VOLTBOOK / GTU DIPLOMA ELECTRICAL

DC Circuit

DETAILED OUTCOME-BASED PRACTICAL MANUAL

COURSE CODE	SEMESTER	PRACTICALS	EFFECTIVE FROM
DI01C00081	1	17	2024-25

Prepared from the Suggested Course Practical List in the current GTU DI-series syllabus, effective 2024-25.

The organization follows the familiar outcome-based pattern used in legacy DTE laboratory manuals. All instructional text is independently written for this edition. This is not an official GTU, DTE or CTE publication.

Student name: ____

Enrollment no.: ____________________ Batch: ________________

Institute: ____

UNIVERSITY-DRAFTED FIGURE EDITION 6.0 / 20 JULY 2026

Certificate

This is to certify that ____, enrollment number ____________________, has satisfactorily completed the prescribed practical work for DC Circuit (DI01C00081) during the academic term ____________________ under the supervision of the department.

Laboratory faculty	Head of department	Principal
Signature and date	Signature and date	Signature and date

Preface

This manual turns the current syllabus practical list into a usable student record. Each practical includes an original experiment-specific vector diagram and is arranged from objective and outcomes through prerequisite theory, setup, resources, safety, procedure, observations, interpretation, questions, references and a 25-mark assessment rubric.

Students should complete pre-lab preparation before the session and record actual readings during the session. Faculty may adapt component values, instrument ranges, software versions and local assessment requirements without changing the intended practical outcome.

Diagram drafting benchmarks were reviewed from Aurora's Electrical Circuits and Simulation manual, MITS Electronic Devices and Circuits manual, Sree Vahini's Electrical Measurements manual, and MSBTE Electrical Estimating and Contracting practice. Edition 6.0 applies stricter university drafting: complete current paths, IEC-style junctions and terminals, protection, instrument coils, test points, load terminals and measurement notes. Every figure is newly drawn and aligned to the current GTU practical title.

Official syllabus reference

Open the referenced GTU syllabus PDF

Programme outcomes and course outcomes

Programme outcomes

Code	Outcome
PO1	Basic and discipline-specific knowledge: apply mathematics, science and engineering fundamentals.
PO2	Problem analysis: identify and analyze well-defined engineering problems using standard methods.
PO3	Design/development of solutions: develop solutions for well-defined technical problems.
PO4	Engineering tools, experimentation and testing: use modern tools and interpret test results.
PO5	Engineering practices for society, sustainability and environment: apply safe and responsible practice.
PO6	Project management: apply engineering management principles individually and in teams.
PO7	Lifelong learning: recognize the need for independent learning in changing technology.

Course competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

Course outcomes

CO	Course outcome
CO1	Apply the fundamental concepts of electricity, Ohm's law and Joule's law.
CO2	Solve DC circuits using source transformation, Kirchhoff's laws, resistor simplification, divider rules and star-delta transformations.
CO3	Analyze linear networks using topology, Superposition, Thevenin, Norton and Maximum Power Transfer theorems.
CO4	Explain electrostatics, capacitors, their connections, and RC charging and discharging.
CO5	Explain magnetic circuits, electromagnetic induction, inductance and inductor connections.

Practical outcome to course outcome matrix

The mapping below is for learning guidance. Faculty should use the assessment scheme prescribed by the institute.

No.	Suggested practical	Mapped CO
1	Demonstrate various types of resistors and measure resistance	CO1
2	Verify Ohm's law in the given electric circuit	CO1
3	Verify Kirchhoff's current law in the given electrical circuit	CO2
4	Measure voltage, current and resistance in the given DC circuit	CO1
5	Verify Kirchhoff's voltage law in the given electrical circuit	CO2
6	Determine equivalent resistance for series connection of resistors	CO2
7	Determine equivalent resistance for parallel connection of resistors	CO2
8	Verify Superposition theorem and determine current and voltage in each branch	CO3
9	Verify Thevenin's theorem and determine current and voltage in each branch	CO3
10	Verify Norton's theorem and determine current and voltage in each branch	CO3
11	Verify Maximum Power Transfer Theorem and determine load resistance for maximum power	CO3
12	Determine equivalent capacitance of series and parallel connected capacitors	CO4
13	Test different types of capacitors	CO4
14	Measure capacitor charging and discharging time and verify the RC time constant	CO4
15	Test different types of inductors	CO5
16	Demonstrate Faraday's law of electromagnetic induction	CO5
17	Measure inductance of an inductor or choke coil using an LCR meter	CO5

Industry skills and laboratory guidance

Industry-relevant skills

- Safe use of DC supplies and multimeters
- Systematic circuit assembly and checking
- Verification of laws and theorems
- Graphing, error calculation and result interpretation

Guidelines for instructors

1. Confirm the practical outcome, risk controls, apparatus readiness and emergency arrangements before the session.
2. Demonstrate only the critical connection, software or measurement steps; require students to reason through the remaining work.
3. Check circuit polarity, earthing, isolation, ranges and ratings before energization.
4. Assess both process and result. Give credit for safe practice, honest data, teamwork and technically sound interpretation.
5. Adapt values and equipment to local facilities while preserving the mapped course outcome.

Instructions for students

1. Read the practical, write the prediction and prepare the setup before entering the laboratory.
2. Record instrument identification, range, least count and component ratings before use.
3. Enter raw readings directly with units. Strike through errors once; do not erase or fabricate data.
4. Switch OFF and verify isolation before changing a connection. Report damage, heating, smell or unstable readings immediately.
5. Attach graphs, code listings, drawings, estimates and technical evidence behind the relevant practical.

Progressive assessment rubric

Each practical is assessed out of 25 marks. The practical-specific rubric repeats at the end of every experiment.

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Suggested interpretation

Total	Level	Interpretation
21-25	Excellent	Independent, accurate, safe and well interpreted
16-20	Good	Sound performance with minor correction
11-15	Satisfactory	Outcome achieved with guidance
0-10	Needs improvement	Repeat preparation or practical work as directed

Safety acknowledgement

I understand that institute rules and faculty instructions take priority over this manual. I will not energize, modify or touch a circuit without authorization.

Student signature and date	Faculty signature and date

Continuous assessment record

Practical	Date	Marks /25	Faculty initials
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
TOTAL		/425	

Experiment index

PRACTICAL 01

Demonstrate various types of resistors and measure resistance

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Demonstrate various types of resistors and measure resistance.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO1: Apply the fundamental concepts of electricity, Ohm's law and Joule's law.

E. Practical learning outcomes

1. Identify construction, rating, operating principle and application of the item or system.
2. Record observations in a labelled diagram and comparative technical table.
3. Form a justified conclusion using verified technical evidence.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

This is an identification and engineering-observation exercise. Record construction, ratings, operating principle, application, limitations and safety requirements for every item or system studied. Use nameplate data and current manufacturer or utility information; clearly distinguish observation from inference.

Key relations / checks

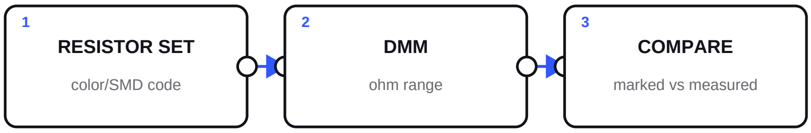
- V = I R
- P = V I = I^2 R = V^2/R
- % error = |measured - calculated| / calculated x 100

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.1 - RESISTOR IDENTIFICATION AND RESISTANCE TEST

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Collect only instructor-approved de-energized samples, models, data sheets or trainer modules.
2. Read markings and nameplate information; record type, material, rating, construction and relevant standard symbol.
3. Inspect each item and identify terminals or functional parts without dismantling sealed or energized equipment.
4. Explain the operating principle and match each type to a suitable application.
5. Compare advantages, limitations, failure modes and safe handling requirements in the observation table.
6. Have the instructor verify the identification and record the final conclusion.

L. Observations and calculations

Record verified ratings and constructional observations. Identify the source of any information not obtained directly from the sample or site.

Item / parameter	Rating / value	Construction / principle	Application	Remarks

LABELLED SKETCH / SINGLE-LINE DIAGRAM / COMPARATIVE NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Demonstrate various types of resistors and measure resistance'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 02

Verify Ohm's law in the given electric circuit

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Verify Ohm's law in the given electric circuit.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO1: Apply the fundamental concepts of electricity, Ohm's law and Joule's law.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

For an ohmic conductor at constant temperature, voltage is proportional to current: $V = I R$. The V-I graph is linear and its slope gives resistance when voltage is plotted against current.

Key relations / checks

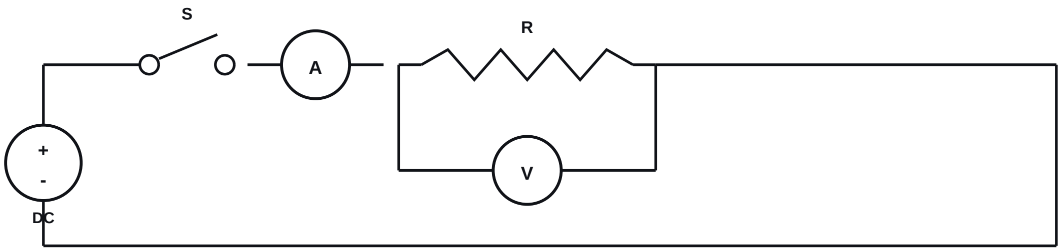
- $V = I R$
- $P = V I = I^2 R = V^2/R$
- % error = |measured - calculated| / calculated x 100

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.2 - OHM-LAW / BASIC DC MEASUREMENT CONNECTION

VERIFY VALUES BEFORE USE



Instructor-approved isolated/current-limited supply

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Verify Ohm's law in the given electric circuit'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 03

Verify Kirchhoff's current law in the given electrical circuit

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Verify Kirchhoff's current law in the given electrical circuit.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO2: Solve DC circuits using source transformation, Kirchhoff's laws, resistor simplification, divider rules and star-delta transformations.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Kirchhoff's current law follows charge conservation at a node, while Kirchhoff's voltage law follows energy conservation around a closed loop. Algebraic signs must match the chosen current directions and voltage polarities.

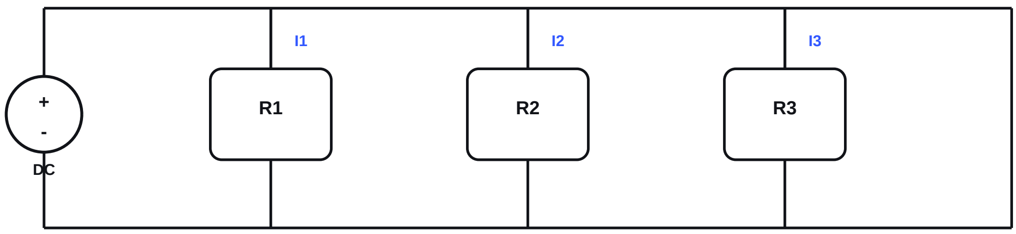
Key relations / checks

- At a node: algebraic sum of currents = 0
- Around a loop: algebraic sum of voltages = 0
- Use one consistent sign convention

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.3 - KIRCHHOFF CURRENT-LAW NODE AND BRANCH CURRENTS VERIFY VALUES BEFORE USE



Measure supply and branch currents; confirm phasor/algebraic sum

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Verify Kirchhoff's current law in the given electrical circuit'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 04

Measure voltage, current and resistance in the given DC circuit

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Measure voltage, current and resistance in the given DC circuit.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO1: Apply the fundamental concepts of electricity, Ohm's law and Joule's law.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The experiment verifies the stated circuit relationship by controlled measurement. Define reference polarities and current directions, use rated components, predict the result before energizing, and compare measured and calculated values using percentage error.

Key relations / checks

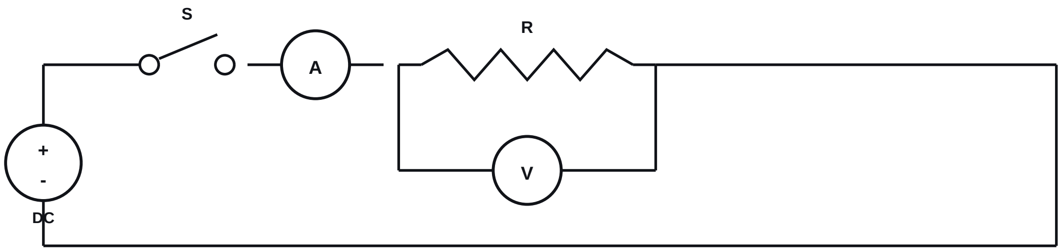
- V = I R
- P = V I = I^2 R = V^2/R
- % error = |measured - calculated| / calculated x 100

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.4 - OHM-LAW / BASIC DC MEASUREMENT CONNECTION

VERIFY VALUES BEFORE USE



Instructor-approved isolated/current-limited supply

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Measure voltage, current and resistance in the given DC circuit'? Answer: ______________________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ______________________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ______________________________
4	What safety step must be completed before changing a connection or configuration? Answer: ______________________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 05

Verify Kirchhoff's voltage law in the given electrical circuit

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Verify Kirchhoff's voltage law in the given electrical circuit.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO2: Solve DC circuits using source transformation, Kirchhoff's laws, resistor simplification, divider rules and star-delta transformations.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Kirchhoff's current law follows charge conservation at a node, while Kirchhoff's voltage law follows energy conservation around a closed loop. Algebraic signs must match the chosen current directions and voltage polarities.

Key relations / checks

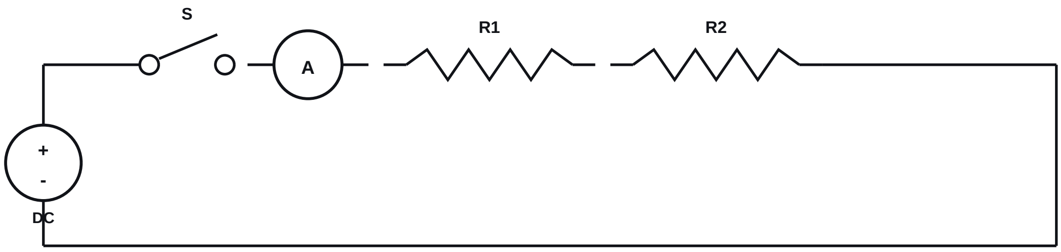
- At a node: algebraic sum of currents = 0
- Around a loop: algebraic sum of voltages = 0
- Use one consistent sign convention

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.5 - KIRCHHOFF VOLTAGE-LAW SINGLE-LOOP CONNECTION

VERIFY VALUES BEFORE USE



Instructor-approved isolated/current-limited supply

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Verify Kirchhoff's voltage law in the given electrical circuit'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 06

Determine equivalent resistance for series connection of resistors

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Determine equivalent resistance for series connection of resistors.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO2: Solve DC circuits using source transformation, Kirchhoff's laws, resistor simplification, divider rules and star-delta transformations.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The experiment verifies the stated circuit relationship by controlled measurement. Define reference polarities and current directions, use rated components, predict the result before energizing, and compare measured and calculated values using percentage error.

Key relations / checks

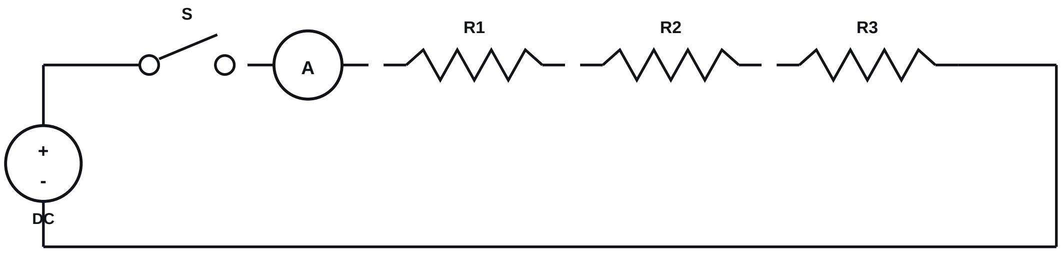
- $V = I R$
- $P = V I = I^2 R = V^2/R$
- % error = |measured - calculated| / calculated x 100

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.6 - SERIES RESISTANCE VERIFICATION

VERIFY VALUES BEFORE USE



Instructor-approved isolated/current-limited supply

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Determine equivalent resistance for series connection of resistors'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 07

Determine equivalent resistance for parallel connection of resistors

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Determine equivalent resistance for parallel connection of resistors.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO2: Solve DC circuits using source transformation, Kirchhoff's laws, resistor simplification, divider rules and star-delta transformations.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The experiment verifies the stated circuit relationship by controlled measurement. Define reference polarities and current directions, use rated components, predict the result before energizing, and compare measured and calculated values using percentage error.

Key relations / checks

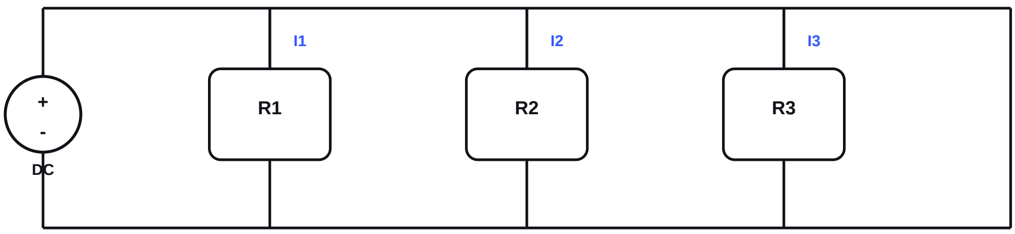
- $V = I R$
- $P = V I = I^2 R = V^2/R$
- % error = |measured - calculated| / calculated x 100

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.7 - PARALLEL RESISTANCE VERIFICATION

VERIFY VALUES BEFORE USE



Measure supply and branch currents; confirm phasor/algebraic sum

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Determine equivalent resistance for parallel connection of resistors'? Answer: ________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ________________
4	What safety step must be completed before changing a connection or configuration? Answer: ________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 08

Verify Superposition theorem and determine current and voltage in each branch

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Verify Superposition theorem and determine current and voltage in each branch.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO3: Analyze linear networks using topology, Superposition, Thevenin, Norton and Maximum Power Transfer theorems.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Network theorems replace or separate linear sources and networks to simplify analysis. The measured load current or voltage should agree with both the original network and the correctly formed equivalent network within component and instrument tolerance.

Key relations / checks

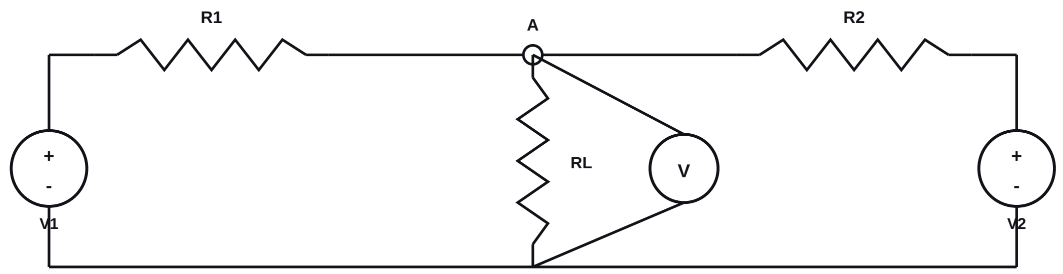
- Superposition: total response = algebraic sum of individual-source responses
- Thevenin: VTH in series with RTH
- Norton: IN in parallel with RN
- Maximum DC power when RL = RTH

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.8 - SUPERPOSITION THEOREM MEASUREMENT NETWORK

VERIFY VALUES BEFORE USE



Measure with V1 only, V2 only, then both sources active

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Verify Superposition theorem and determine current and voltage in each branch'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 09

Verify Thevenin's theorem and determine current and voltage in each branch

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Verify Thevenin's theorem and determine current and voltage in each branch.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO3: Analyze linear networks using topology, Superposition, Thevenin, Norton and Maximum Power Transfer theorems.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Network theorems replace or separate linear sources and networks to simplify analysis. The measured load current or voltage should agree with both the original network and the correctly formed equivalent network within component and instrument tolerance.

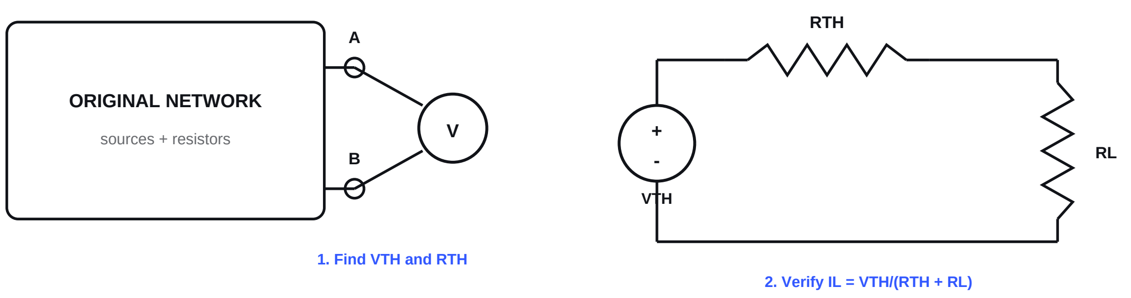
Key relations / checks

- Superposition: total response = algebraic sum of individual-source responses
- Thevenin: VTH in series with RTH
- Norton: IN in parallel with RN
- Maximum DC power when RL = RTH

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.9 - ORIGINAL NETWORK AND THEVENIN EQUIVALENT VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Verify Thevenin's theorem and determine current and voltage in each branch'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 10

Verify Norton's theorem and determine current and voltage in each branch

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Verify Norton's theorem and determine current and voltage in each branch.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO3: Analyze linear networks using topology, Superposition, Thevenin, Norton and Maximum Power Transfer theorems.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Network theorems replace or separate linear sources and networks to simplify analysis. The measured load current or voltage should agree with both the original network and the correctly formed equivalent network within component and instrument tolerance.

Key relations / checks

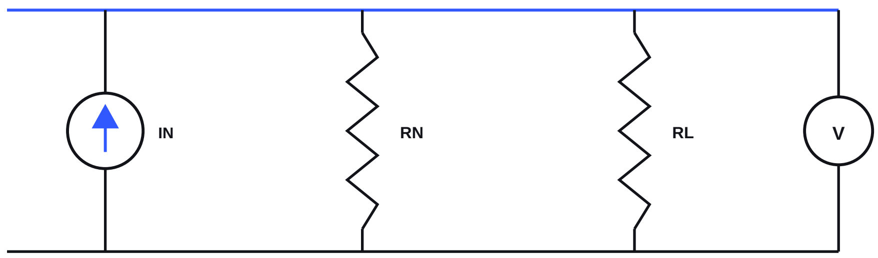
- Superposition: total response = algebraic sum of individual-source responses
- Thevenin: VTH in series with RTH
- Norton: IN in parallel with RN
- Maximum DC power when RL = RTH

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.10 - NORTON EQUIVALENT WITH LOAD

VERIFY VALUES BEFORE USE



RN is measured with independent sources deactivated; RN = RTH

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Verify Norton's theorem and determine current and voltage in each branch'? Answer: ______________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ______________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ______________________
4	What safety step must be completed before changing a connection or configuration? Answer: ______________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 11

Verify Maximum Power Transfer Theorem and determine load resistance for maximum power

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Verify Maximum Power Transfer Theorem and determine load resistance for maximum power.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO3: Analyze linear networks using topology, Superposition, Thevenin, Norton and Maximum Power Transfer theorems.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Network theorems replace or separate linear sources and networks to simplify analysis. The measured load current or voltage should agree with both the original network and the correctly formed equivalent network within component and instrument tolerance.

Key relations / checks

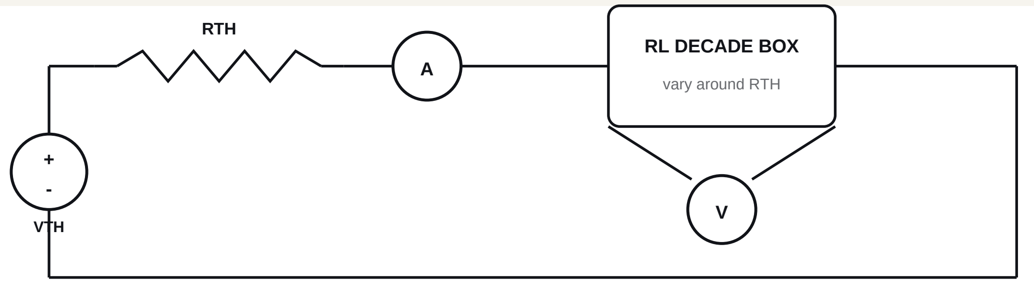
- V = I R
- P = V I = I^2 R = V^2/R
- % error = |measured - calculated| / calculated x 100

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.11 - MAXIMUM-POWER-TRANSFER LOAD TEST

VERIFY VALUES BEFORE USE



For each RL record VL and IL; compute PL = VL x IL and plot PL versus RL

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Verify Maximum Power Transfer Theorem and determine load resistance for maximum power'? Answer: ____
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____
4	What safety step must be completed before changing a connection or configuration? Answer: ____

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 12

Determine equivalent capacitance of series and parallel connected capacitors

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Determine equivalent capacitance of series and parallel connected capacitors.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO4: Explain electrostatics, capacitors, their connections, and RC charging and discharging.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Capacitance combines as the inverse sum in series and directly in parallel. In an RC circuit the capacitor voltage changes exponentially, and one time constant tau = R C corresponds to about 63.2 percent charging or 36.8 percent remaining during discharge.

Key relations / checks

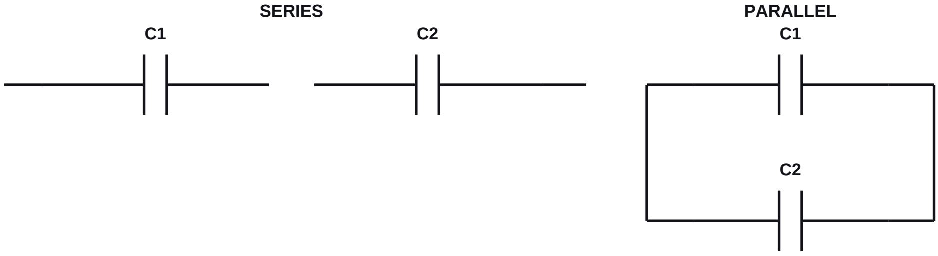
- Parallel: Ceq = C1 + C2 + ...
- Series: 1/Ceq = 1/C1 + 1/C2 + ...
- RC time constant: tau = R C

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.12 - EQUIVALENT CAPACITANCE: SERIES AND PARALLEL

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Determine equivalent capacitance of series and parallel connected capacitors'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 13

Test different types of capacitors

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Test different types of capacitors.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO4: Explain electrostatics, capacitors, their connections, and RC charging and discharging.

E. Practical learning outcomes

1. Identify construction, rating, operating principle and application of the item or system.
2. Record observations in a labelled diagram and comparative technical table.
3. Form a justified conclusion using verified technical evidence.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

This is an identification and engineering-observation exercise. Record construction, ratings, operating principle, application, limitations and safety requirements for every item or system studied. Use nameplate data and current manufacturer or utility information; clearly distinguish observation from inference.

Key relations / checks

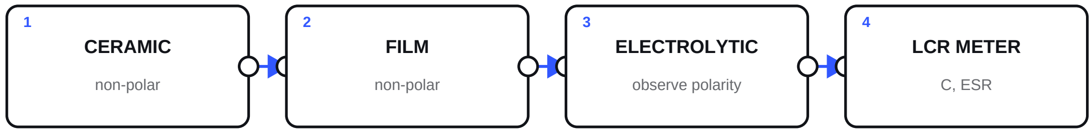
- Parallel: Ceq = C1 + C2 + ...
- Series: 1/Ceq = 1/C1 + 1/C2 + ...
- RC time constant: tau = R C

H. Experimental setup / drawing

Study the labelled constructional, single-line or system diagram below and add the verified ratings, terminal designations and functional details for the item observed.

FIG. H.13 - CAPACITOR TYPE IDENTIFICATION AND TEST

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Collect only instructor-approved de-energized samples, models, data sheets or trainer modules.
2. Read markings and nameplate information; record type, material, rating, construction and relevant standard symbol.
3. Inspect each item and identify terminals or functional parts without dismantling sealed or energized equipment.
4. Explain the operating principle and match each type to a suitable application.
5. Compare advantages, limitations, failure modes and safe handling requirements in the observation table.
6. Have the instructor verify the identification and record the final conclusion.

L. Observations and calculations

Record verified ratings and constructional observations. Identify the source of any information not obtained directly from the sample or site.

Item / parameter	Rating / value	Construction / principle	Application	Remarks

LABELLED SKETCH / SINGLE-LINE DIAGRAM / COMPARATIVE NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Test different types of capacitors'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 14

Measure capacitor charging and discharging time and verify the RC time constant

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Measure capacitor charging and discharging time and verify the RC time constant.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO4: Explain electrostatics, capacitors, their connections, and RC charging and discharging.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Capacitance combines as the inverse sum in series and directly in parallel. In an RC circuit the capacitor voltage changes exponentially, and one time constant tau = R C corresponds to about 63.2 percent charging or 36.8 percent remaining during discharge.

Key relations / checks

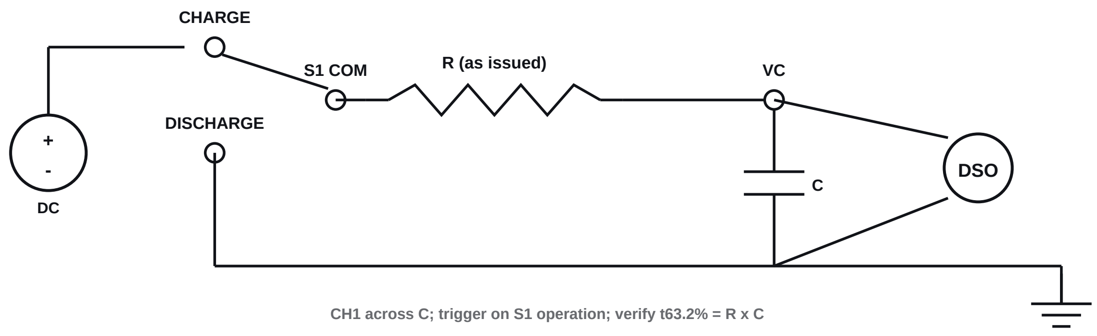
- Parallel: Ceq = C1 + C2 + ...
- Series: 1/Ceq = 1/C1 + 1/C2 + ...
- RC time constant: tau = R C

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.14 - RC CHARGING/DISCHARGING CONNECTION WITH DSO

VERIFY VALUES BEFORE USE



CH1 across C; trigger on S1 operation; verify t63.2% = R x C

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Measure capacitor charging and discharging time and verify the RC time constant'? Answer: ______________________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ______________________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ______________________________
4	What safety step must be completed before changing a connection or configuration? Answer: ______________________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 15

Test different types of inductors

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Test different types of inductors.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO5: Explain magnetic circuits, electromagnetic induction, inductance and inductor connections.

E. Practical learning outcomes

1. Identify construction, rating, operating principle and application of the item or system.
2. Record observations in a labelled diagram and comparative technical table.
3. Form a justified conclusion using verified technical evidence.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

This is an identification and engineering-observation exercise. Record construction, ratings, operating principle, application, limitations and safety requirements for every item or system studied. Use nameplate data and current manufacturer or utility information; clearly distinguish observation from inference.

Key relations / checks

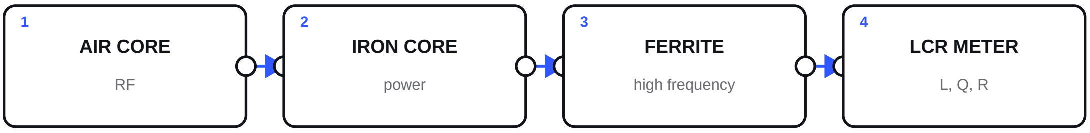
- e = -N d(phi)/dt
- v = L di/dt
- Inductive reactance XL = 2 pi f L

H. Experimental setup / drawing

Study the labelled constructional, single-line or system diagram below and add the verified ratings, terminal designations and functional details for the item observed.

FIG. H.15 - INDUCTOR TYPE IDENTIFICATION AND TEST

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Collect only instructor-approved de-energized samples, models, data sheets or trainer modules.
2. Read markings and nameplate information; record type, material, rating, construction and relevant standard symbol.
3. Inspect each item and identify terminals or functional parts without dismantling sealed or energized equipment.
4. Explain the operating principle and match each type to a suitable application.
5. Compare advantages, limitations, failure modes and safe handling requirements in the observation table.
6. Have the instructor verify the identification and record the final conclusion.

L. Observations and calculations

Record verified ratings and constructional observations. Identify the source of any information not obtained directly from the sample or site.

Item / parameter	Rating / value	Construction / principle	Application	Remarks

LABELLED SKETCH / SINGLE-LINE DIAGRAM / COMPARATIVE NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Test different types of inductors'? Answer: ______________________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ______________________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ______________________________
4	What safety step must be completed before changing a connection or configuration? Answer: ______________________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 16

Demonstrate Faraday's law of electromagnetic induction

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Demonstrate Faraday's law of electromagnetic induction.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO5: Explain magnetic circuits, electromagnetic induction, inductance and inductor connections.

E. Practical learning outcomes

1. Identify construction, rating, operating principle and application of the item or system.
2. Record observations in a labelled diagram and comparative technical table.
3. Form a justified conclusion using verified technical evidence.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

This is an identification and engineering-observation exercise. Record construction, ratings, operating principle, application, limitations and safety requirements for every item or system studied. Use nameplate data and current manufacturer or utility information; clearly distinguish observation from inference.

Key relations / checks

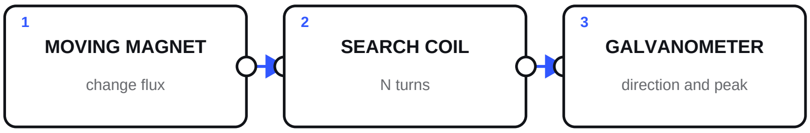
- e = -N d(phi)/dt
- v = L di/dt
- Inductive reactance XL = 2 pi f L

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.16 - FARADAY-LAW DEMONSTRATION

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Collect only instructor-approved de-energized samples, models, data sheets or trainer modules.
2. Read markings and nameplate information; record type, material, rating, construction and relevant standard symbol.
3. Inspect each item and identify terminals or functional parts without dismantling sealed or energized equipment.
4. Explain the operating principle and match each type to a suitable application.
5. Compare advantages, limitations, failure modes and safe handling requirements in the observation table.
6. Have the instructor verify the identification and record the final conclusion.

L. Observations and calculations

Record verified ratings and constructional observations. Identify the source of any information not obtained directly from the sample or site.

Item / parameter	Rating / value	Construction / principle	Application	Remarks

LABELLED SKETCH / SINGLE-LINE DIAGRAM / COMPARATIVE NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Demonstrate Faraday's law of electromagnetic induction'? Answer: ____________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ____________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ____________________
4	What safety step must be completed before changing a connection or configuration? Answer: ____________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 17

Measure inductance of an inductor or choke coil using an LCR meter

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Measure inductance of an inductor or choke coil using an LCR meter.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Analyze and test DC electrical circuits using standard instruments, circuit laws and network theorems.

D. Expected course outcome

CO5: Explain magnetic circuits, electromagnetic induction, inductance and inductor connections.

E. Practical learning outcomes

1. Prepare the circuit, select suitable ranges and predict the expected response.
2. Perform controlled measurements safely and record readings with correct units.
3. Compare measured and calculated results and explain the observed difference.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

Inductance opposes change in current. Faraday's law relates induced emf to the rate of change of magnetic flux linkage. Polarity follows Lenz's law, and stored magnetic energy is proportional to L I squared.

Key relations / checks

- e = -N d(phi)/dt
- v = L di/dt
- Inductive reactance XL = 2 pi f L

H. Experimental setup / drawing

Study the experimental circuit below. Enter the component values, instrument ranges, terminal polarity and protection used in your laboratory, then obtain instructor approval before connection.

FIG. H.17 - INDUCTANCE MEASUREMENT VERIFY VALUES BEFORE USE

Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
Regulated DC source	0-30 V, current limited	1
DMM / meters	Suitable ranges	1 set
Trainer / breadboard	Instructor approved	1
Components	As per circuit and ratings	As req.
Leads and PPE	Inspected	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Keep exposed live parts guarded and use only the approved laboratory supply.

K. Procedure

1. Study the circuit or connection diagram, predict the expected result, and select instruments with suitable ranges.
2. Keep the supply OFF. Inspect leads and components, set controls to minimum, and make the circuit exactly as shown.
3. Ask the instructor to verify connections, polarity, earthing, instrument range and component ratings before energizing.
4. Switch ON using an isolated/current-limited source. Increase the input gradually and watch for abnormal heating or readings.
5. Take at least five sets of stable readings over the safe operating range and record units immediately.
6. Switch OFF before changing any connection. Repeat only the approved changes required by the experiment.
7. Calculate theoretical values and percentage error, plot the required characteristic where applicable, and state the result.

L. Observations and calculations

Record instrument ranges and least counts. Enter observed readings first, then calculated values. Do not replace actual readings with expected values.

Trial	Applied value	Measured value 1	Measured value 2	Calculated result

SAMPLE CALCULATION WITH UNITS AND PERCENTAGE ERROR

GRAPH / PHASOR / CHARACTERISTIC / ADDITIONAL READINGS

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Measure inductance of an inductor or choke coil using an LCR meter'? Answer: ______________________
2	Why was the selected instrument range, component rating or data source suitable? Answer: ______________________
3	Which two errors or uncertainties have the greatest effect on this result? Answer: ______________________
4	What safety step must be completed before changing a connection or configuration? Answer: ______________________

P. References and suggestions

1. B. L. Theraja, Basic Electrical Engineering
2. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering
3. Current GTU syllabus DI01C00081 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
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Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

Final submission checklist

1. Every practical has a date, mapped outcome, actual readings or evidence, calculations and a signed conclusion.
2. Circuit diagrams, programs, graphs, estimates, reports and test sheets are attached where required.
3. Instrument ranges, component ratings, source dates and safety precautions are recorded.
4. Technical sources are acknowledged and all assumptions are stated.
5. Faculty feedback and required corrections have been completed.

FACULTY REMARKS