. Measured the resistance between base and emitter.
3. Measured the resistance between base and collector.
4. Measured the resistance between emitter and collector.
5. Verify the above steps with following chart.

Between Transistor Terminals		**PNP**	**NPN**
Collector	Emitter	R_{HIGH}	R_{HIGH}
Collector	Base	R_{LOW}	R_{HIGH}
Emitter	Collector	R_{HIGH}	R_{HIGH}
Emitter	Base	R_{LOW}	R_{HIGH}
Base	Collector	R_{HIGH}	R_{LOW}
Base	Emitter	R_{HIGH}	R_{LOW}

XII Precautions

Select proper range in Digital Multimeter.

XIII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			

XIV Actual procedure followed

……
……
……

XV Precautions followed

……
……
……

XVI Observations and Calculations:

- **Testing of PNP terminal resistance using Multimeter**

1. Resistance between emitter and base R_{BE} = ----------
2. Resistance between Collector and base R_{CB} = ----------
3. Resistance between Collector and Emitter R_{CE} = ----------

- **Testing of NPN terminal resistance using Multimeter**

1. Resistance between emitter and base R_{BE} = ----------
2. Resistance between Collector and base R_{CB} = ----------
3. Resistance between Collector and Emitter R_{CE} = ----------

- **For PNP following pattern is observed on CRO between base and emitter:**

- **For PNP following pattern is observed on CRO between base and collector:**

- **For NPN following pattern is observed on CRO between base and emitter:**

- **For NPN following pattern is observed on CRO between base and collector:**

Calculations: NA

XVI. Results

- From the values of $R_{BE}R_{CB}$ andR_{CE} on DMM the transistor is identified as ……
- From CRO pattern the transistor is identified as ……

XVII. Interpretation of results

……

……

XVIII. Conclusions

……

……

XIX. Practical related Questions

List the specification of transistor.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX. References / Suggestions for further Reading

1. http://www.electricalbasicprojects.com/how-to-identify-npn-and-pnp-transistor-using-multimeter/
2. http://www.nptel.ac.in/courses/117107095/lecturers/lecture_10/lecture10_page1.htm
3. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-4/meter-check-transistor-bjt/
4. https://www.youtube.com/watch?v=ojdNj1lUJFE
5. https://www.youtube.com/watch?v=X7BT73KIHPk
6. https://www.youtube.com/watch?v=WmIgusHZyPc

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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal in time	05%
	Total (25 Marks)	**100 %**

Name of student Team Members

1. ……
2. ……
3. ……
4. ……

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

Practical No. 21: Find Specifications of a Given Transistor Using Data Sheets.

I Practical Significance:

In industries as well as in domestic appliances transistor is used in amplifier circuits, oscillator circuits and in DC Power Supplies. For these applications transistor selection plays vital role. In this practical students will find specifications of the given transistor to understand transistor selection with respect to change in applications.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry-identified competency **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component selection skills.
2. Specification reading skills.
3. Use Data Book to find compatible /equivalent transistor.
4. Use specifications to calculate biasing circuit components values.

IV Relevant Course Outcomes

- Use BJT in electronics circuits

V Practical Outcome

Find specifications of a given transistor using data sheets to:

1. Select transistor for particular application.
2. Determine equivalent transistor.
3. Calculate biasing circuit components value.
4. Handle and interpret data book specification carefully

VI Relevant Affective domain related Outcomes

- Handle and interpret data book specification carefully.

VII Minimum Theoretical Background

A BJT is a most commonly used semiconductor device, and which has variety of applications. It is suitable for amplifier circuits, oscillator circuits and in DC regulated power supplies. Transistor selection depends on its specification and application. Transistor requires biasing circuit. Rating of biasing circuit components are calculated using specification of transistor.

Data sheet consists of transistor package diagram to know lead position, absolute maximum rating, thermal data, electrical characteristics and mechanical data. Data sheet also provide compatible transistor part numbers.

VIII Practical Circuit Diagram :

a. Sample

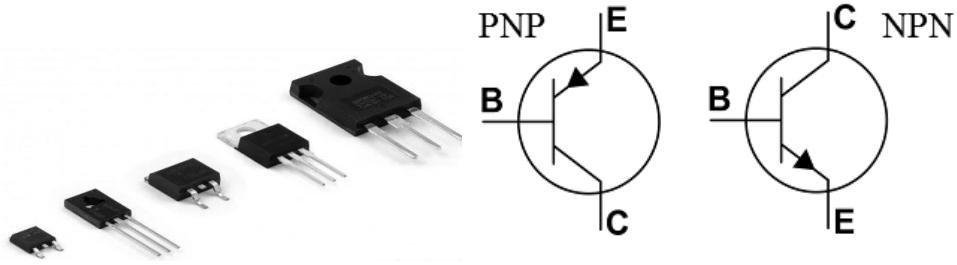


Figure 1: Transistors and its symbol

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Transistor	2N2222. 2N3055 SL100 BC147 (or any other equivalent transistor)	1No. each	
2.	Data book	Transistor data book Tower's International transistor selection data book (or any other equivalent data book)	1 No.	Datasheets may be referred using web site

X Precautions

Hold the transistor in proper position so that its leads will not break.

XI Procedure

1. Read out given transistor number on its casing.
2. Find out this number in data book.
3. Record the transistor package terminals.
4. Record absolute maximum rating of transistor.
5. Record the electrical characteristics.
6. Record thermal data.
7. Calculate the rating of required collector resistor, Base resistors for biasing circuit.
8. Repeat the procedure for another transistor.

XII Resources used (with major specifications)

S. No.	Data book /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……...
……...
……...

XIV Precautions followed

…...……
……...

XV Observations and Calculations:

Table 1: Absolute maximum rating of BJT1 ( )

S.No.	Specifications	Value
1		
2		
3		
4		
5		
6		

Calculations:

Calculate required collector resistance

$$R_C = Vcc/I_{c(max)}$$

Calculate Base resistance

R_{B1} = Ω
R_{B2} = Ω

XVI Results

1. BJT 1 is a NPN / PNP Si / Ge transistor
2. For BJT1 Collector resistors = …….
3. For BJT 1 R_{B1} = ……
4. For BJT 1 R_{B2} = ……

XVIIInterpretation of results

……..

……..

XVIII Conclusions

…….

…….

XIX Practical related Questions

1.Repeat the above experiment for BJT 2.

2. Identify the legs of given transistor

[Space for answers]

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

…….

XX References / Suggestions for further Reading

- http://www.onsemi.com/pub/Collateral/P2N2222A-D.PDF
- http://www.alldatasheet.com/view_datasheet.jsp?Searchword=BC147

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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)**	

Practical No. 22: Test the Performance of BJT Operated In CE Mode

I Practical Significance

A BJT is commonly used as an amplifier. Common Emitter (CE) mode is the universal mode of operation for a BJT. All types of amplifications can be performed using CE mode with suitable biasing. Common-emitter amplifiers are also used in radio frequency circuits.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

- Use BJT in Electronic circuits.

V Practical Outcome

1. Identify terminals of given transistor.
2. Measure input and output currents and voltages.
3. Sketch graph for voltage versus current.
4. Calculate current amplification factor β.

VI Relevant Affective domain related Outcome(s)

Handle components and equipment carefully

VII Minimum Theoretical Background

CE is the most frequently used configuration in practical amplifier circuits, since it provides good voltage, current, and power gain. The input is applied across the base-emitter circuit and the output is taken from the collector-emitter circuit, making the emitter "common" to both input and output. CE configuration provides a phase reversal between input and output signals.

VIII Circuit Diagram

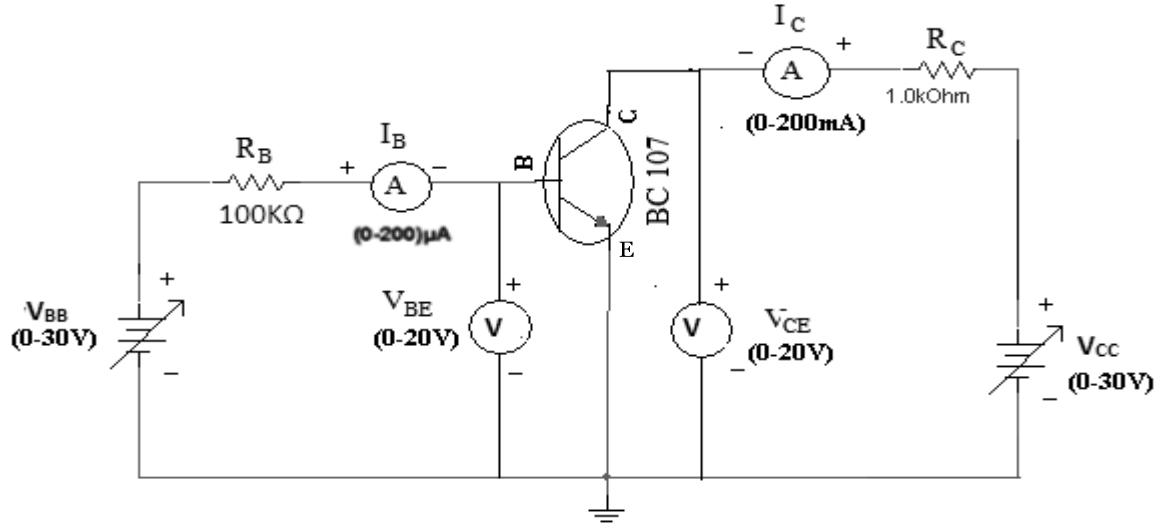


Figure 1: Circuit diagram of BJT in CE mode

Actual Circuit used in laboratory

Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2	1. Digital Multimeter with transistor testing facilities will be preferred. 2. In place of Digital Multimeter, Voltmeter and ammeter can be used.

S. No.	Instrument /Components	Specification	Quantity	Remarks
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1	
3.	Voltmeter	(0-20 V), (0-2 V),	1	
4.	Ammeter	(0 - 200 mA, (0 - 200 μA)	1	
5.	Transistor	BC107 or any other equivalent	1	
6.	Resistor	1KΩ(0.5watts/0.25watts)	1	
7.	Bread board	5.5 CM X 17CM	1	
8.	Connecting wires	Single strand Teflon coating 0.6mm	As per requirement	

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 transistor beyond its rated voltage. This may lead to damaging of the transistor.
3. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

XI. Procedure

Part I

Input characteristics:

1. Connect the circuit as shown in Figure 1.
2. Set V_{CE} at constant voltage (2V) by varying $V_{CC.}$
3. Vary the input voltage V_{BE} in steps of 0.1V from 0V up to 1V and record the corresponding value of I_B in observation table.
4. Repeat the above steps 2 and 3 by keeping V_{CE} at 5V, and 10V.
5. Sketch the characteristics from the recorded readings.
6. At suitable operating point calculate input resistance (R_i).

Part II

Output characteristics:

1. Connect the circuit as shown in Figure 1.
2. Set I_B constant at 10μA by varying $V_{BB.}$
3. Vary the output voltage V_{CC} in steps of 1V from 0V upto 10V and record the corresponding value of V_{CE} and I_C in observation table.
4. Repeat the above steps 2 and 3by keeping I_B at 20μA and 30μA.
5. Sketch the characteristics from the recorded readings.
6. At suitable operating point calculate output resistance (R_o).

XI Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XII Actual procedure followed

……
……..……...
…...……..

XIII Precautions followed

…...……...……
……

XIV Observations and Calculations

Table 1: Input Characteristics

S.No.	V_{CE}=2V		V_{CE}=5V		V_{CE}=10V	
	V_{BE} (V)	I_B(µA)	V_{BE} (V)	I_B(µA)	V_{BE} (V)	I_B(µA)
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Table 2: Output Characteristics

S.No.	I_B=10μA		I_B=20μA		I_B=30μA	
	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Calculations(from graph)

1. Input resistance Ri:

2. Output resistance $R_{o:}$

3. Current amplification factor β:

XV Results

1. Input resistance R_i = Ω
2. Output resistance R_o = Ω
3. Current amplification factor β =……..…..

XVI Interpretation of results

…..……

…….

XVII Conclusions

……

……

XVIII Practical related Questions

Repeat the same experiment using PNP transistor.

[Space for answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XIX References / Suggestions for further Reading

1. https://www.electrical4u.com/transistor-characteristics/
2. http://nptel.ac.in/courses/117107095/11

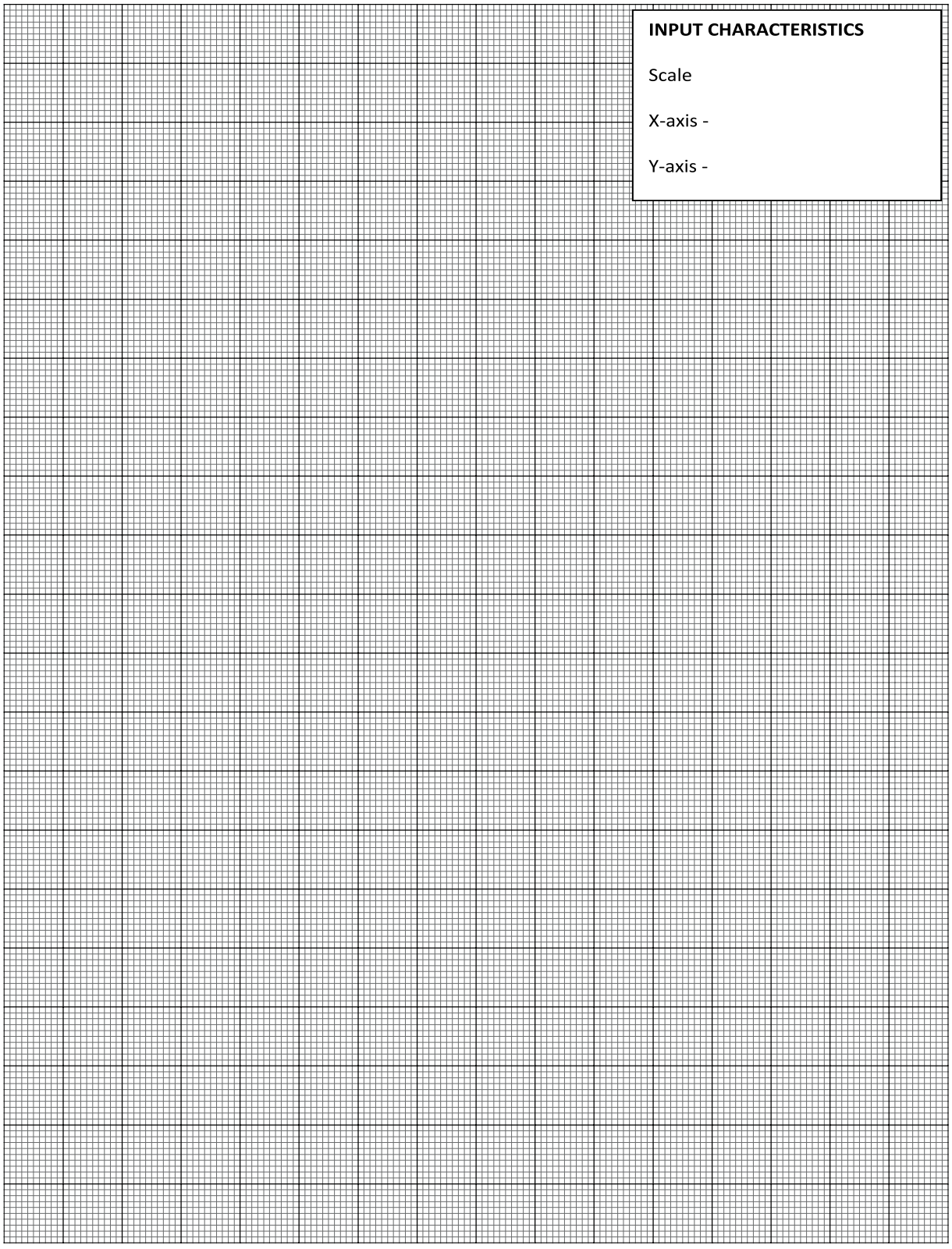
XX Assessment Scheme

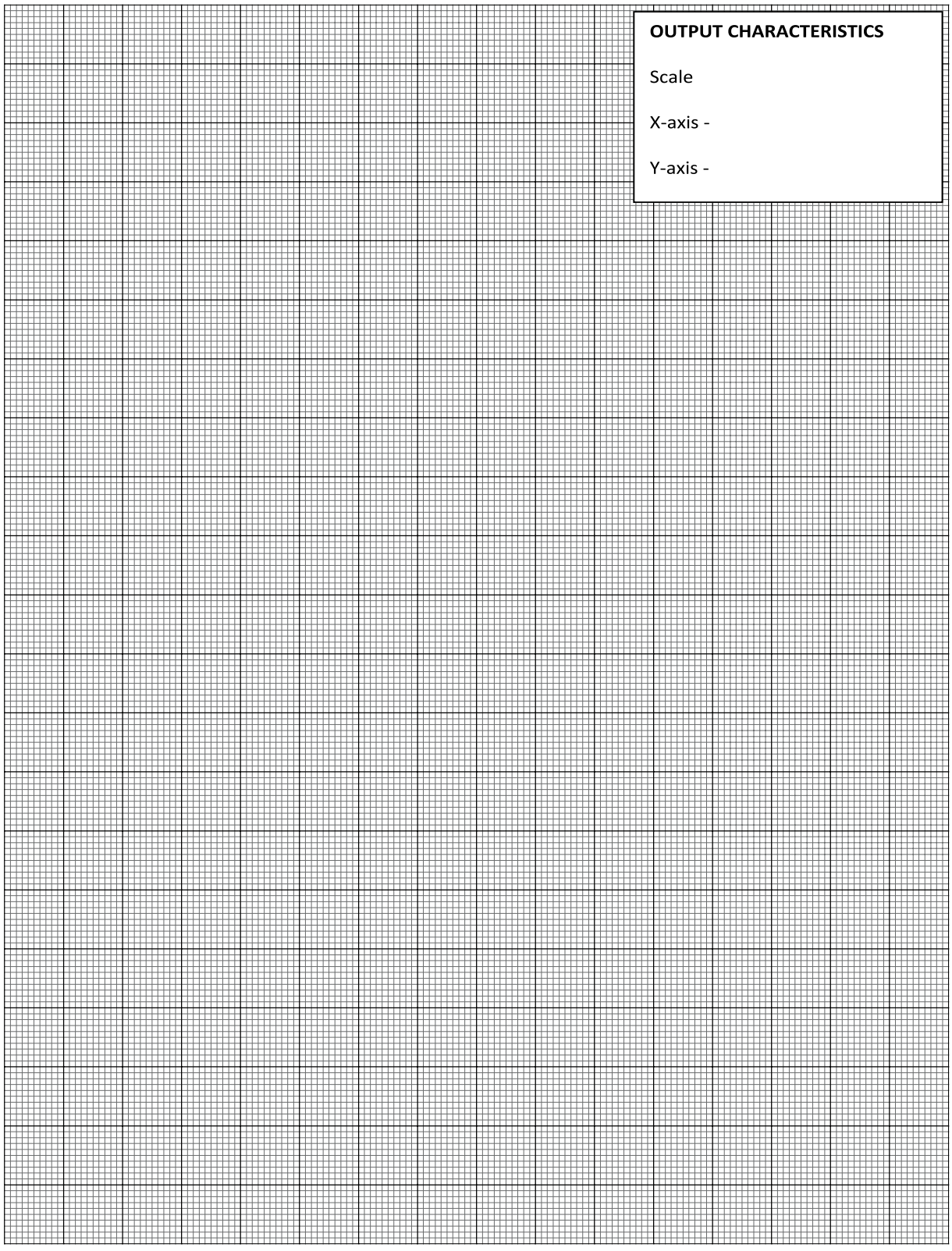
Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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)**	


INPUT CHARACTERISTICS
Scale
X-axis -
Y-axis -


OUTPUT CHARACTERISTICS
Scale
X-axis -
Y-axis -

Practical No. 23: Test the Performance of BJT Working On CB Mode

I Practical Significance:

Transistor is a basic building block of modern electronic circuits. A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. In electronics, a common-base (also known as grounded-base) amplifier is one of three basic single-stage bipolar junction transistor (BJT) amplifier topologies, typically used as a voltage amplifier.

In this configuration the emitter terminal of the transistor serves as the input, the collector as the output, and the base is connected to ground.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use DC Power supply to give different voltages.
4. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

Use BJT in Electronic circuits.

V Practical Outcome

Test input/output characteristics of NPN Transistor in CB Mode:

1. Identify terminals of given transistor.
2. Measure input / output currents / voltages.
3. Sketch graph for input and output characteristics.
4. Identify different regions of operation of transistor from the graph.
5. Calculate current amplification factor α.

VI Minimum Theoretical Background

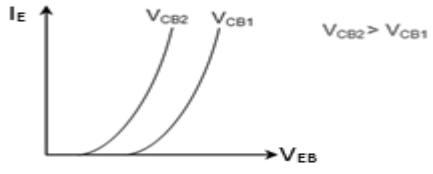


Figure 1: Input Characteristics for CB

Input Characteristics for CB configuration:

The curve given in figure 1 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}).

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

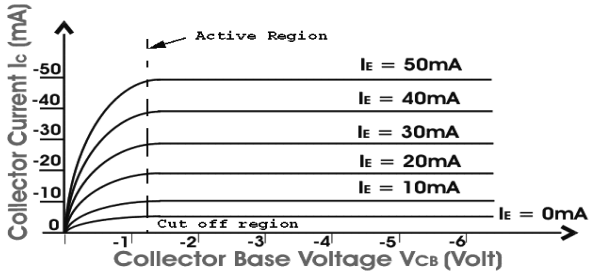


Figure 2: Output Characteristics for CB

Output Characteristics for CB configuration:

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 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).

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

VII Circuit Diagram :

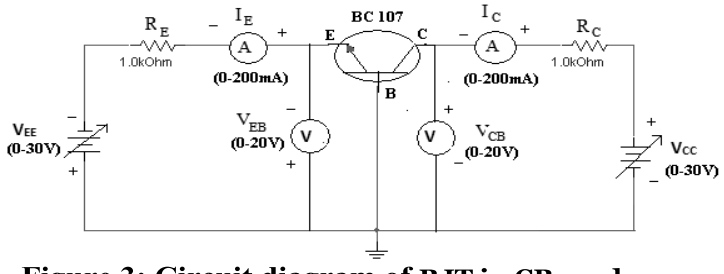


Figure 3: Circuit diagram of BJT in CB mode

Actual Circuit used in laboratory

Actual Experimental Set up used in laboratory

VIII Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2	1. Digital Multimeter with transistor testing facilities will be preferred. 2. In place of Digital Multimeter, Voltmeter and ammeter can be used.
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1	
3.	Voltmeter	(0-20 V), (0-2 V),	1	
4.	Ammeter	(0 - 200 mA, (0 - 200 μA)	1	
5.	Transistor	BC107 or any other equivalent	1	
6.	Resistor	1KΩ(0.5watts/0.25watts)	1	
7.	Bread board	5.5 CM X 17CM	1	
8.	Connecting wires	Single strand Teflon coating (0.6mm)	As per requirement	

IX Precautions

1. Care should be taken while handling terminals of components.
2. Select proper range of ammeter and voltmeter.
3. Connect wires tightly while building circuit.

X Procedure

Part I

Input characteristics:

1. Connect the circuit as shown in figure 3.
2. Keep output voltage $V_{CB} = 0V$ by varying V_{CC}.
3. Vary V_{EB} in step of 0.1V from 0 to 1Vand note down the corresponding emitter current I_E .
4. Repeat above procedure (step 3) for $V_{CB} = 4V$.

Part II

Output characteristics:

1. Connect the circuit as shown in figure 3.
2. Keep input current $I_E = 0mA$ by varying V_{EE}.
3. Vary V_{CB} in step of 1V from 1 to 10 V and note down the corresponding collector current I_C .
4. Repeat above procedure (step 3) for $I_E = 10mA$

XI. Resources used (with major specifications)

S. No.			
1.			
2.			
3.			
4.			
5.			

XII. Actual procedure followed

……..……

……..……

……..……

XIII. Precautions followed

……..……..……

……..……..

……..……..……..

XIV. Observations and Calculations:

Table 1: Input Characteristics

S. No.	V_{CB}=0V		V_{CB} =4V	
	V_{EB} (V)	I_E(mA)	V_{EB} (V)	I_E(mA)
1				
2				
3				
4				
5				
6				

Table 2: Output Characteristics

S. No.	I_E(mA)=0		I_E(mA)=10	
	V_{CB} (Volts)	**I_C (mA)**	**V_{CB} (Volts)**	**I_C (mA)**
1				
2				
3				
4				
5				
6				

Calculations (from graph)

1. Input resistance Ri:
2. Output resistance $R_{o:}$
3. Current amplification factor α:

XV. Results

1. Input resistance R_i = Ω
2. Output resistance R_o = Ω
3. Current amplification factor α = ……..…..

XVI. Interpretation of results

……

……

XVII. Conclusions

……

……

XVIII. Practical related Questions

1. Repeat the same experiment using PNP transistor.

[Space for Answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XIX. References / Suggestions for further Reading

1. https://www.electrical4u.com/transistor-characteristics/
2. http://nptel.ac.in/courses/117107095/11

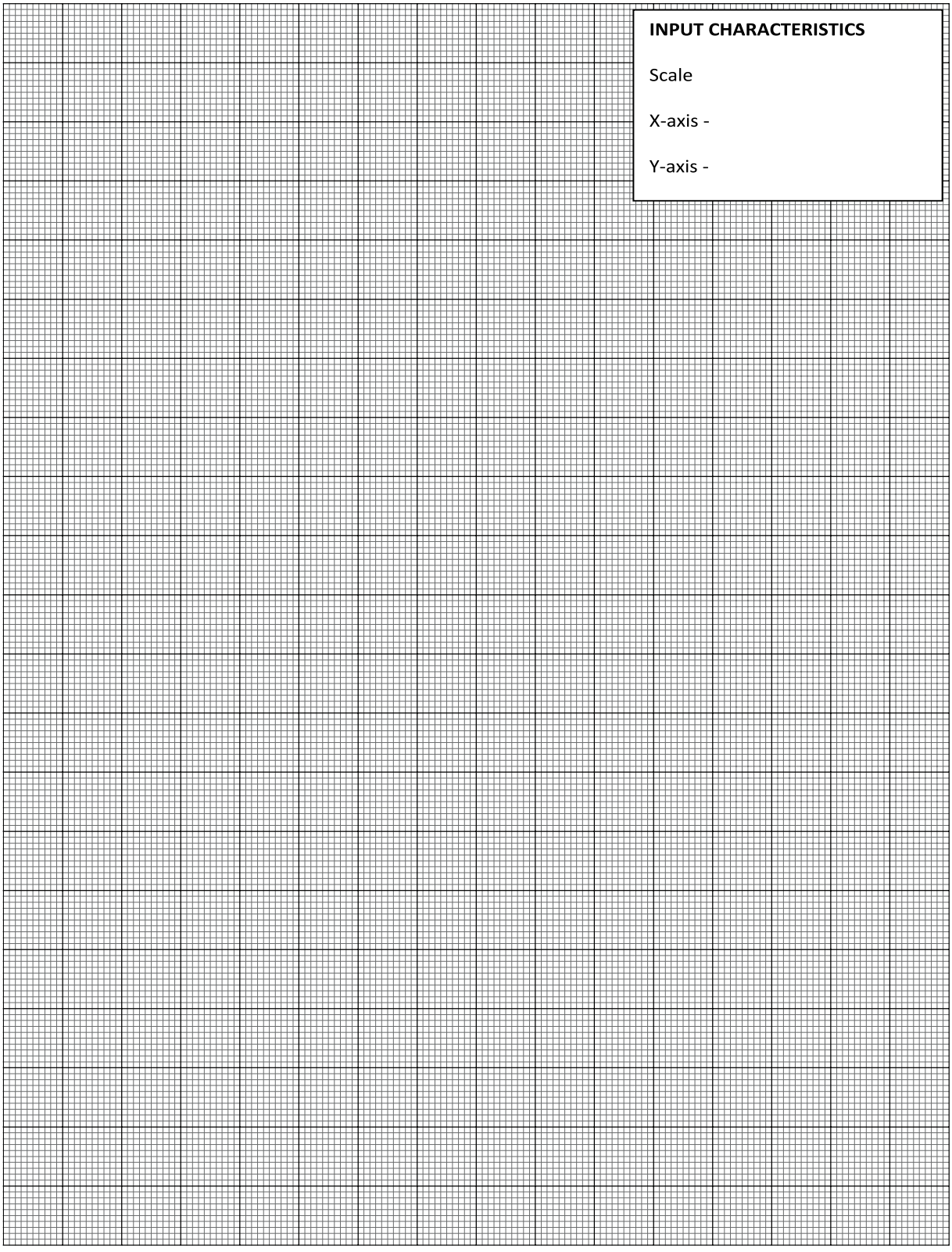
XX Assessment Scheme

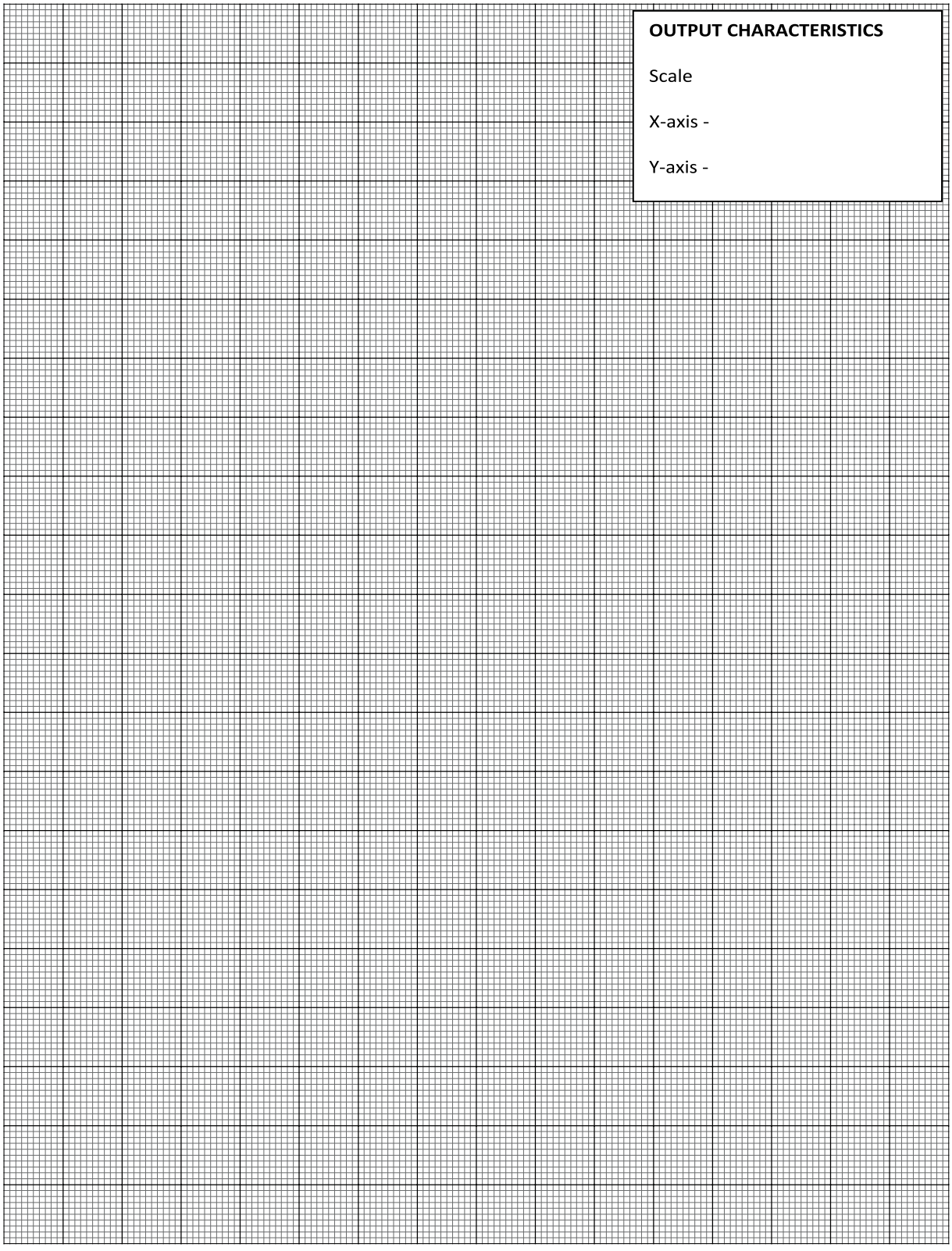
Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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)**	


INPUT CHARACTERISTICS
Scale
X-axis -
Y-axis -


OUTPUT CHARACTERISTICS
Scale
X-axis -
Y-axis -

Practical No. 24 and 25: Test the Assembled BJT Voltage Divider Bias Circuit For Given Input. (Part I and Part II)

I Practical Significance:

Wherever there is need to reduce the voltage, voltage dividers are used. The voltage divider bias configuration is considered the simplest method that gives a very stable and predictable bias current. Voltage dividers are useful for setting the output voltage of linear regulators, dividing down a higher voltage to the input range of an A/D inside a microcontroller.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problem
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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 **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use DC Power supply to give different voltages.
4. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

- Use BJT in Electronic circuits.

V Practical Outcome

Test BJT performance with voltage divider bias circuit:

1. Identify terminals of given transistor.
2. Measure input / output currents / voltages.
3. Calculate output voltage at given point.

VI Relevant Affective domain related Outcomes

- Handle equipment and component carefully.

VII Minimum Theoretical Background

The voltage divider configuration achieves the correct voltages by the use of resistors in certain patterns. By selecting the proper resistor values, stable current levels can be achieved that vary only little over temperature and with transistor properties such as β.

Transistors used in amplifier circuits must be biased with constant (direct) levels of collector, base and emitter current and constant terminal voltages. The levels of I_C and V_{CE} define the transistor dc operating point, or quiescent point. The circuit that provides this state is known as a bias circuit. Ideally, the current and voltage levels in bias circuits should remain absolutely constant. In practical circuits these quantities are affected by the transistor current gain and by temperature changes. The best bias circuits have the greatest stability; they hold the currents and voltages substantially constant regardless of the transistor current gain and temperature variations.

VIII Practical Circuit Diagram :

a. Sample

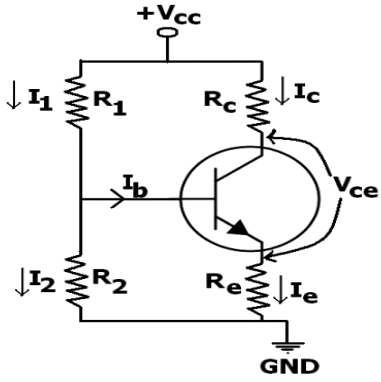


Figure 1: Voltage divider biasing

b. Actual Circuit used in laboratory

c. Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred. 2. In place of Digital Multimeter, Voltmeter and ammeter can be used.
2.	DC Regulated power supply	Variable DC power supply 0-30V, 2A, SC protection, display for voltage and current.	1	
3.	Voltmeter	0-20 V	1	
4.	Ammeter	(0 - 200 mA, 0-200 μA)	1	
5.	Transistor	BC107(or any other equivalent diode)	1	
6.	Resistor	Suitable as per voltage division	1	
7.	Connecting wires	Single strand Teflon coating 0.6mm	As per requirement	
8.	Breadboard	5.5 CM X 17CM	1	

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 transistor beyond its rated voltage. This may lead to damaging of the transistor.
3. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.

XI Procedure

1. Connect the electrical circuit as in Figure 1.
2. Switch on the power supply.
3. Measure the voltage V_E and V_C at emitter and collector terminal respectively.
4. Measure V_{CE} means the difference between V_C and V_E.
5. Calculate the collector current $I_C=(V_{CC}-V_C)/R_C$.
6. Compare the measured values with the designed values.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……..

……..……...

XIV Precautions followed

……

……

XV Observations and Calculations:

$V_{CE}=V_C-V_E$

$I_C=(V_{CC}-V_C)/R_C$

Calculations:

XVI Results

……..

……..

XVII Interpretation of results

……..

……

XVIII Conclusions

……

……

XIX Practical related Questions

Change value of R1 and find change in voltages.

[Space for Answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. http://www.srmuniv.ac.in/downloads/biasing.pdfhttp://www.srmuniv.ac.in/downloads/biasing.pdf
2. https://www.youtube.com/watch?v=9trNaY6C7bQ
3. https://www.youtube.com/watch?v=wGDi3zZhtqc
4. https://en.wikipedia.org/wiki/Voltage_divider

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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)**	

Practical No. 26 and 27: Test the Performance of FET Drain Characteristics, Transfer Characteristics And Calculate Trans- Conductance. (Part I and II)

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)

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.

III Competency and Skills

This practical is expected to develop the following skills for the industry-identified competency **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use DC Power supply to give different voltages.
4. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

- 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 related Outcomes

- Handle equipment and component carefully.

VII Minimum Theoretical Background

Junction Field Effect Transistors are a type of FETs (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-between the drain and the source terminals.

N-channel JFET

N-channel JFET has its major portion made of n-type semiconductor. The mutually-opposite two faces of this bulk material form 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

P-channel JFET has its major portion made of p-type semiconductor. The mutually-opposite two faces of this bulk material form the source and the drain terminals. There are two relatively-small-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.

Curve AB: 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 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: This is also called saturation 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 of breakdown of gate to source junction due to avalanche effect.

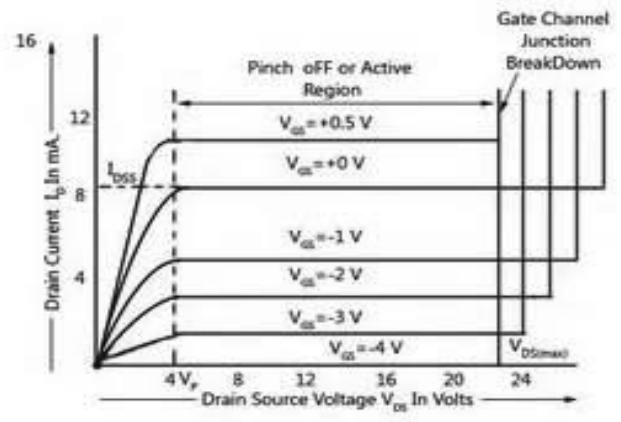


Figure 1: Drain characteristic

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})

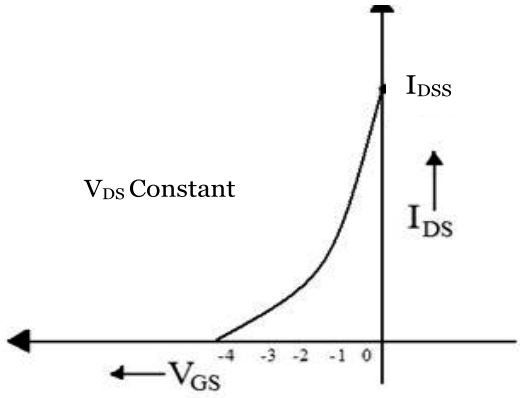


Figure 2: Transfer Characteristics

VIII Practical Circuit Diagram :

a. Sample

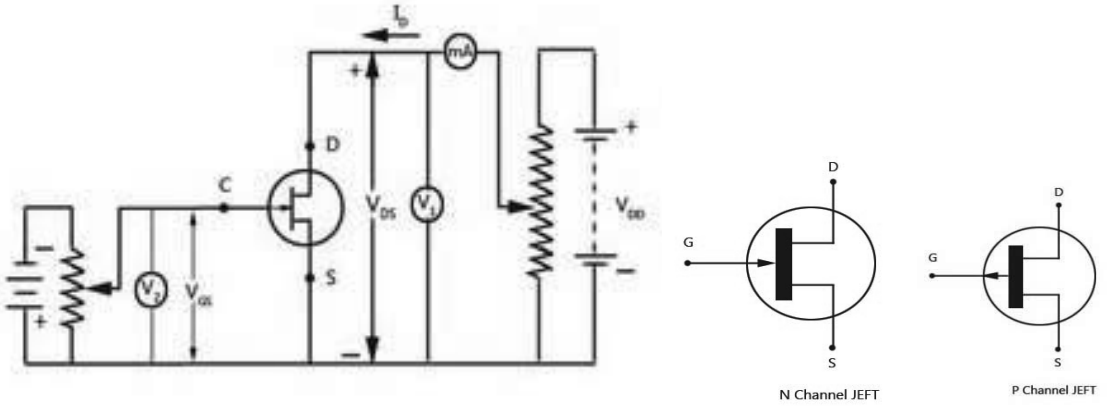


Figure 3: FET characteristic and its symbol

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.	Power Supply	0-30V 1 Amp	2No.
2.	Voltmeter	0-20V	1 No.
3.	Ammeter	(0-50milliamps) (0-500μA)	1 No.
4.	JFET	BFW10, BFW15 or equivalent JFET	1 No.
5.	Connecting wires / probes	Single strand 0.6mm Teflon coating	As per requirement
6.	Bread Board	5.5 CM X 17CM	1

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 fig 3.
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.
7. Plot a graph of V_{DS} verses I_D for various values of $V_{GS.}$

Part II

Transfer characteristics:

1. Connect the electrical circuit as shown in fig 3.
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.
4. Plot a graph of gate to source voltage verses drain current for different set values of drain to source voltage.
5. A graph will be in second quadrant as gate to source voltage is negative.

XII Resources used (with major specifications)

S. No.	Data book /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……
……
……

XIV Precautions followed

……
……

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)
1						
2						
3						
4						
5						
6						

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						
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)
5						
6						

Calculations:

Drain dynamic Resistance:

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

Mutual Conductance:

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

Amplification Factor:

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

XVI Results

1. Drain dynamic Resistance=……..…..
2. Mutual Conductance (Gm) =……..
3. Amplification Factor (μ) =……..

XVII Interpretation of results

……

……

XVIII Conclusions

……

……

XIX Practical related Questions

1. Write the Part number and manufacturer of given JFET.
2. Write the steps to identify terminals of given JFET.

[Space for answer]

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

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

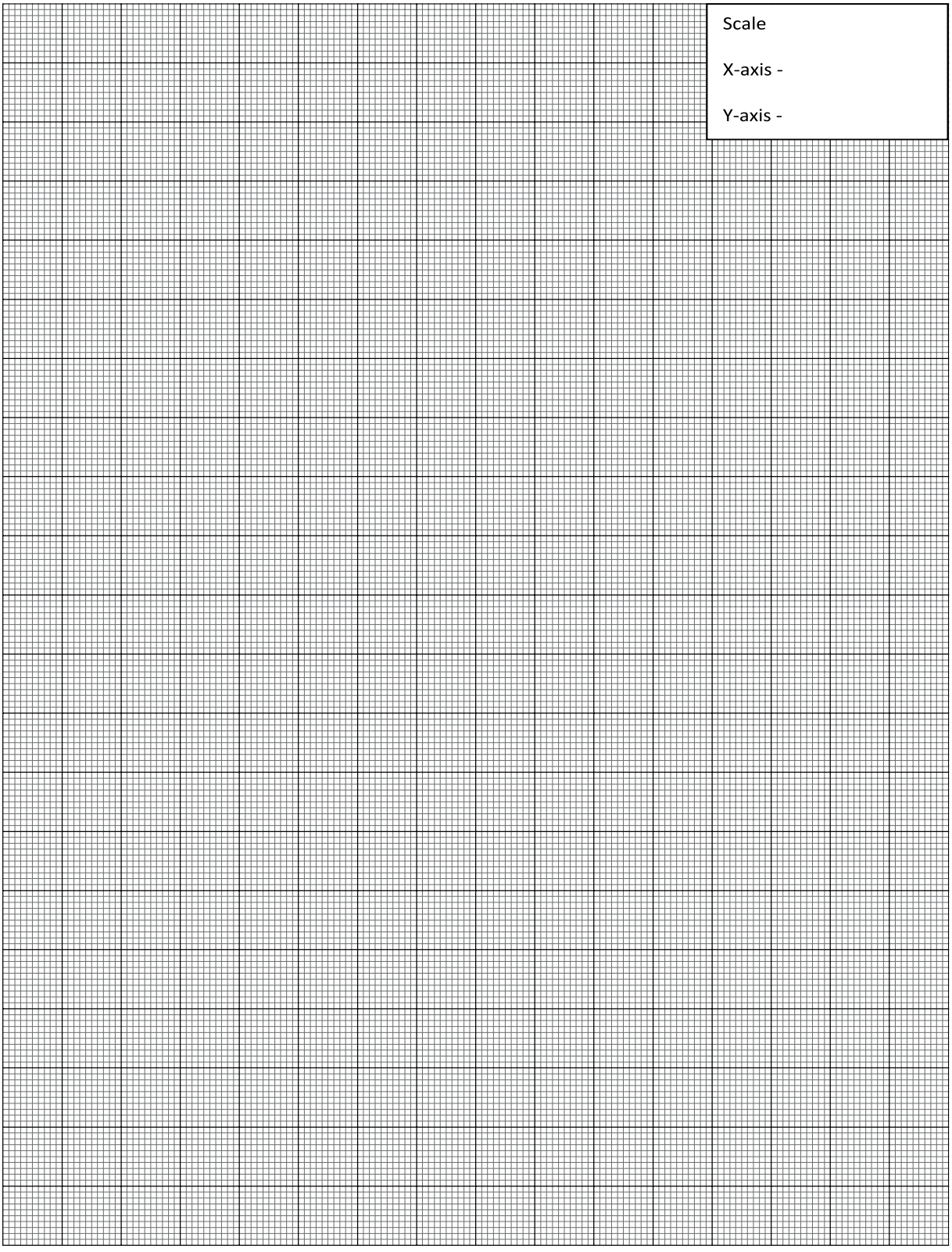
XXI Assessment Scheme

Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 -


Scale
X-axis -
Y-axis -

Practical No. 28: Build and Test Zener Voltage Regulator for the given Voltage.

I Practical Significance:

The Zener diode is like a general-purpose PN junction diode. When biased in the forward direction it behaves just like a normal PN junction diode, but when a reverse voltage is applied to it, the voltage remains constant for a wide range of currents.

Zener Breakdown: There is a limit for the reverse biasing voltage. Reverse biasing voltage can increase until the diode breakdown voltage reaches. This reverse biased voltage is called Zener *Breakdown voltage*. At this stage, maximum current will flow through the Zener diode.

The fact that the voltage across the diode in the breakdown region is almost constant turns out to be an important application of the Zener diode as a voltage regulator

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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 **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Component mounting skills.
3. Use DC Power supply to give different voltages.
4. Use Digital multimeter to measure the voltage and current.

IV Relevant Course Outcomes

Use relevant diode in different electronics circuits.

V Practical Outcome

Test Zener voltage regulator for the given voltage.

1. Selection of Zener diode.
2. Determine load regulation and line regulation of a given Zener diode

VI Relevant Affective domain related Outcomes

Handle components and equipment carefully.

VII Minimum Theoretical Background

a) Line Regulation

In line regulation, series resistance and load resistance are fixed, only input voltage is changing. Output voltage remains the same as long as the input voltage is maintained above a minimum value.

Percentage of line regulation can be calculated by =

$$\frac{\Delta V_0}{\Delta V_{IN}} * 100$$

where V_0 is the output voltage and V_{IN} is the input voltage and ΔV_0 is the change in output voltage for a particular change in input voltage ΔV_{IN}.

b) Load Regulation

In this type of regulation, input voltage is fixed and the load resistance is varying. Output voltage remains same, as long as the load resistance is maintained above a minimum value.

Percentage of load regulation =

$$\left[\frac{V_{NL} - V_{FL}}{V_{NL}}\right] * 100$$

where V_{NL} is the no load resistor voltage (ie. remove the load resistance and measure the voltage across the Zener Diode) and V_{FL} is the full load voltage.

VIII Practical Circuit Diagram :

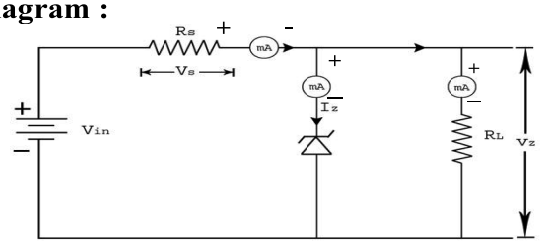


Figure 1: ZenerDiode shunt regulator

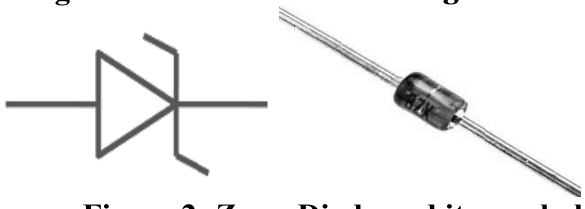


Figure 2: ZenerDiode and its symbol

Courtesy: (**https://www.google.co.in/search?biw=998&bih=617&tbm=isch&sa=1&q=Zener+Diode**)

b. Actual Circuit used in laboratory

c. Actual Experimental set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2 No.	1. Digital Multimeter with diode testing facilities will be preferred. 2. In place of Digital Multimeter, DC Voltmeter and DC ammeter can be used.
2.	DC Regulated power supply	Variable DC power supply 0- 30V, 2A, SC protection, display for voltage and current.	1 No.	
3.	Voltmeter	0-20 V	1 No.	
4.	Ammeter	(0 - 200 mA, 0 - 200 μA)	2 No.	
5.	Bread board	5.5 CM X 17CM	1 No.	
6.	Diode	**1N4733 (or any other equivalent Zener diode)**	1 No.	
7.	Variable Load Resistor		1 No.	
8.	Resistor	1KΩ(0.5watts/0.25watts)	1 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

A) Line Regulation:

1. Connect the circuit as in figure 1.
2. Keep load resistance fixed value; vary DC input voltage from 5V to 15V.
3. Record the output voltage as a load voltage with high line voltage 'V_{HL}' and as a load voltage with low line voltage 'V_{LL}' in the observation table.

B) **Load Regulation**:

1. Keep input voltage constant say 10V, vary load resistance value.
2. Record no load voltage 'V_{NL}' for maximum load resistance value and full load voltage 'V_{FL}' for minimum load resistance value.
3. Calculate load regulation as per formula.
4. Sketch the graph for recorded readings.

XII Resources used (with major specifications)

S. No.	Equipments/Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……

……

……

XIV Precautions followed

……

……

XV Observations and Calculations:

Table 1: Measurement of V_{in} and V_z

S.No.	Line Regulation ($R_L$constant) I_L=10(mA)		Load Regulation (V_{in}constant) V_{in}=10(V)	
	Input voltage $V_{in(VOLTS)}$	**Output voltage $V_{z(VOLTS)}$**	**Load current I_L(mA)**	**Output voltage $V_{z(VOLTS)}$**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Calculations:

Percentage of line regulation=

Percentage of load regulation=

XVI Results

Load Resistance	Output voltage $V_{Z(VOLTS)}$	Load current I_L(mA)
R_L minimum		
R_L maximum		

XVII Interpretation of results

……
……

XVIII Conclusions

……
……

XIX Practical related Questions

Repeat the above experiment different Zener diode.

[Space for Answers]

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=n5_6b6-j0r4
2. https://www.youtube.com/watch?v=jG2YAtTWxv
3. https://www.youtube.com/watch?v=mfGEODPzTmc

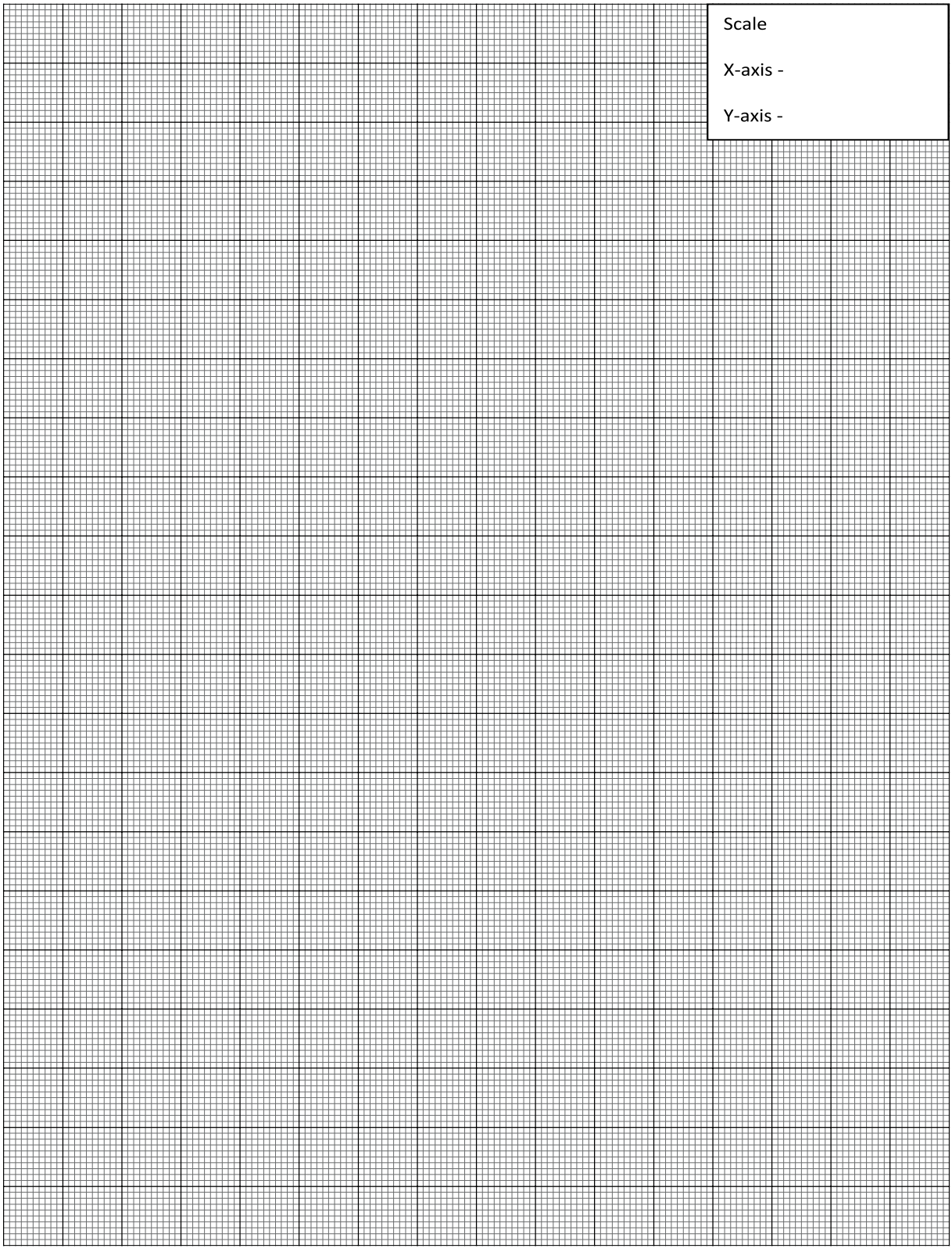
XXI Assessment Scheme

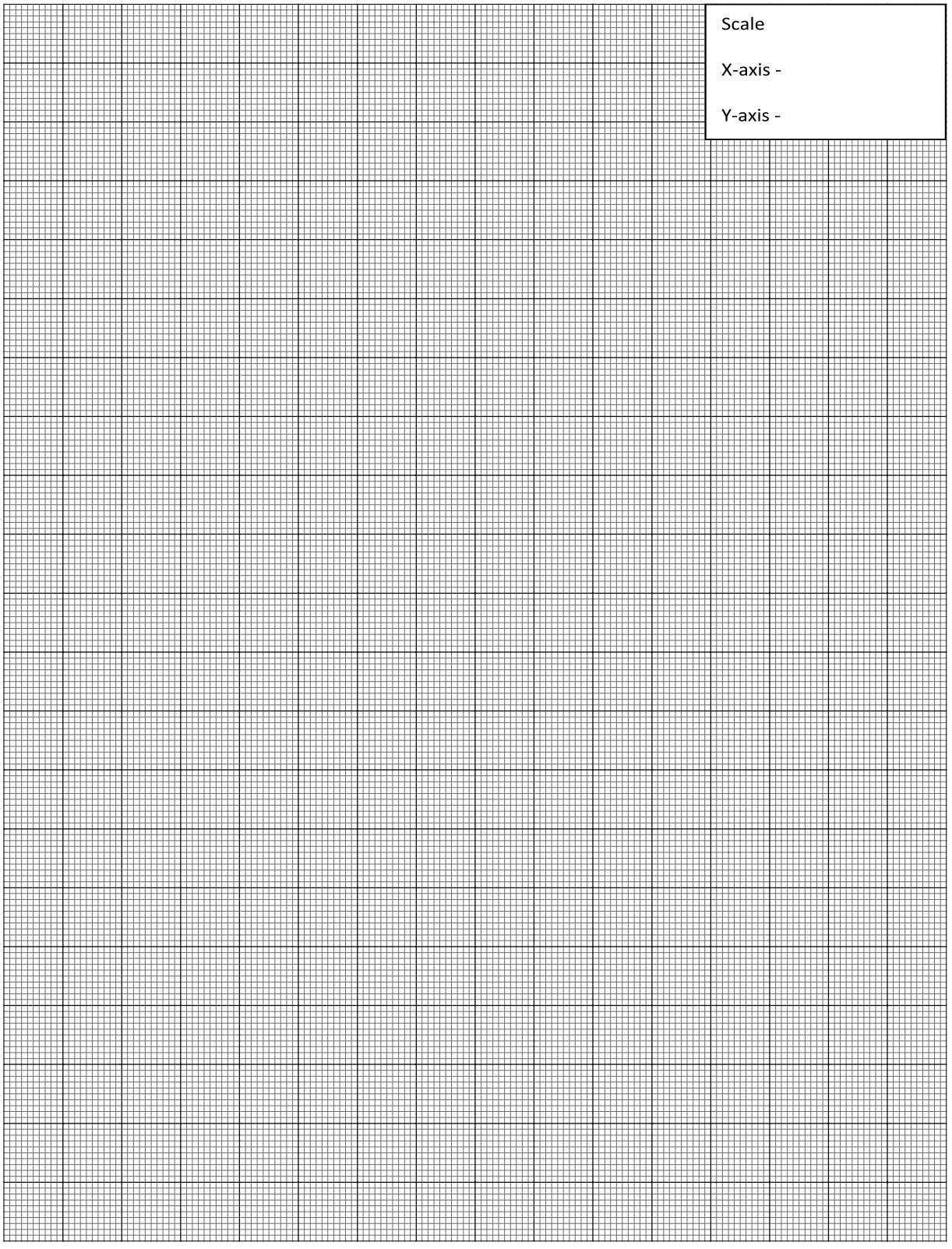
Performance indicators		Weightage
Process related (15 Marks)		**60%**
1	Handling of the components	10 %
2	Identification of component	20 %
3	Measuring value using suitable instrument	20 %
4	Working in team	10 %
Product related (10 Marks)		**40%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 -


Scale
X-axis -
Y-axis -

Practical No.29: Test the Performance of the Transistorized Series Voltage Regulator.

I Practical Significance:

A voltage regulator is a device that maintains a constant voltage across a load even if the load current requirement changes. Voltage regulator is a major building block in power supplies. Voltage regulator circuit is built by using transistor which is termed as transistorized voltage regulator.

A voltage regulator is designed to maintain a constant voltage level irrespective of load variations or changes in input A.C voltage.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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 **'Maintain electronic circuits comprising of discrete electronic components.'**

1. Circuit connections
2. Measurement Skills
3. Graph plotting skills
4. Analytical skills

IV Relevant Course Outcomes

- Maintain DC regulated power supply.

V Practical Outcome

Calculate load and line regulation of the given transistorized regulator.

1. Select instruments of required range.
2. Following safety measure.

VI Relevant Affective domain related Outcomes

- Handle components and equipment carefully.

VII Minimum Theoretical Background

In series voltage regulator, BJT is placed in series with the load. The output voltage remains constant even if the input voltage varies.

Voltage Regulation: The D.C. voltage available across the output terminals of a given power supply depends upon load current. If the load current is increased by decreasing load resistance, there will be greater voltage drop in the power supply and hence smaller D.C. output voltage will be available. Reverse will happen if the load current decreases. The variation of output voltage w.r.t. the amount of load current drawn from the power supply is known as voltage regulation or Load regulation.

Line Regulation: Line regulation is defined as the ratio of change in output voltage to change in input voltage with load (R_L) constant.

Line Regulation: $\Delta V_{Out} / \Delta V_{in}$ at R_L constant

Load Regulation: Load regulation is defined as the ratio of change in output voltage to change in load current with input (line) voltage constant.

$$\textbf{\% Load regulation} = \frac{V_{NL}-V_{FL}}{V_{FL}} \times 100\%$$

Where
V_{NL} = D.C. output voltage at no- load
V_{FL} = D.C. output voltage at full- load

VIII Practical Circuit Diagram :

a. Sample

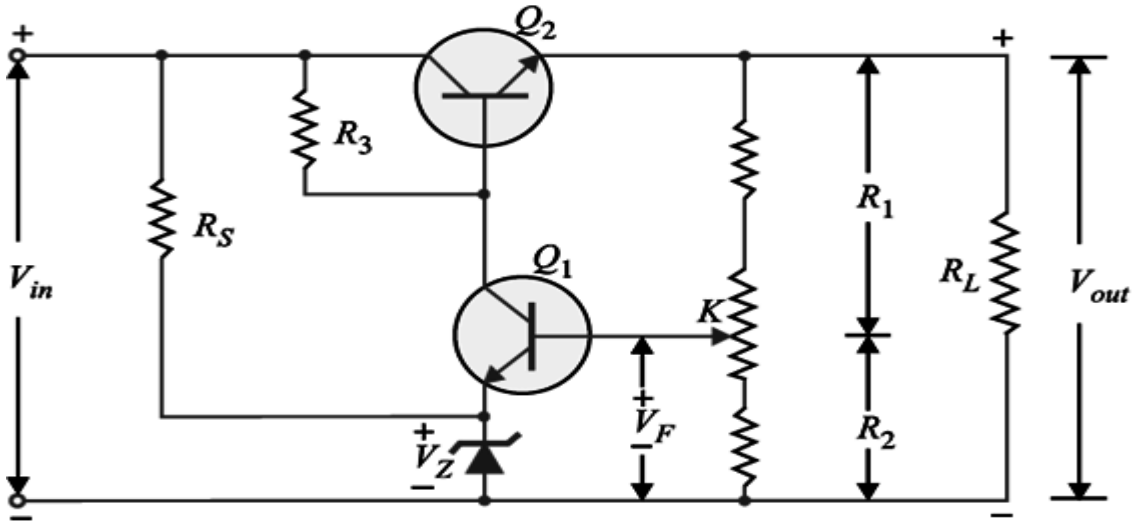


Figure 1: Transistor Series Voltage Regulator

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources Required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	3 1/2 digit display, 9999 counts digital multimeter measures: Vac, Vdc(1000V max), Adc, Aac(10 amp max), Resistance (0 - 100 MΩ)	2	Voltmeter- 0-25 Volt Ammeter -0-25mA
2.	Experimental Kit OR Breadboard	5.5 CM X 17CM	1	
3.	Patch cords	Uitable rating		
4.	Transistor	BC548,SL100	2	
5.	Zener Diode	1N4728A	1	
6.	Load Resistor	S		
7.	Resistor	1K	1	

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. Connect voltmeter and ammeter in correct polarities

XI Procedure

1. Connect the electrical circuit as in Figure 1.
2. Switch on the power supply.
3. Connect the voltmeter at input and outputside.
4. For Line Regulation vary the input voltage Vin in step of 1 volt, keeping R_L Load constant and record the input voltage Vin and output voltage Vout.
5. For Load Regulation keep the input voltage Vin constant (Vin>10V), vary the R_L in steps and record output voltage Vout.
6. Calculate line and load regulation for corresponding readings.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……

……

……

XIV Precautions followed

……

……

XV Observations and Calculations:

Table 1: Measurement of Line Regulation

(R_L Constant ,V_{in} Variable)

S.No.	V_{IN} (V)	V_{OUT} (V)	R_L (Ω)

Table 2: Measurement of Load Regulation

(R_L Variable,V_{in} Constant)

S.No.	R_L (Ω)	V_{out} (V)	V_{in} (V)
	R_L No- load		
	R_L Full- load		

Calculations:

XVI Results

1. Line regulation = …….
2. Load regulation = …….

XVII Interpretation of results

……..……

……...

XVIII Conclusions

…….

…….....

XIX Practical related Questions

Repeat the above experiment with zener diode of 9volt.

[Space for Answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=hLHNufw5kMg
2. https://www.youtube.com/watch?v=DJY-Y8N5Hng
3. https://www.youtube.com/watch?v=R_QnIAEk7Go
4. https://www.youtube.com/watch?v=TzGkO4QqJy0

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 -


Scale
X-axis -
Y-axis -

Practical No 30: Test the Performance of the Transistorized Shunt Voltage Regulator.

I Practical Significance:

A voltage regulator is a device that maintains a constant voltage across a load even if the load current requirement changes. Voltage regulator is a major building block in power supplies. Voltage regulator circuit is built by using transistor which is termed as transistorized voltage regulator.

A voltage regulator is designed to maintain a constant voltage level irrespective of load variations or changes in input A.C voltage.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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:**'Maintain electronic circuits comprising of discrete electronic components.'**

1. Circuit connections
2. Measurement Skills
3. Graph plotting skills
4. Analytical skills

IV Relevant Course Outcomes

Maintain DC regulated power supply.

V Practical Outcome

Calculate load and line regulation of the given transistorized regulator.

1. Handle components and equipment carefully.
2. Select instruments of required range.
3. Following safety measure.

VI Relevant Affective domain related Outcomes

- Handle components and equipment carefully.

VII Minimum Theoretical Background

In shunt voltage regulator, BJT is placed in parallel with the load. The output voltage remains constant even if the input voltage varies.

Voltage Regulation: The D.C. voltage available across the output terminals of a given power supply depends upon load current. If the load current is increased by decreasing load resistance, there will be greater voltage drop in the power supply and hence smaller D.C. output voltage will be available. Reverse will happen if the load current decreases. The variation of output voltage w.r.t. the amount of load current drawn from the power supply is known as voltage regulation.

Line Regulation: Line regulation is defined as the ratio of change in output voltage to change in input voltage with load (R_L) constant.

Line Regulation: $\Delta V_{Out} / \Delta V_{in}$ at R_L constant

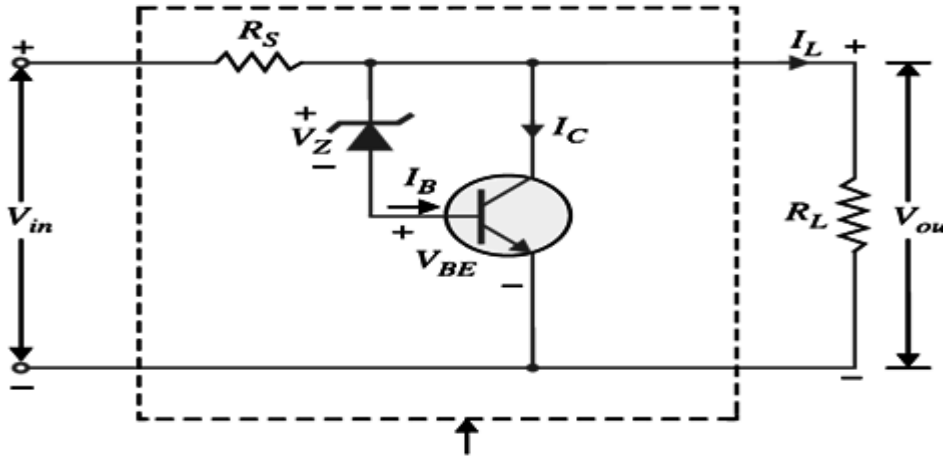
Load Regulation: Load regulation is defined as the ratio of change in output voltage to change in load current with input (line) voltage constant.

$$\textbf{\% Load regulation} = \frac{V_{NL}-V_{FL}}{V_{FL}} \times 100\%$$

V_{NL} = D.C. output voltage at no- load
V_{FL} = D.C. output voltage at full- load

VIII Practical Circuit Diagram:

Figure 1: Shunt Regulator



Actual Circuit used in laboratory

Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	3 1/2 digit display, 9999 counts digital multimeter measures: Vac, Vdc(1000V max), Adc, Aac(10 amp max), Resistance (0 - 100 MΩ)	2	Voltmeter- 0-25 Volt Ammeter -0-25mA
2.	Experimental Kit OR Breadboard		1	
3.	Patch cords			
4.	Transistor	BC548,CL100	2	
5.	Resistor	1KΩ,180Ω.	2	
6.	Zener Diode	1N4728A	1	

X Precautions

1. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.
2. Connect voltmeter and ammeter in correct polarities.

XI Procedure

1. Connect the electrical circuit as in Figure 1.
2. Switch on the power supply.
3. Connect the voltmeter at input and output side.
4. For Line Regulation vary the input voltage Vin in step of 1 volt, keeping R_L Load constant and record the input voltage Vin and output voltage Vout.
5. For Load Regulation keep the input voltage Vin constant (Vin>10V), vary the R_L Load in steps and record output voltage Vout.
6. Calculate line and load regulation for corresponding readings.

XII Resources used (with major specifications)

S. No.	Instrument /Components	Specification	Quantity
1.			
2.			
3.			
4.			
5.			

XIII Actual procedure followed

……

……

……

XIV Precautions followed

……

……

……

XV Observations and Calculations:

Table 1: Measurement of Line Regulation

(R_L Constant ,V_{in} Variable)

S.No.	V_{in} (V)	V_{out} (V)	R_L (Ω)

Table 2: Measurement of Load Regulation

(R_L Variable, V_{in} Constant)

S.No.	R_L (Ω)	V_{out} (V)	V_{in} (V)
	R_L No- load		
	R_L Full- load		

Calculations:

XVI Results

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

XVII Interpretation of results

……

……

XVIII Conclusions:

……

……..

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.

Repeat the above experiment with zener diode of 9volt

[Space for Answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. https://www.youtube.com/watch?v=hLHNufw5kMg
2. https://www.youtube.com/watch?v=DJY-Y8N5Hng
3. https://www.youtube.com/watch?v=R_QnIAEk7Go
4. https://www.youtube.com/watch?v=TzGkO4QqJy0

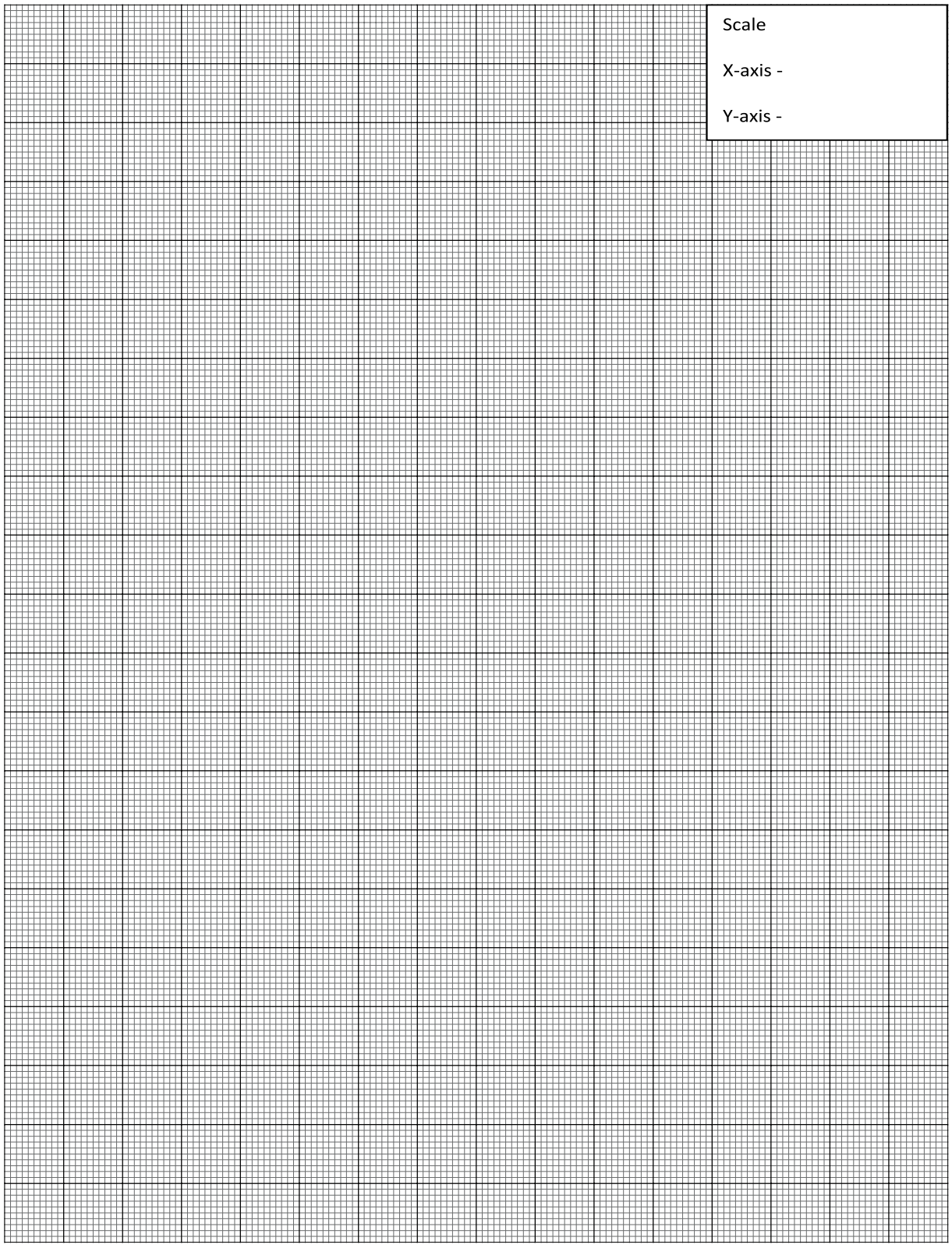
XXI Assessment Scheme

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%**
5	Calculate theoretical values of given component	10 %
6	Interpretation of result	05 %
7	Conclusions	05 %
8	Practical related questions	15 %
9	Submitting the journal 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 -


Scale
X-axis -
Y-axis -

Practical No. 31: Test The Various Blocks of Regulated DC Power Supply.

I Practical Significance

AC power is generated and transmitted from power plants. But the integrated circuits and electronic components used inside office automation equipment, factory automation equipment, and other electronics appliances cannot be operated with the AC voltage and they will be damaged by the high voltages. Stable DC voltage is required to operate these integrated circuits and electronic components. The device that converts commercial AC power to regulated DC power is called a regulated DC Power Supply. A regulated power supply converts unregulated AC into a constant DC. With the help of a rectifier it converts AC supply into DC. The output from the regulated power supply may be constant or variable, but is always DC. (Direct Current). The testing of regulated DC power supply is carried out to check whether the expected output is obtained at the output stage, else this will conclude that there is fault at the particular stage.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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: '**Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Use Digital multimeter to measure the voltage at output of each block.
3. Visual circuit inspection skill

IV Relevant Course Outcome(s)

Maintain DC regulated power supply.

V Practical Outcome

1. Component identification skills.
2. Use Digital multimeter to measure the voltages.
3. Tracing actual circuit as per diagram.

VI Relevant Affective domain related Outcome(s)

- Handle components and equipment carefully.
- Select instruments of required range.

VII Minimum Theoretical Background

Testing of regulated DC power supply is used to troubleshoot the power supply. Testing is used to solve and eliminate the causes of fault. These faults cause voltage and current instability. Which can have a significant impact on equipment. The aim of a DC power supply is to provide the required level of DC power to the load using an AC

supply at the input. The DC power supplies, consists of following major components /circuits :

- Input transformer: The input transformer is a step down transformer of required voltage and current rating.
- Rectifier: The rectifier converts AC to pulsating DC.
- Filter: It removes ripples.
- Voltage Regulator: It provides a constant output voltage irrespective of change in line voltage and load current.

VIII Block diagram:

a. Sample

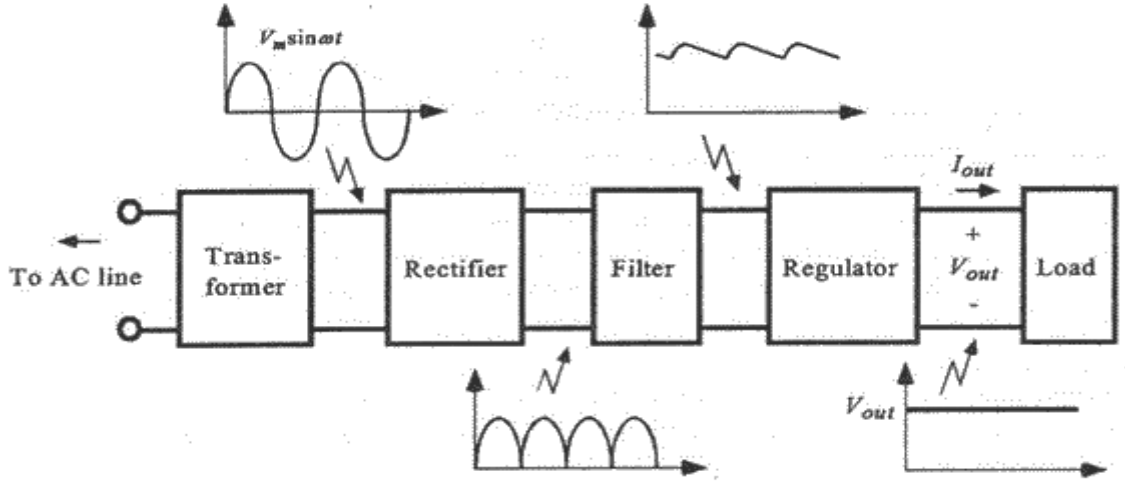


Figure1:Regulated power supply Block diagram

Courtesy: *(http://www.circuitstoday.com/wp-content/uploads/2009/10/Regulated-Power-Suppley-Block-Digram.jpg)*

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred. 2. In place of Digital Multimeter, Voltmeter and ammeter can be used.
2.	CRO	25MHz Dual scope	1	
3.	DC regulated Power supply Trainer Kit		2	
4	Electric Tester		1	

X Precautions to be Followed

Before connecting the plug to the mains check, check the wires insulation.

XI Procedure

1. Use trainer kit of regulated DC power supply.
2. ON the AC supply.
3. Check and Sketch the nature of waveform using CRO:
   - at primary of the Transformer on CRO
   - at secondary of the Transformer on CRO
   - at output of rectifier.
   - at output of filter .
   - at output of regulator.
4. Draw all waveforms nature in the observation table.
5. Draw all waveforms nature on graph paper.

XII Resources Used

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

XIII Actual Procedure Followed

……

……

XIV Precautions Followed

……

……

XV Observations and Calculations

Table 1: Output voltage and Output waveform.

S.No.	Stage	Output voltage (V)	Output waveform
1	Primary of Transformer		
2	Secondary of Transformer		
3	Output of Rectifier		
4	Output of Filter		
5	Output of Regulator		

Calculations: **Not Applicable**

XVI Results

……

……

XVII Interpretation of results

……
……

XVIII Conclusions

……
……..

XIX Practical related Questions

1. Measure the voltages at different stages given in observation table using DMM.

[Space for Answers]

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

XX References / Suggestions for further Reading

1. https://commons.wikimedia.org/wiki/File:Practical_Regulated_Power_Supply_Components.jpg#/media/File:Practical_Regulated_Power_Supply_Components.jpg
2. https://www.electrical4u.com/regulated-power-supply/
3. http://www.circuitstoday.com/regulated-power-supply

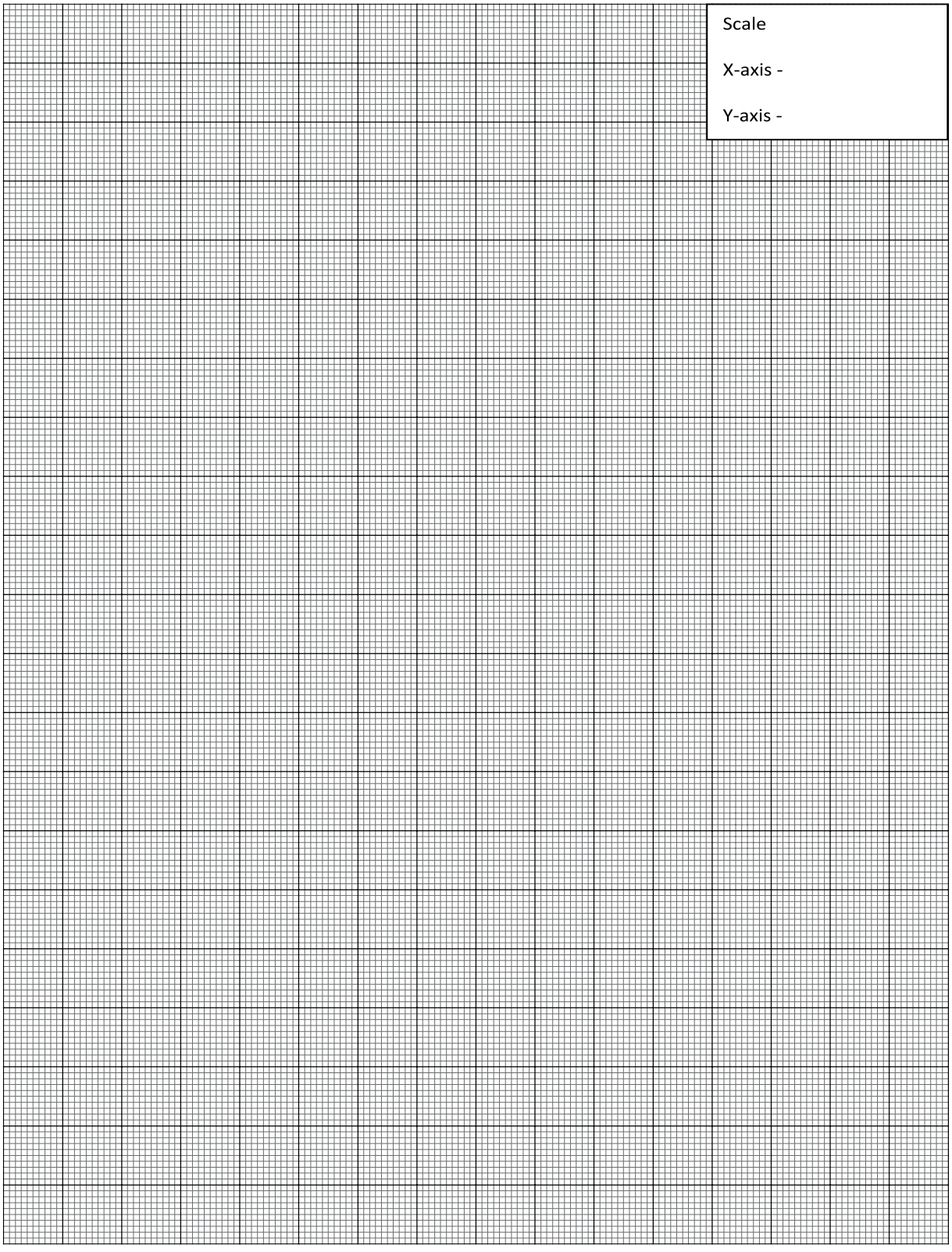
XXI Assessment Scheme

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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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. 32: Find Out Faults at Different Stages of Regulated DC Power Supply

I Practical Significance

AC power is generated and transmitted from power plants. AC power generation and transmission is easier and cheaper than DC supply transmission. But the integrated circuits and electronic components used inside office automation equipment, factory automation equipment, and other electronics appliances cannot be operated with the AC voltage and they will be damaged by the high voltages. Stable DC voltages are required to operate these integrated circuits and electronic components. The device that converts commercial AC power to regulated DC power is called a regulated DC Power Supply. A regulated power supply converts unregulated AC into a constant DC. With the help of a rectifier it converts AC supply into DC. The output from the regulated power supply may be constant or variable, but is always DC. (Direct Current). The testing of regulated DC power supply is carried out to check whether the expected output is obtained at the output stage, else this will conclude that there is fault at the particular stage.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.
- **Engineering tools:** Apply relevant Electronics and Telecommunications 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: '**Maintain electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Use Digital multimeter to measure the voltage at output of each block.
3. Fault finding skills .

IV Relevant Course Outcome(s)

- Maintain DC regulated power supply.

V Practical Outcome

1. Component identification skills
2. Use Digital multimeter to measure the voltages.
3. Circuit troubleshooting skills

VI Relevant Affective domain related Outcome(s)

1.Handle components and equipment carefully.
2.Select instruments of required range.

VII Minimum Theoretical Background

Testing of regulated DC power supply is used to troubleshoot the power supply. Testing is used to solve and eliminate the causes of fault. These faults cause voltage and current instability. Which can have a significant impact on equipment. The aim of a DC

power supply is to provide the required level of DC power to the load using an AC supply at the input. The DC power supply consists of following major components/circuits:

- Input transformer: The input transformer is a step down transformer.
- Rectifier: The rectifier converts AC to pulsating DC.
- Filter: It removes ripples.
- Voltage Regulator: It provides a constant output voltage irrespective ofchange in line and load voltage.

VIII Block diagram:

a. Sample

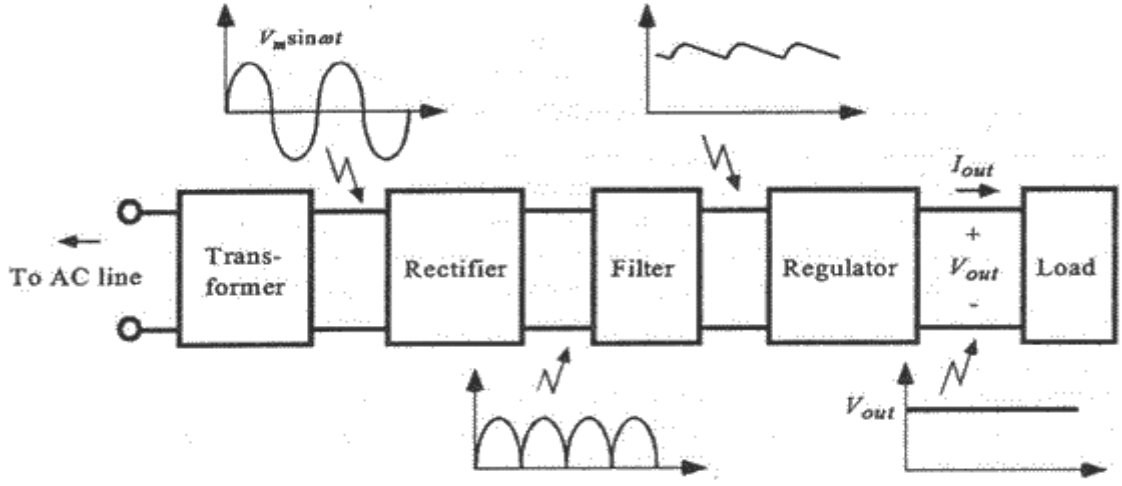


Figure1:Regulated power supply Block diagram

Courtesy: *(http://www.circuitstoday.com/wp-content/uploads/2009/10/Regulated-Power-Suppley-Block-Digram.jpg)*

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred. 2. In place of Digital Multimeter, Voltmeter and ammeter can be used.
2.	CRO	25MHz Dual scope	1	
3.	DC regulated Power supply Trainer Kit		2	

X Precautions to be Followed

Before connecting the plug to the mains, check the insulation of wires.

XI Procedure

1. Use trainer kit of regulated DC power supply.
2. ON the AC supply.
3. Create faults at different stages, compare the observed output voltage with the expected output voltage at each stage and comment on the values.

XII Resources Used

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

XIII Actual Procedure Followed

……
……

XIV Precautions Followed

……
……

XV Observations and Calculations

Table 1: Observe output voltage and fault..

S.No.	Create fault at Stage	Expected Output Voltage (V)	Observed Output Voltage (V)	Comment Related to Observed fault
1.				
2.				
3.				
4.				
5.				

Calculations: **Not Applicable**

XVI Results

……....
…….....

XVII Interpretation of results

……..……..
…….....

XVIII Conclusions

……

……

XIX Practical related Questions

Measure the voltages at given different stages given in observation table using DMM.

[Space for Answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. https://commons.wikimedia.org/wiki/File:Practical_Regulated_Power_Supply_Components.jpg#/media/File:Practical_Regulated_Power_Supply_Components.jpg
2. https://www.electrical4u.com/regulated-power-supply/
3. http://www.circuitstoday.com/regulated-power-supply

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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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)**	

Practical No. 33 and 34: Troubleshoot given DC Regulated Power Supply (Part I And II).

I Practical Significance

Troubleshooting of an *electronic circuit* is a process of having a special outlook on components that comes out with remedies to repair it. The unexpected behavior exhibited by the *circuit* is due to improper locating or soldering of components, component damage due to aging, faults, overheat, and so on.

II Relevant Program Outcomes (POs)

- **Discipline knowledge:** Apply Electronics and Telecommunications engineering knowledge to solve broad-based Electronics engineering related problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electronics and Telecommunications engineering problems.

Engineering tools: Apply relevant Electronics and Telecommunications 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: 'Maintain **electronic circuits comprising of discrete electronic components.'**

1. Component identification skills.
2. Use Digital multimeter to measure the voltage at output of each block.

IV Relevant Course Outcome(s)

- Maintain DC regulated power supply.

V Practical Outcome

1. Component identification skills
2. Use Digital multimeter to measure the voltages.

VI Relevant Affective domain related Outcome(s)

1. Handle components and equipment carefully.
2. Select instruments of required range.

VII Minimum Theoretical Background

Troubleshooting is a form of problem solving, often applied to repair failed products or processes on a machine or a system. It is a logical, systematic search for the source of a problem in order to solve it, and make the product or process operational again.

Troubleshooting approach consists of the following:

Step 1 -Physical Observation
(Locating different electronic components in different section)
Step 2 -Define Problem Area
Step 3 -Identify Possible Causes
Step 4 -Determine Most Probable Cause
Step5-Test and Repair.

VIII Circuit diagram:

a. Sample

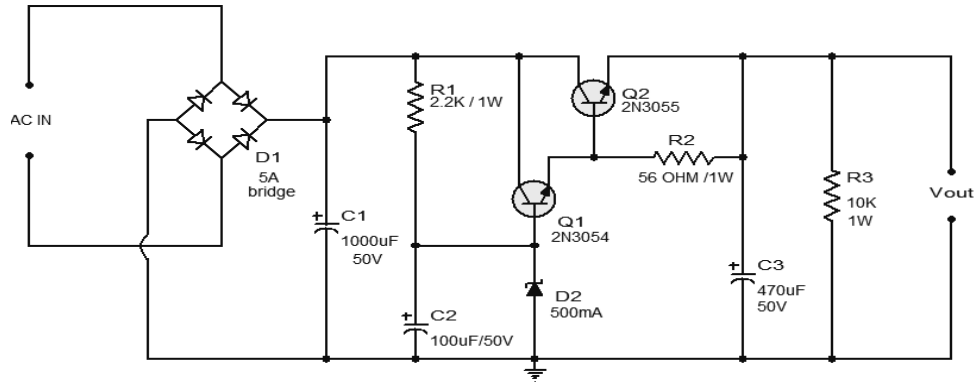


Figure1: Regulated power supply

Note: *This circuit is just a sample you can have any regulated power supply*

b. Actual Circuit used in laboratory

c. Actual Experimental Set up used in laboratory

IX Resources required

S. No.	Instrument /Components	Specification	Quantity	Remarks
1.	Digital Multimeter	Digital Multimeter : 3 1/2 digit display.	2	1. Digital Multimeter with diode testing facilities will be preferred. 2. In place of Digital Multimeter, Voltmeter and ammeter can be used.
2.	CRO	25MHz Dual scope	1	
3.	DC regulated Power supply Trainer Kit		2	

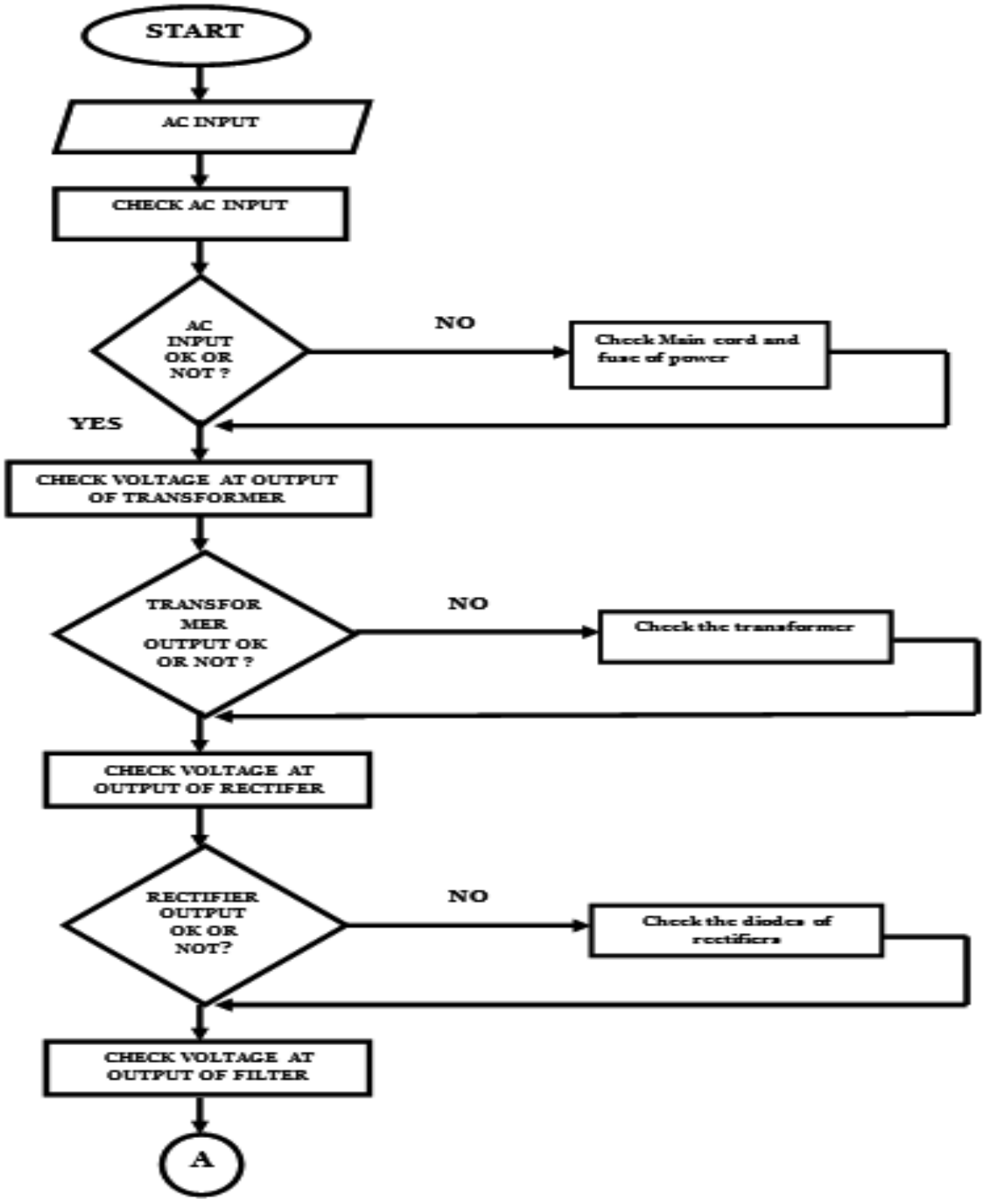
X Precautions to be Followed

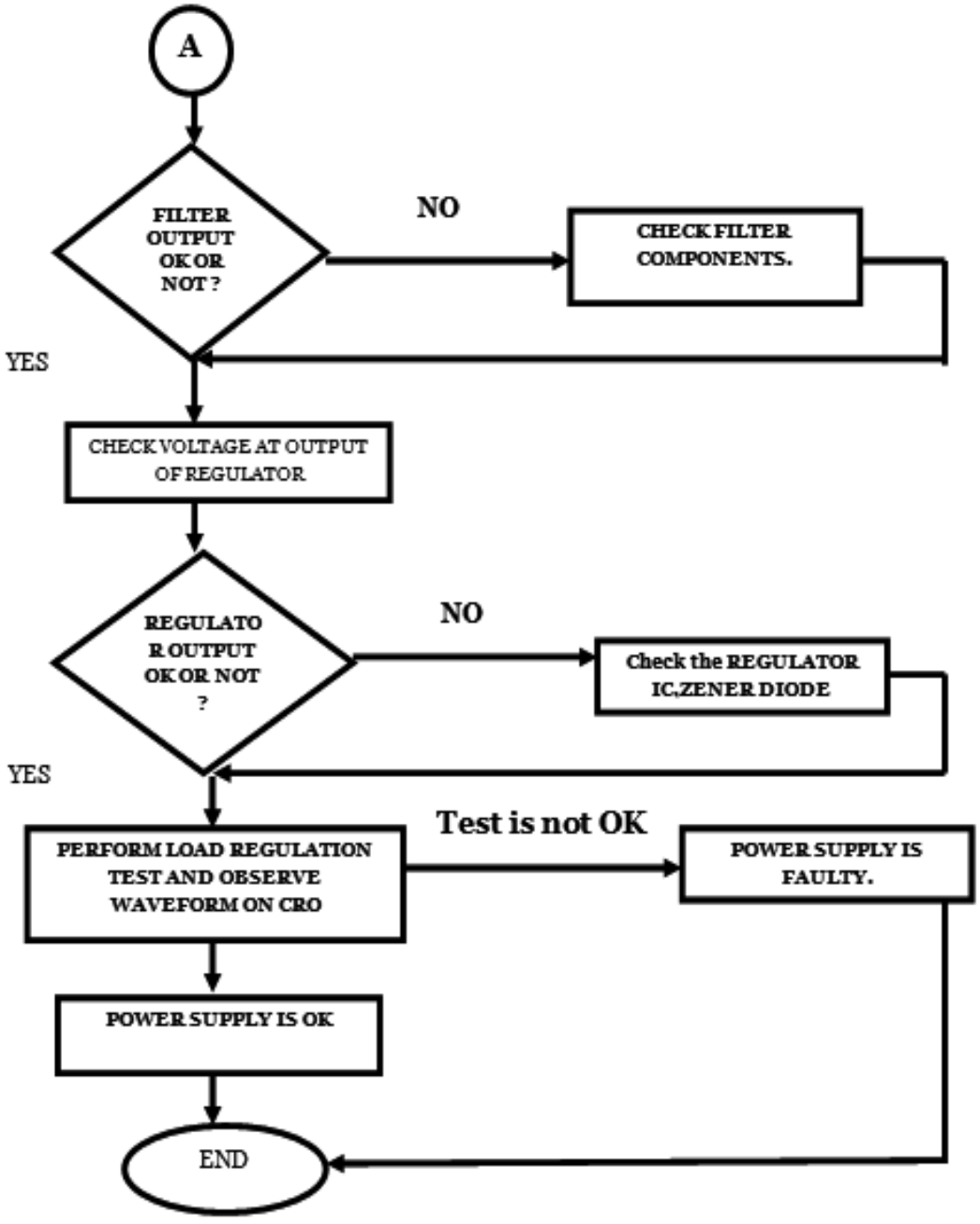
1. Before connecting the plug to the mains, check the wires are properly insulated.

XI Procedure

Follow the given flow chart for troubling shooting the given power supply.

1. Do the physical observations of different sections of the given power supply.
2. Draw the circuit diagram of the given power supply and mark test point as per the flow chart.
3. Go on testing each section of given circuit from input side to output side and test output.
4. Record the voltage and sketch waveforms at all check points in the table.
5. Compare the voltage value at given point with expected value, check waveform at given point and then identify the fault in given supply.


START
AC INPUT
CHECK AC INPUT
AC INPUT OK OR NOT ?
NO
Check Main cord and fuse of power
YES
CHECK VOLTAGE AT OUTPUT OF TRANSFORMER
TRANSFORMER OUTPUT OK OR NOT ?
NO
Check the transformer
CHECK VOLTAGE AT OUTPUT OF RECTIFER
RECTIFIER OUTPUT OK OR NOT?
NO
Check the diodes of rectifiers
CHECK VOLTAGE AT OUTPUT OF FILTER
A



Flow chart for trouble shooting of power supply

XII Resources Used

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

XIII Actual Procedure Followed

……

……

XIV Precautions Followed

……

……

XV Observations and Calculations

Table 1: Observed waveforms.

S.No.	Test Points	Standard value	Measured value	Observed waveform

Calculations: **Not Applicable**

XVI Results

……

……

XVII Interpretation of results

……...

……..

XVIII Conclusions

……

……

XIX Practical related Questions

Repeat the experiment with different faults.

[Space for Answers]

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

……

XX References / Suggestions for further Reading

1. https://commons.wikimedia.org/wiki/File:Practical_Regulated_Power_Supply_Components.jpg#/media/File:Practical_Regulated_Power_Supply_Components.jpg
2. https://www.electrical4u.com/regulated-power-supply/
3. http://www.circuitstoday.com/regulated-power-supply

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%**
5	Interpretation of result	15 %
6	Conclusions	05 %
7	Practical related questions	15 %
8	Submitting the journal 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)**	

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

HEAD OFFICE

Secretary,
Maharashtra State Board of Technical Education
49, Kherwadi, Bandra (East), Mumbai - 400 051
Maharashtra (INDIA)
Tel: (022)26471255 (5 -lines)
Fax: 022 - 26473980
Email: -secretary@msbte.com
Web -www.msbte.org.in

REGIONAL OFFICES:

MUMBAI

Deputy Secretary (T),
Mumbai Sub-region,
2nd Floor, Govt. Polytechnic Building,
49, Kherwadi, Bandra (East)
Mumbai - 400 051
Phone: 022-26473253 / 54
Fax: 022-26478795
Email: rbtemumbai@msbte.com

PUNE

Deputy Secretary (T),
M.S. Board of Technical Education,
Regional Office,
412-E, Bahirat Patil Chowk,
Shivaji Nagar, Pune
Phone: 020-25656994 / 25660319
Fax: 020-25656994
Email: rbtepn@msbte.com

NAGPUR

Deputy Secretary (T),
M.S. Board of Technical Education
Regional Office,
Mangalwari Bazar, Sadar, Nagpur - 440 001
Phone: 0712-2564836 / 2562223
Fax: 0712-2560350
Email: rbteng@msbte.com

AURANGABAD

Deputy Secretary (T),
M.S. Board of Technical Education,
Regional Office,
Osmanpura, Aurangabad -431 001.
Phone: 0240-2334025 / 2331273
Fax: 0240-2349669
Email: rbteau@msbte.com