Lab Manual

OF

APPLIED PHYSICS – II

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DEPARTMENT OF BASIC SCIENCE

& HUMANITIES

C.V RAMAN POLYTECHNIC

BHUBANESWAR

Practical 1 - Cantilever

P1.1 Practical Statement

To determine and verify the Time period of a cantilever.

P1.2 Practical Significance

Cantilever is beam, in which the length is very large as compare to its width. It is common structure in buildings and bridges which has single support. Bending of beam with mass loaded on free end depends on the elasticity of material of beam and moment of inertia of beam. The cantilever also vibrates with natural frequency, if displacement is introduced on free end. This experiment helps to find the Frequency of cantilever and elasticity of material of cantilever.

P1.3 Relevant Theory

Refer: Section 1.2.3 of Unit 1

P1.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

Pr O1: Determine the Time period of a given cantilever.

Pr O2 : Determine the Young's modulus

P1.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

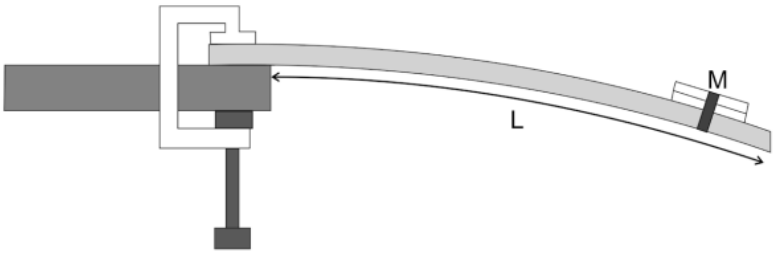


Fig P1.1

P1.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
	Clamp, Stopwatch, Cantilever beam	01			
	Slotted masses	5 no.			

P1.7 Precautions

1. Load mass on a cantilever gradually.
2. Displace cantilever carefully such that oscillations are in one direction.
3. Displace cantilever with small amplitude.
4. Add mass of pan for calculations if any.

P1.8 Suggested Procedure

1. Set the cantilever, fixed one end and add mass hanger on free end
2. Add mass ($m_1 = 50$) grams on free end.
3. Give little displacement at free end.
4. Start stop watch and measure time for 20 Oscillations to measure time period.
5. Repeat the process two times with same mass.
6. Add 50 grams mass and measure time period.
7. Plot graph between square of time period v/s mass for further calculations.

P1.9 Observations and Calculations

Length of cantilever (L) = ...m
Width of cantilever (w) = ...m
Thickness of cantilever (t) = ...m

Sr. No	Mass on Free end	Time for Twenty Oscillations (sec)			Time period ($T = t_{mean}/20$)	T^2
		t_1	t_2	$t_{mean} = (t_1 + t_2)/2$		
1						
2						
3						
4						
5						

Plot graph between T^2 v/s mass

Slope of graph:

$$k = 4\pi^2 / slope$$

For rectangular cantilever, $$Y = k\,4L^3 / w\,t^3$$

P1.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P1.11Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P1.12 Practical related Questions

(Use separate sheet for answer)

Note : Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Predict the change in time period of cantilever oscillator with material?
2. For the given practical setup find the maximum amplitude, so that oscillations will remain SHM?
3. Predict the change in time period if the length of cantilever is halved.
4. Give reasons for measuring the time taken for twenty oscillations, for determination of time period.
5. Give the sources of errors in the present experiment.

P1.13 Suggested Learning Resources

- https://vlab.amrita.edu/?sub=3&brch=175&sim=1078&cnt=1

P1.14 Suggested Assessment Scheme

(to be filled by teacher)

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

Practical 2 - Ultrasonic Interferometer

P2.1 Practical Statement

To determine velocity of ultrasonic in different liquids using ultrasonic interferometer.

P2.2 Practical Significance

Ultrasonic waves have numbers of medical and engineering applications. As ultrasonic have high frequency and shorter wavelength as compare to sonic waves, it can move larger distance with less attenuation as compared to sonics waves. The velocity of waves is different in different medium. This experiment will help students to measure the velocity of ultrasonic waves in different liquids.

P2.3 Relevant Theory

The velocity (v) of ultrasonic waves in a liquid is given by

$$v = \upsilon\lambda \qquad \ldots(1)$$

Where, υ is the frequency and

λ is the wavelength and of the ultrasonic waves in the liquid.

P2.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Use ultrasonic interferometer to determine the velocity of ultrasonic waves in a given liquid.

P2.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

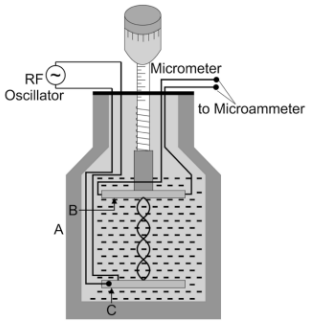


Fig P2.1

Ultrasonic interferometer set up, consist of rf generator, vessel, micrometer and current meter. The liquid (may be distilled water) in which the velocity of ultrasonic waves is to be determined is filled in a vessel (A). Two quartz crystal, (B) and (C) are placed in liquid, C is placed at the bottom of a vessel (A) and (B) is placed above (C) such that B and C are parallel inside the liquid. The crystal (B) is movable. The quartz crystal (C) is given RF oscillation of its natural frequency from external RF Oscillator. Due to piezoelectric effect ultrasonic wave generated by the crystal (C), which moves up in liquid in the vessel. This ultrasonic wave is reflected from crystal B. The position of the crystal B is changed with micrometer screw arrangement, such that stationary waves are formed inside the liquid column due to the superposition of the incident waves from C and the reflected waves from B. Maximum energy is transfer to B when stationary waves are formed. Again, due to piezoelectric effect, maximum voltage is generated along the ends of crystal B which are perpendicular to the vibrations and maximum anode current flows in external circuit, which can be measured by external ammeter. When the position B is again changed, then at some other position, the anode current is again have maximum value. The distance (d) between two consecutive positions of maximum anode current is half of the wavelength.

$$d = \lambda / 2$$

$$v = 2d\upsilon \qquad \ldots(2)$$

υ is in Hz and d is in m, v is obtained in m/s.

P2.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Ultrasonic interferometer set up consists of rf oscillator, Quarts crystal, ammeter, micrometer screw gauge.				
2	Liquid (Distilled water)				

P2.7 Precautions

1. The length and vessel should be much larger than the wavelength of the ultrasonic waves in the liquid.
2. The temperature of the liquid should remain constant during the experiment.
3. Rotate the micrometer screw always in one direction to avoid the back-lash error.

P2.8 Suggested Procedure

1. Set up the apparatus as shown in Fig. P2.1
2. Keep the position the reflecting crystal B at a convenient height from C inside the liquid.
3. Note the reading of the micrometer.
4. Switch on the RF power oscillator and adjust its frequency to the natural frequency of the crystal C (given as per apparatus specifications). In some apparatus it is already set.
5. Decrease the height of B slowly.
6. Observe the reading of the ac microammeter.
7. Note the micrometer reading when the microammeter shows maximum value (x_1).
8. Repeat the step 5 -7 for five times and note position of maximum current as x_2, x_3 ...
9. The difference between x_1-x_2, x_2-x_3,.....is half of wavelength.
10. Calculate velocity of ultrasonic wave from formula

P2.9 Observations and Calculations

Frequency of rf oscillator = ... Hz least count of micrometer = ... mm

Sr. No	Micrometer reading x (cm)			d (cm)
	Circular scale reading	Main scale reading	Total reading	
1			x_1	$x_1 - x_2 =$
2			x_2	$x_3 - x_2 =$
3			x_3	$x_4 - x_3 =$
4			x_4	...

Mean d = ...

$v = \upsilon \times 2\,d$

P2.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P2.11Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P2.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give reasons for taking length of vessel more than the wavelength of ultrasonic waves.
2. Can this experiment be performed by using any other liquid also?
3. Give the sources of errors in present experiment.
4. Suggest method to minimize error.

P2.13 Suggested Learning Resources

- https://vlab.amrita.edu/?sub=1&brch=201&sim=803&cnt=4

Practical 3 - Laws of reflection

P3.1Practical Statement

To verify laws of reflection from a plane mirror/interface

P3.2 Practical Significance

Reflection phenomena shown by light rays has numerous examples and applications in daily life, such as image formation in plane mirror, convex mirror, periscope, telescope and microscope. This experiment will help learner to observe the phenomena of reflection from experimental point of view and measure the angles incidence and reflection.

P3.3 Relevant Theory

Refer Section : 2.1.1 of this unit

P3.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:
PrO1: Measure the angle of incidence and reflection in reflection phenomena

P3.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

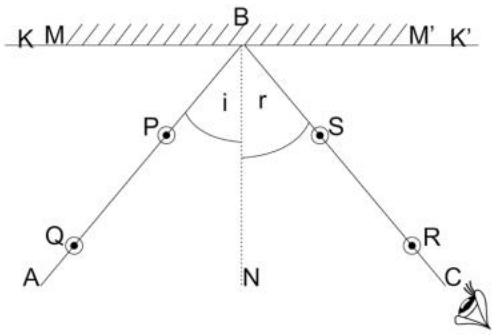


Fig P3.1

P3.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
	Soft board, white sheet of paper, pins, push pins, plane mirror, pencil, protractor and ruler				

P3.7 Precautions

1. Plane mirror should be hold vertical throughout the experiment.
2. Pins used as object and for image tracing should be placed vertical.

P3.8 Suggested Procedure

1. Fix A4/A3 size white paper on the board.
2. Draw two perpendicular line on paper (KK' and BN).
3. Place the mirror vertically on line, KK'. (The perpendicular BN to this line is normal)
4. Draw a line (AB) making angle 30^0 (= i) with normal.
5. Place two pins, P and Q at distance of 2 cm on line AB
6. Place two other pins R and S on other side of normal in such a way that pins R, S and images of P and Q lie on the same line and there is no parallax between pins and images.

P3.7 Precautions

1. Plane mirror should be hold vertical throughout the experiment.
2. Pins used as object and for image tracing should be placed vertical.

P3.8 Suggested Procedure

1. Fix A4/A3 size white paper on the board.
2. Draw two perpendicular line on paper (KK' and BN).
3. Place the mirror vertically on line, KK'. (The perpendicular BN to this line is normal)
4. Draw a line (AB) making angle 30^0 (= i) with normal.
5. Place two pins, P and Q at distance of 2 cm on line AB
6. Place two other pins R and S on other side of normal in such a way that pins R, S and images of P and Q lie on the same line and there is no parallax between pins and images.
7. Remove pins R and S and join the dots with a straight line.
8. Measure and record angle of reflection r.
9. Repeat procedure 4, 5, 6 and 8 for angles i = 35^0, 40^0, 45^0 and 50^0
10. Record the results in a table.

P3.9 Observations and Calculations

Sr. No	Angle ABN	Angle CBN
1		
2		
3		
4		
5		
6		

P3.10 Results and/or Interpretation

(to be filled by student)

1. .....

P3.11Conclusions and/or Validation

(to be filled by student)

1. .....

P3.12 Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give the least count of the protractor used in experiment?
2. Is the size of pin and its image is same?
3. If we keep the pins on normal, then the image will be formed at which position?
4. Give the reasons for error in experiments.

P3.13 Suggested Learning Resources

- https://phet.colorado.edu/en/simulation/bending-light
- https://www.youtube.com/watch?v=QZFfm05ZOek

Practical 4 - Laws of Refraction

P4.1 Practical Statement

To verify laws of refraction (Snell's law) using a glass slab.

P4.2 Practical Significance

Refraction phenomena shown by light rays when passes through optically transparent medium has numerous examples and applications in daily life such as image formation in convex lens, concave lens, prism and optical instruments. This experiment will help learner to observe the phenomena of refraction from experimental point of view and measure the angles incidence and refraction.

P4.3 Relevant Theory

Refer section : 2.1.2 of this unit

P4.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:
PrO1: Measure the angle of incidence and refraction in refraction phenomena

P4.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

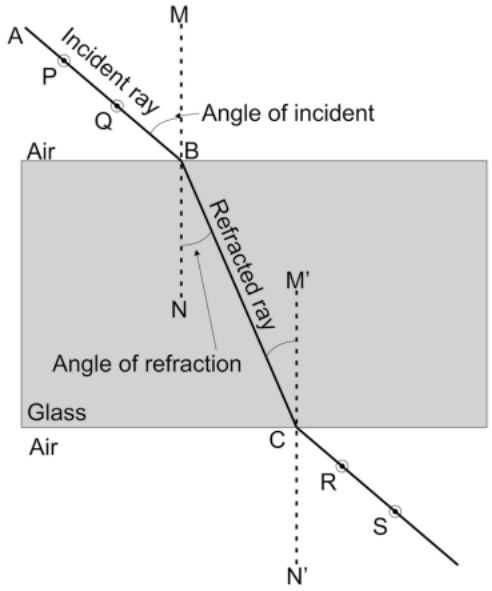


Fig P4.1

P4.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
	Soft board, white sheet of paper, pins, push pins, plane mirror, pencil, protractor and ruler				

P4.7 Precautions

1. Plane mirror should be hold vertical throughout the experiment.
2. Pins used as object and for image tracing should be placed vertical.

P4.8 Suggested Procedure

1. Fix A4/A3 size white paper on the board.
2. Place the rectangular glass slab at center of paper and trace its edges.
3. Remove the glass slab.
4. Draw a normal to any one side of rectangle drawn by tracing edges of glass slab (MN).
5. Draw a line (AB) making an angle 30^0 (= i) with normal.
6. Place the glass slab again.
7. Place two pins, P and Q at distance of 5 cm on line AB.
8. See the image of these two pins from the opposite side of glass slab.
9. Place two other pins R and S on other side of glass slab such that they are in line with the images of P and Q
10. Remove the glass slab.
11. Remove pins R and S and join the dots with a straight line touching the rectangle at C.
12. Draw a normal at point(M' N') C and join point B and C.
13. Measure and record angle of refraction ∠ r i.e angle NBC.
14. Repeat procedure 5 to 13 for angles ∠ i = 35^0, 40^0, 45^0 and 50^0
15. Record the results in a table.

P4.9 Observations and Calculations

Sr. No	∠ ABM (angle of incidence)	∠ CBN (angle of refraction)
1		
2		
3		
4		
5		
6		

P4.10 Results and/or Interpretation

(to be filled by student)

1. .....

P4.11 Conclusions and/or Validation

(to be filled by student)

1. .....

P4.12 Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give the least count of the protractor used in experiment?
2. If we replace glass slab with water, predict the change in angle of refraction?
3. Is emergent ray is parallel to incident ray, if yes give reasons.?
4. Can we do this experiment without protractor?

P4.13 Suggested Learning Resources

- http://cdac.olabs.edu.in/?sub=74&brch=9&sim=37&cnt=1

Practical 5 - Convex lens

P5.1 Practical Statement

To determine focal length and magnifying power of convex lens.

P5.2 Practical Significance

Conve2x lenses are commonly used in eyeglasses for correcting hypermetropia / farsightedness and for image formation in microscope and telescope. The power of convex lens depends on its focal length. This experiment will help learner to use convex lens for image formation and find its focal length.

P5.3 Relevant Theory

Refer Section : Table 2.3 and 2.1.5 of this unit

P5.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Determine the focal length and magnifying power of a given convex lens.

P5.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

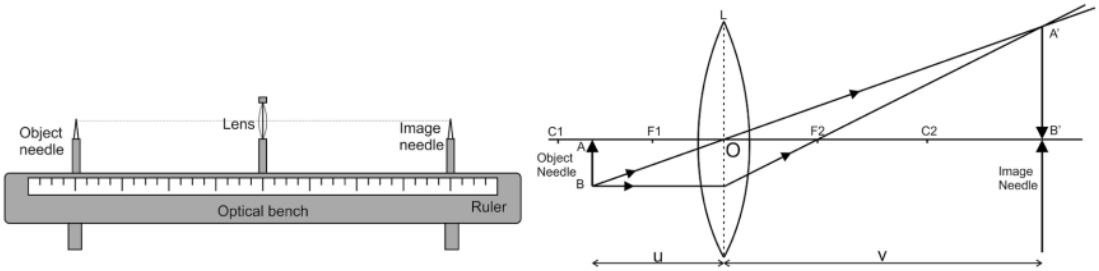


Fig P5.1

P5.6 Resources Require

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Re-marks (if any)
			Make	Details	
	Optical bench, Uprights, a convex lens, lens holder, optical needle and a meter scale.				

P5.7 Precautions

1. Tips of the object needle, image needle and center of the lens should lie at the same height.
2. Parallax should be removed before taking reading.
3. Placement of object needle should be such that experiment is performed for real images only.
4. Apply index correction in measurements.

P5.8 Suggested Procedure

1. Measure the rough focal length of convex lens by observing the image of distant object on plain paper.
2. Keep fixed upright at the center of optical bench.
3. Fix the lens holder with lens in fixed upright.
4. Adjust the lens so it is vertical and perpendicular to the length of the optical bench.
5. Mount a thin optical needle (object needle) in a movable upright.
6. Mount the thick optical needle (image needle) in a movable upright on the other side of lens on the optical bench.
7. Adjust the height of the image needle in line with the optical center of the lens.
8. Put a knitting needle of known distance between the lens and object needle tip.
9. Measure the distance between the object needle and lens from the index at the base of upright.
10. Put knitting needle between the lens and image needle tip.
11. Measure the distance between the image needle and lens from index.
12. Measure index correction from steps 8 to 11 (index correction means to measuring actual distance).
13. Fix the object needle upright at a distance nearly 1.5 times the rough focal length of the lens (fix u).
14. Set the height of the object needle in line with the optical center of the lens.
15. Note the position of object needle upright from the index marked on the base of the upright.
16. Observe the inverted image of object needle from the other side (tip of image of object needle in line with tip of image needle)
17. Move eye right or left. If the tips of image and image needle separates (due to parallax), then
18. Change the distance of image needle, until the parallax removed.
19. Note this position of image needle (find v).
20. Change the position of object needle by 1 to 2 cm.
21. Repeat the steps 11 to 14.
22. Find v for at least five different values of u
23. Plot graph between -u (as x) and v (as y) in second quadrant (rectangular hyperbola).
24. Draw a line making 45^0 angle with x or y axis.
25. Note the coordinates of point at which the line intersects the hyperbola.
26. Calculate the focal length of convex lens.
27. Calculate the magnifying power of lens using formula, m = 25/f

P5.9 Observations and Calculations

Length of knitting needle x = …. cm

Distance between the object needle and the lens, when knitting needle is placed between them y = ...cm

Distance between the image needle and the lens, when knitting needle is placed between them z = ...cm

Index correction for the object distance u, x – y = ...cm

Index correction for the image distance v, x – z = ...cm

Index reading of lens upright, F = ...cm

Sr. No	Reading of		Observed Distance (cm)		Actual Distance [(cm) (after sub-tracting index correction)]	
	Object needle (O)	Image needle (I)	u = F – O	v = I – F	u	v
1						
2						
3						
4						
5						
6						

f = (coordinate of point of intersection of line and hyperbola)/2

f = ……cm and m = 25/f

P5.10 Results and/or Interpretation

(to be filled by student)

1. .....

P5.11 Conclusions and/or Validation

(to be filled by student)

1. .....

P5.12 Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Describe the change in parallax when the object needle is moved in either side from its position?
2. Give the source of index error.
3. Can we take Convex lens of 40 cm in the present experiment?

P5.13 Suggested learning resources

- https://phet.colorado.edu/en/simulations/bending-light

Practical 6 - Ohm's law

P6.1 Practical Statement

To verify Ohm's law by plotting graph between current and potential difference.

P6.2 Practical Significance

Measurement of electric current, voltage and resistance in a given electrical circuit is an essential requirement for diploma engineers of every branch. Ohm's law helps to design electrical circuits and this experiment helps to find the relation between voltage, current and resistance of a given electrical circuit.

P6.3 Relevant Theory

Refer: Section 4.10 of this unit

P6.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Use Ohm's law to find current, voltage and resistance of given circuit.

P6.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

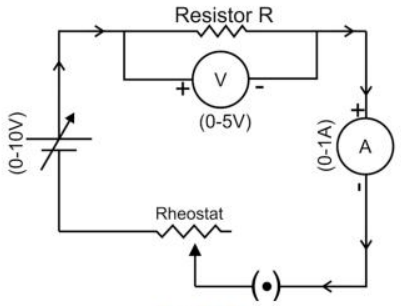


Fig P6.1

P6.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
	Variable DC Power supply 0-10 V	01			
	Ammeter 0-1 A, Voltmeter 0- 10 V	01			
	Rheostat 500 Ohm	01			
	Key	01			
	Resistance Wire 1 meter Nichrome	01			

P6.7 Precautions

1. Connections should be tight.
2. All the components should be placed such that they can be properly connected.
3. The pointer of ammeter/voltmeter should coincide with zero mark.
4. Check the power supply before connection.
5. Check connection with the help of teacher.
6. Connect ammeter in series and voltmeter in parallel.
7. The key should be inserted only while taking readings.

P6.8 Suggested Procedure

1. Make connections as per circuit diagram in Fig. P6.1.
2. Note the LC and range of Ammeter and voltmeter.
3. Switch on power supply and close key.

4. Keep the position of rheostat at maximum resistance.
5. Note the reading of ammeter and voltmeter.
6. Change the position of variable arm of rheostat gradually.
7. Note the corresponding change in reading of ammeter and voltmeter.
8. Repeat the step from 6 to 7 eight times.
9. Plot the graph between electric current (I) along X-axis and voltage (V) along Y-axis.
10. Plot graph and find the slope of line.

P6.9 Observations and Calculations

Least count of ammeter = ... Range of ammeter = ...

Least count of voltmeter = ... Range of voltmeter = ...

Sr. No	I (Ampere)	V- (Volts)	R = V/I

Mean R = ...

Slope of graph : .....

P6.10 Results and/or Interpretation

(to be filled by student)

1. .....

P6.11 Conclusions and/or Validation

(to be filled by student)

1. .....

P6.12 Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give least count of ammeter and voltmeter used in experiment.
2. Give reasons to connect voltmeter in parallel to resistance wire.
3. Give reasons to keep rheostat at maximum resistance.
4. Is the resistance of wire and circuit remains constant through out the experiment?

P6.13 Suggested Learning Resources

- amrita.olabs.edu.in/?sub=1&brch=6&sim=22&cnt=2

Practical 7 - Series and parallel combination of Resistances

P7.1 Practical Statement

To verify laws of resistances in series and parallel combination.

P7.2 Practical Significance

Series and parallel circuit connections are employed in electrical equipment. Current controlling devices and fuses are connected in series with a voltage source. Use of parallel circuits is found in lighting fixtures in our house hold. The applications of series and parallel circuits connection can be evidently seen in our homes and industry. In this experiment, resistive wires are connected in series & parallel and equivalent resistance of circuit is determined using ohm's law.

P7.3 Relevant Theory

Refer: Section 4.7 and 4.10 of this unit

P7.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Use the principle of series and parallel combination of resistances in solving a given circuit problem.

P7.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

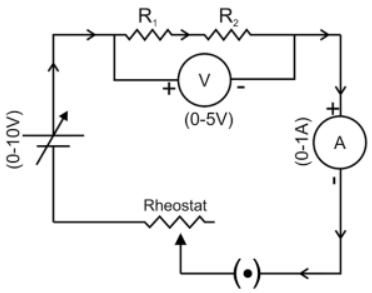


Fig P7.1

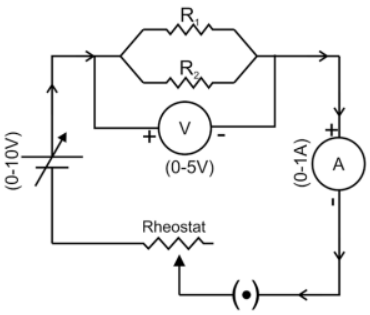


Fig P7.2

P7.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Re-marks (if any)
			Make	Details	
1	Variable DC Power supply (0-10 V), Voltmeter 0- 10 V, Rheostat 500 Ohm, Key, Ammeter 0-1 A	01			
2	Resistance Wire (length 1 meter, Nichrome)	2			

P7.7 Precautions

1. Connections should be tight.
2. All the component should be placed such that they can be properly connected.
3. The pointer of ammeter/voltmeter should coincide with zero mark.
4. Check the power supply before connection.
5. Check connection with the help of teacher.
6. Connect ammeter in series and voltmeter in parallel.
7. The key should be inserted only while taking readings.

P7.8 Suggested Procedure

1. Connect the circuit according to the circuit diagram (Fig. P7.1) with R_1 only.
2. Vary current in the circuit using rheostat.
3. Record the observations from voltmeter and ammeter in equal intervals.
4. Take five observations.
5. Calculate the resistance of given wire by ohm's law as per the formula.
6. Find mean resistance R_1.
7. Repeat the steps 1 to 6 to calculate resistance R_2.
8. Connect the two resistances R_1 and R_2 in series combination as per the circuit diagram (Fig. P7.1).
9. Repeat the steps 2 to 6 to calculate equivalent resistance R_s by experiment.
10. Calculate equivalent resistance R_s by theory using formula.
11. Connect two resistances R_1 and R_2 in parallel combination as per the circuit diagram (Fig. P7.2).
12. Repeat the steps 2 to 6 to calculate equivalent resistance R_p by experiment.
13. Calculate equivalent resistance R_p by theory using formula.

P7.9 Observations and Calculations

Least count of ammeter = ... Range of ammeter = ...

Least count of voltmeter = ... Range of voltmeter = ...

Table 1: For R_1 and R_2

Sr. No	I (ampere)	V- (volts)	R_1= V/I	I (ampere)	V- (volts)	R_2= V/I
1						
2						
3						
4						

Mean R_1 = ... Mean R_2 = ...

Table 2: For series and parallel combinations R_1 and R_2

	Series Combination			Parallel Combination		
Sr. No	**I (ampere)**	**V- (volts)**	**R_1= V/I**	**I (ampere)**	**V- (volts)**	**R_2= V/I**
1						
2						
3						
4						
5						

R_s by Theory = $R_1 + R_2$ = ...; Rs by experiment (from Table 2) = ...

R_p by Theory = $R_1 \times R_2/(R_1 + R_2)$ = ...; Rp by experiment (from Table 2) = ...

P7.10 Results and/or Interpretation

(to be filled by student)

1. .....

P7.11 Conclusions and/or Validation

(to be filled by student)

.....

P7.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give least count of ammeter and voltmeter used in experiment.
2. Give reasons to connect voltmeter in parallel to resistance wire.
3. Give reasons to keep rheostat at maximum position in the beginning of experiment.
4. Is the resistance of wire and circuit remains constant through out the experiment?

P7.13 Suggested Learning Resources

- amrita.olabs.edu.in/?sub=1&brch=5&sim=168&cnt=2
- https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc-virtual-lab

Practical 8 - AC mains

P8.1 Practical Statement

To find the frequency of AC main using electrical vibrator

P8.2 Practical Significance

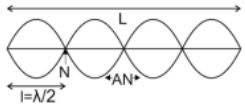
House hold electrical circuits are supplied with AC mains of 220 Volts and 50 Hz. In AC currents magnitude and direction of current changes with time. This experiment helps to find the frequency of AC mains and also demonstrate formation of standing waves, variation of velocity of mechanical waves with tension on string and resonance phenomenon.

P8.3 Relevant Theory

When a string of mass per unit length 'm' is connected to the vibrating rod of the electrical vibrator (supplied with AC mains) and stretch with tension T, the string vibrates in segments. The frequency of the stretched string is the same as of the vibrating rod, which is vibrating with the frequency of AC mains. Then if 'l' is the length of one loop of this vibrating string, its frequency of vibration is given by

$$f = \frac{1}{2l}\sqrt{\frac{T}{m}}$$

Where, T (tension in the string) = Mg, M = Total mass (mass of the pan + mass placed on pan), l = length of one loop, g = acceleration due to gravity and m = mass per unit length of the string.



Formation of standing waves

P8.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Determine the frequency of AC mains using electrical vibrator.

P8.5 PRACTICAL SETUP (DRAWING/SKETCH/CIRCUIT DIAGRAM/WORK SITUATION)

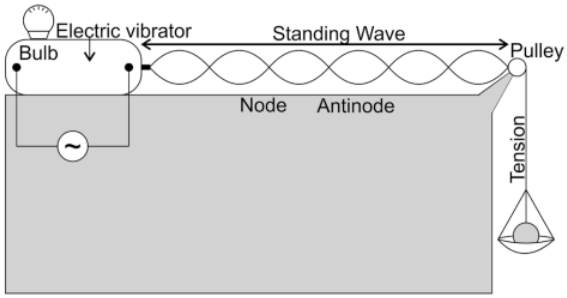


Fig P8.1

P8.6 RESOURCES REQUIRED

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
	Electrical Vibrator, String, Pan, weight box, a stand with clamp and pulley and meter scale.	01 each			

P8.7 Precautions

1. Load mass on a pan gradually.
2. The string should be uniform.
3. Measurement should be taken, when the amplitude of the loops is maximum.
4. Add mass of pan for calculations if any.

P8.8 Suggested Procedure

1. Switch on vibrator by connecting plug to AC mains.
2. Add some weight on pan say 20 grams.
3. Adjust the length of the string to get loops (4 or 5).
4. Set the length for maximum amplitude.
5. Note no. of loops and mass on the pan and length of the string.
6. Repeat the same adjustment for different mass and no. of loops.
7. Calculate the frequency of AC mains '*f*'.

P8.9 Observations and Calculations

Mass of Pan =.....grams, Mass per unit length of string =.....

Sr. No	No. of loops *(n)*	Length of String (L)	Length of one loop (l = L/n)	Mass on Pan	Tension (T = Mg)
1					
2					
3					
4					
5					

Frequency of A.C. mains = ...

Mean = ...

P8.10 Results and/or Interpretation

(to be filled by student)

1. .....

P8.11 Conclusions and/or Validation

(to be filled by student)

1. .....

P8.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions to ensure the achievement of pre-defined course outcomes.

1. Give reasons for formation of loops?
2. At the pulley end, whether node or antinode is formed? Give reasons.
3. Predict the change in the formation of loops if the mass per length of string is increased.
4. Predict the type of waves on string in this experiment with reasons. Whether they are electro magnetic or mechanical waves?
5. Give reason to add bulb in electrical vibrator.

P8.13 Suggested Learning Resources

- http://www.olabs.edu.in/?sub=1&brch=6&sim=151&cnt=4

Practical 9 - Kirchhoff's law

P9.1 Practical Statement

To verify Kirchhoff's law using electric circuits.

P9.2 Practical Significance

Kirchhoff's laws are used to analyze a given circuit. Two Kirchhoff's laws, one for voltage Kirchhoff's voltage law (KVL) and one for current Kirchhoff's current law (KCL) helps us to find voltage and current respectively in a given circuit. This experiment helps students to experimentally measure the sum of current at nodes and voltage across different components in a loop.

P9.3 Relevant Theory

Refer: Section 4.11 of this unit

P9.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Use Kirchhoff's law to find current and voltage across elements in a given circuit.

P9.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

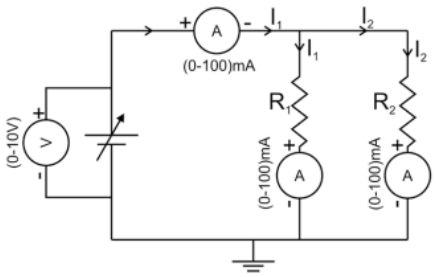


Fig P9.1

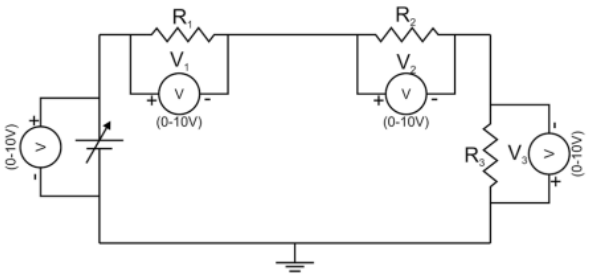


Fig P9.2

P9.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Re-marks (if any)
			Make	Details	
1	Variable DC Power supply 0-10 V	01			
2	Ammeter 0-500 mA	03			
3	Voltmeter 0-10 V	04			
4	Resistances 100Ω, 220Ω , 330Ω, 1000Ω 2200Ω, 3300Ω	06			
5	Key	01			

P9.7 Precautions

1. Connections should be tight.
2. All the component should be placed such that they can be properly connected.
3. The pointer of ammeter/voltmeter should coincide with zero mark.
4. Check the power supply before connection.
5. Check connection with the help of teacher.
6. Connect ammeter in series and voltmeter in parallel.
7. The key should be inserted only while taking readings.

P9.8 Suggested Procedure

For KCL

1. Make connection as per circuit diagram in Fig P9.1.
2. Note the LC and range of Ammeter and voltmeter.
3. Switch on power supply and close key.
4. Note the reading of ammeters for I, I_1 and I_2.
5. Change the voltage of power supply and repeat step 4.

For KVL

6. Make connection as per circuit diagram in Fig P9.2.
7. Switch on power supply and close key.
8. Note the reading of voltmeter for V, V_1,V_2 and V_3
9. Change the voltage of power supply and repeat step 8.

P9.9 Observations and Calculations

Least count of ammeter 1 = ... Range of ammeter 1 = ...
Least count of ammeter 2 = ... Range of ammeter 2 = ...
Least count of ammeter 3 = ... Range of ammeter 3 = ...
Least count of voltmeter = ... Range of voltmeter = ...

Table 1 for KCL

Sr. No	Voltage (V)	I_1	I_2	I	$I_1 + I_2$
1					
2					
3					
4					
5					

Least count of voltmeter = ... Range of voltmeter = ...
Least count of voltmeter 1 = ... Range of voltmeter 1 = ...
Least count of voltmeter 2 = ... Range of voltmeter 2 = ...
Least count of voltmeter 3 = ... Range of voltmeter 3 = ...

TABLE 2 for KVL

Sr. No	Voltage (V)	V_1	V_2	V_3	$V_1 + V_2 + V_3$
1					
2					
3					
4					
5					

P9.10 Results and/or Interpretation

(to be filled by student)

1. .....

P9.11 Conclusions and/or Validation

(to be filled by student)

1. .....

P9.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give least count of ammeter and voltmeter used in experiment.
2. Is resistance of circuit in Fig 1 will be less than or greater than the individual resistance?
3. Can we find the internal resistance of the voltage source by this experiment.

P9.13 Suggested Learning Resources

- https://vlab.amrita.edu/?sub=1&brch=75&sim=217&cnt=1

Practical 10 - Parallel plate capacitor

P10.1Practical Statement

To study the dependence of capacitance of a parallel plate capacitor on various factors and determine permittivity of air at a place.

P10.2 Practical Significance

Capacitors are active components in electrical circuit which are used in AC circuits to introduce phase delay and in filter circuits to pass AC and block DC current. Besides these there are number of applications of capacitors. This experiment helps students to vary the capacitance of parallel plate capacitors and determine the factors affecting the capacitance of parallel plate capacitor.

P10.3 Relevant Theory

Refer: Section 3.2.3 of this unit

P10.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Determine the variation in capacitance of parallel plate capacitor with area of plates and their separation.

PrO2: Use capacitor to find the permittivity of air.

P10.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

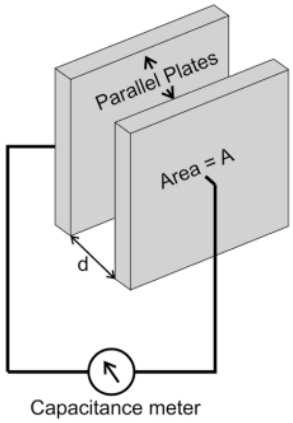


Fig P10.1

P10.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Parallel plate capacitor	01			
2	Capacitance meter	03			
3	Connecting wires	03			

P10.7 Precautions

1. Connections should be tight.
2. Plates of capacitors should be parallel
3. Measure distance accurately.

P10.8 Suggested Procedure

For measuring the effect of distance (d)

1. Measure the area of plates.
2. Keep plate at separation say 5 cm.
3. Charge capacitor with DC supply of 10V.
4. Make connection as per circuit diagram in Fig P10.1.
5. Measure capacitance C with capacitance meter or multimeter.
6. Gradually decrease the distance between the plates and measure C.

For measuring the effect of Area (A)

1. Fix separation between plate say 2 cm.
2. Charge capacitor with DC supply of 10V
3. Measure capacitance C with capacitance meter or multimeter.
4. Slide one of the plates of capacitor laterally.
5. Note the change in capacitance.
6. Repeat step 4 and 5 for five observations.

P10.9 Observations and Calculations

Least count of capacitance meter = ...

Area of plates = ... Separation between plates = ... cm

TABLE 1 for measuring the effect of d

Sr. No	Area of plates	Capacitance
1		
2		
3		
4		

TABLE 2 for measuring the effect of A

TABLE 2 for measuring the effect of A

Sr. No	Separation between plates	Capacitance
1		
2		
3		
4		

Plot Graph 1 between C v/s 1/d and ε = slope /A

Plot Graph 2 between C v/s A and ε = slope $\times$ d

P10.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P10.11 Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P10.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Is the voltage between plate changes if we change 'd' (distance between plates).
2. Give the reasons for errors in the present experiment.
3. Is the charge on capacitors changes, if we change 'd' (distance between plates).

10.13 Suggested Learning Resources

- https://phet.colorado.edu/en/simulation/capacitor-lab-basics

Practical – 11 Half deflection method

P11.1 Practical Statement

To find resistance of a galvanometer by half deflection method.

P11.2 Practical Significance

A galvanometer is a sensitive electrical device for measuring small electrical currents. It gives a deflection whenever the current passes through it. The internal resistance of galvanometer is an important parameter and it is used to convert galvanometer into voltmeter and ammeter. This experiment helps student to find resistance of galvanometer.

P11.3 Relevant Theory

For half deflection method following circuit is made:

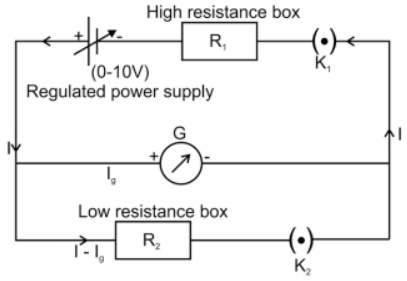


Fig P11.1

When R_1 is connected in circuit (K_1 is closed) and R_2 is not added (or K_2 is open) then current I_1 passing through the circuit and through galvanometer also is

$I_1 = E/(R_1 + G)$, where G is resistance of galvanometer

Now K_2 is closed and R_2 is adjusted such that the deflection in galvanometer is half or the current in galvanometer is $I_1' = I_1/2$ and current (I_2) in circuit is given by,

$I_2 = E/[R_1 + GR_2/(G + R_2)]$

Also, $GI_1' = R_2(I_2 - I_1')$

Hence, $I_1' = I_2R_2/(G + R_2)$

On simplifying

$I_1' = ER_2/[R_1(R_2 + G) + R_2G]$

As $I_1' = I_1/2$

$ER_2/[R_1(R_2 + G) + R_2G] = E/[2(R_1 + G)]$

On simplification

$G = R_1R_2/(R_1 - R_2)$

P11.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Use half deflection method to find the resistance of a given galvanometer

P11.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

As given in Section P11.3 of this experiment

P11.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

As given in Section P11.3 of this experiment

P11.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Moving coil galvanometer	01			
2	DC power supply (0-10 V)	01			
3	Resistance box – Range 0 - 10 kΩ	01			
4	Resistance box – Range 0 – 200 Ω	01			
5	One way key	02			

P11.7 Precautions

1. Connections should be tight and clean.
2. Remove parallax while reading galvanometer.
3. The current in galvanometer should not be increased above full scale deflection (FSD) of galvanometer.

P11.8 Suggested Procedure

1. Make circuit as per the circuit diagram in Fig. P11.1
2. From the high resistance box (1-10 kΩ), remove 10 kΩ key and close the key K_1
3. Adjust the resistance R_1 from this resistance box to get FSD on the galvanometer.
4. Note the value of resistance R_1.
5. Insert the key K_2.
6. Adjust the value of R_2, such that the deflection is exactly half as observed in step 3.
7. Note down the value of R_2 and remove plug K_2.
8. Repeat the steps from point number 3 to 7 by changing R_1 (The deflection may be less than FSD).

P11.9 Observations and Calculations

Least count of voltmeter = ... FSD of galvanometer = ... DC supply Voltage = ...V

Sr. No	R_1 (ohms)	R_2 (ohms)	$G = R_1R_2/(R_1 - R_2)$
1			
2			
3			
4			
5			

Mean G=.....

P11.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P11.11 Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P11.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Can we measure the figure of merit of galvanometer by this experiment?.
2. Give the reasons for error in the present experiment.

P11.13 Suggested Learning Resources

- http://www.olabs.edu.in/?sub=1&brch=6&sim=152&cnt=2

Practical 12 - Galvanometer to ammeter

P12.1 Practical Statement

To convert a galvanometer into an ammeter.

P12.2 Practical Significance

Ammeter is a current measuring device and is connected in series to measure the current of given circuit. A moving coil galvanometer can be converted into ammeter of desired range by adding shunt. In this experiment the students will convert the given galvanometer into ammeter.

P12.3 Relevant Theory

Refer: Section 5.3 of this unit

P12.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Convert a given galvanometer into ammeter of desired range.

PrO2: Make measuring instrument as per requirements.

P12.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

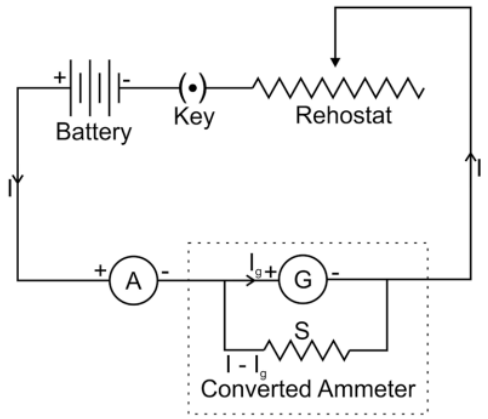


Fig P12.1

P12.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	A Galvanometer	01			
2	Shunt resistance/ low resistance box	03			
3	DC power supply (0-10V) and Connecting wires	01			
4	Ammeter (0-1 A)	01			
5	Rheostat and a key	1 each			

P 12.7 Precautions

1. Connections should be tight.
2. Handle the instrument carefully.
3. Rating of shunt resistance should be taken care off.

P 12.8 Suggested Procedure

1. Note FSD of Galvanometer.
2. Measure the internal resistance of galvanometer with multimeter.
3. Calculate the shunt resistance theoretically for desired ammeter (say 500mA)
4. Connect the shunt (low resistance box) parallel to galvanometer.

5. Make connection as per circuit diagram in Fig P12.1.
6. Note the reading in standard ammeter and the converted ammeter.
7. Adjust the shunt in case of difference between the readings of both meters.
8. Vary the current in the circuit and note readings from the meters.

P12.9 Observations and Calculations

FSD of galvanometer : ..... internal resistance of galvanometer : .....

Theoretical calculation for shunt

Sr. No	Galvanometer converted into ammeter reading (I)	Ammeter reading (I')	Error = I' – I
1			
2			
3			
4			
5			

Value of shunt by experiment.....

P12.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P12.11 Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P12.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Predict the change in converted ammeter, if shunt is increased.
2. Give Least count of given voltmeter.
3. Give reasons to use additional ammeter in circuit.

12.13 Suggested Learning Resources

- http://amrita.olabs.edu.in/?sub=1&brch=6&sim=26&cnt=4basics

Practical 13 - Galvanometer to voltmeter

P13.1 Practical Statement

To convert a galvanometer into a voltmeter.

P13.2 Practical Significance

Voltmeter is a voltage measuring device and is connected in parallel to measure the voltage between two points of given circuit. A moving coil galvanometer can be converted into voltmeter of desired range by adding high resistance in series. In this experiment the students will convert the given galvanometer into voltmeter.

P13.3 Relevant Theory

Refer: Section 5.3 of this unit

P13.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Convert a given galvanometer into voltmeter of desired range.

PrO2: Make measuring instrument as per requirements.

P13.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

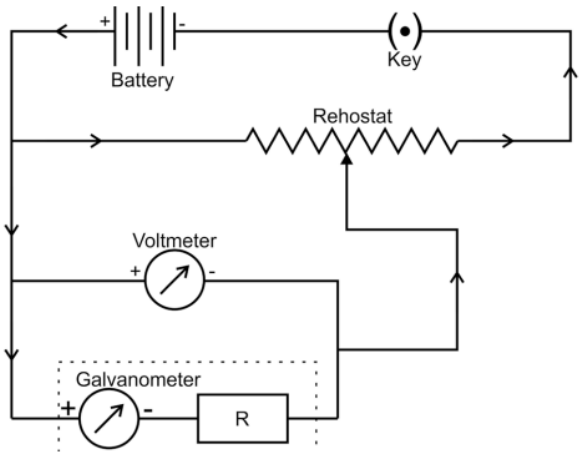


Fig P13.1

P13.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/ Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Galvanometer	01			
2	High resistances/ high resistance box	01			
3	DC power supply (0-10V) and Connecting wires	01			
4	Voltmeter (0-10 V)	01			
5	Rheostat and a key	1 each			

P13.7 Precautions

1. Connections should be tight.
2. Handle the instrument carefully.

P13.8 Suggested Procedure

1. Note FSD of Galvanometer.
2. Measure the internal resistance of galvanometer with multimeter.
3. Calculate the high resistance theoretically for desired voltmeter (say 5V)
4. Connect the high resistance (high resistance box) in series to galvanometer.
5. Make connection as per circuit diagram in Fig P13.1.

6. Note the reading in standard voltmeter and the converted voltmeter.
7. Adjust the high resistance in case of difference between the readings of both meters.
8. Slide the variable arm of rheostat and change the voltage across galvanometer.
9. Measure the voltage with both meters (converted voltmeter and voltmeter).

P13.9 Observations and Calculations

FSD of galvanometer

Sr. No	Galvanometer converted into Voltmeter reading (V)	Voltmeter reading (V')	Error = V' – V
1			
2			
3			
4			
5			

Theoretical calculation for high resistance

Value of high resistance by experiment.....

P13.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P13.11 Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P13.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Predict the change in converted voltmeter, if the series high resistance increased or decreased.
2. Give Least count of given voltmeter.
3. Give reasons to use additional voltmeter in circuit.
4. Give reasons to add the voltmeter in parallel.

P13.13 Suggested Learning Resources

- https://www.robolab.in/conversion-of-galvanometer-to-voltmeter/

Practical 14 - V-I Characteristic of diode

P14.1 Practical Statement

To draw V-I characteristics of a semiconductor diode (Ge, Si) and determine its knee voltage.

P14.2 Practical Significance

p-n junction diode is used in rectifier, clipping, clamping and voltage multiplier circuits. Diode is also used in designing logic circuits. The V- I characteristics of diode decides its working and applications. In this lab experience, students will determine the forward bias and reverse bias characteristics and also determine the knee voltage

P14.3 Relevant Theory

Refer: Section 6.4 of Unit 6

P14.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Determine V-I Characteristics of Si/Ge diode.

PrO2: Find the knee voltage of Si/Ge diode.

P14.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

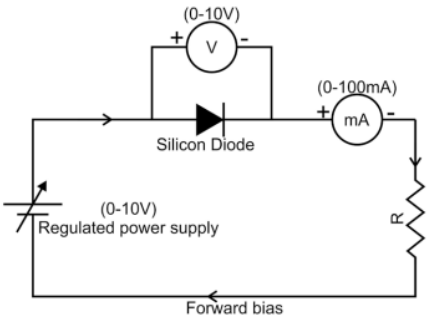


Fig P14.1

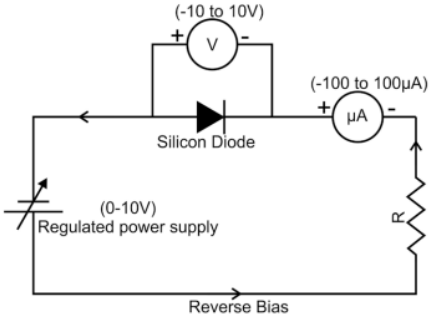


Fig P14.2

P14.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	DC power supply (0-10V)	01			
2	Voltmeter (0-10V)	01			
3	Ammeter (0-100 mA)/(0±100 µA)	02			
4	Resistor (100 ohm, 1 kohm)	2			
5	Connecting wires				

P14.7 Precautions

1. Connections should be tight.
2. Handle the instrument carefully.
3. The current flowing through the diode should not exceed the maximum current as per specifications of diode.
4. Connect voltmeter and Ammeter as shown in the circuit diagram.

P14.7 Precautions

1. Connections should be tight.
2. Handle the instrument carefully.
3. The current flowing through the diode should not exceed the maximum current as per specifications of diode.
4. Connect voltmeter and Ammeter as shown in the circuit diagram.

P14.8 Suggested Procedure

Forward bias characteristics

1. Connect the p-n Junction diode (Si/Ge) in forward bias as shown in Fig. P14.1.
2. Vary the supply voltage (V_s) in steps of 0.1V.
3. Note the voltage across diode (Vd)
4. Note the corresponding values of forward bias current (I_D).
5. Plot a graph of forward current (I_D) Vs forward voltage (V_D)
6. Find the voltage on x- axis where the forward current (I_D) increases rapidly.
7. Note this voltage as the knee voltage or cut in voltage of the diode.

Reverse bias characteristics

8. Connect the p-n Junction diode (Si/Ge) in reverse bias as shown in Fig. P14.2.
9. Vary the supply voltage (V_s) in steps of 0.5 V.
10 Note the voltage across diode (V_R)
11 Note the corresponding values of reverse current (I_s).
12. Plot a graph of reverse current (I_s) and V_R.

P14.9 Observations and Calculations

LC of Voltmeter = ... LC of ammeter = ...

Table 1

Sr. No	Forward Voltage (V_D) (volts)	Forward current (I_D) (mA)
1		
2		
3		
4		
5		
6		

Table 2

Sr. No	Reverse Voltage (V_R) (volts)	Reverse current (I_S) (μA)
1		
2		
3		
4		
5		
6		

P14.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P14.11Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P14.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give the ideal value of knee voltage for the Si and Ge diode used.
2. Give the steps to identify the p and n terminals of diode using multimeter.
3. Give reasons for using micro ammeter in a reverse bias mode.
4. State the specifications of diode used in this lab experiment.

P14.13 Suggested Learning Resources

- http://www.olabs.edu.in/?sub=1&brch=6&sim=233&cnt=4

Practical 15 - Inverse square law of radiation

P15.1 Practical Statement

To verify inverse square law of radiations using a photo-electric cell.

P15.2 Practical Significance

A photoconductive cell is a two terminal semiconductor device, the resistance between terminals varies with the intensity of light. It is used for number of applications such as Automatic Headlight Dimmer, Night Light Control and Street Light Control. This experiment will help students to find the variation of Intensity with distance of between light source and photo-electric/ photoconductive cell.

P15.3 Relevant Theory

Refer: Section 6.4 of Unit 6 for photoconductive cell.

The intensity (I) of the light source at point 'O' to an observer at point 'P' from a source is inversely proportional to the square of the distance between the observer and source. In case of photoconductive cell, the intensity of light falling on cell decides the magnitude of photocurrent passing through the photo cell. Hence the magnitude of photocurrent also inversely proportional to square of the distance between source and photocell.

$I \alpha 1/d^2$

P15.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Find relation between the intensity of light radiation with distance.

P15.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

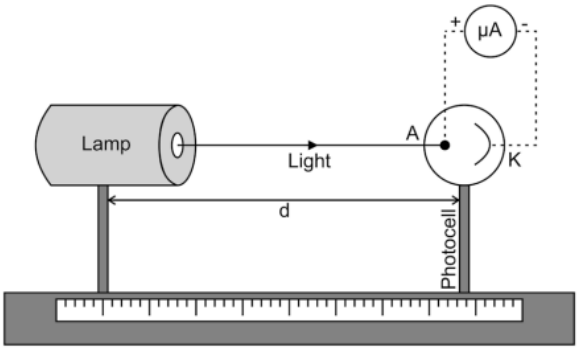


Fig P15.1

P15.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	DC power supply (0-10V)	01			
2	Photocell	01			
3	Ammeter 0-100 μA	01			
4	Connecting wires, meter scale				

P15.7 Precautions

1. Connections should be tight.
2. Handle the instrument carefully.
3. Stray light should be avoided on photocell.
4. The photocell and lamp should be in line and vertical.

P15.8 Suggested Procedure

1. Connect the circuit as shown in Fig. P15.1
2. Keep lamp and photo cell at distance. (d = 12 cm)
3. Switch on the lamp.
4. Note the current in ammeter.
5. Keeping lamp/cell at fix point, decrease the distance between lamp and cell and note change in current.
6. Repeat the step 5 for five times.
7. Plot a graph of current (I) Vs $1/d^2$

P15.9 Observations and Calculations

LC of ammeter = …… Position of photocell = …… cm (x_1)

Sr. No	Position of lamp (x_2)	$d = x_1 - x_2$	I in Circuit (micro Ampere)	$1/d^2$
1				
2				
3				
4				
5				

Plot Graph between I v/s $1/d^2$

P15.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P15.11Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P15.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Explain the concept of solid angle in present experiment.
2. Give the source of errors in present experiment.
3. State the specifications of photocell used in this lab experience.
4. State the current in the circuit when there was no light on photocell.

P15.13 Suggested Learning Resources

- https://vlab.amrita.edu/index.php?sub=1&brch=195&sim=840&cnt=1

Practical 16 - Wave length of He Ne Laser

P16.1 Practical Statement

To measure wavelength of a He-Ne/diode laser using a diffraction grating.

P16.2 Practical Significance

Visible light spectrum wavelength ranges from 4000A° – 7000A°. Diffraction phenomena is used for measurement of wavelength of a light color. Laser is coherent source of light. This experiment will help student to measure the wave length of light using diffraction grating.

P16.3 Relevant Theory

A grating is an optical device, in which N number of parallel slits are formed on transparent material. It is an arrangement of N parallel slits of width of the order of wavelength of light. When light passes through these slits, diffraction phenomenon occurs. The diffraction maxima are observed at angle θ and is given by:

Grating Equation: (For maxima) $(a+b)\sin\theta = n\lambda$

Where, $(a + b)$ = grating element, θ = angle of diffraction n =order of diffraction pattern and λ=wave-length of light falling on grating.

Hence $$\lambda = \frac{(a+b)\sin\theta}{n}$$

P16.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Use diffraction phenomenon and grating to find the wave length of He-Ne/ diode Laser.

P16.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

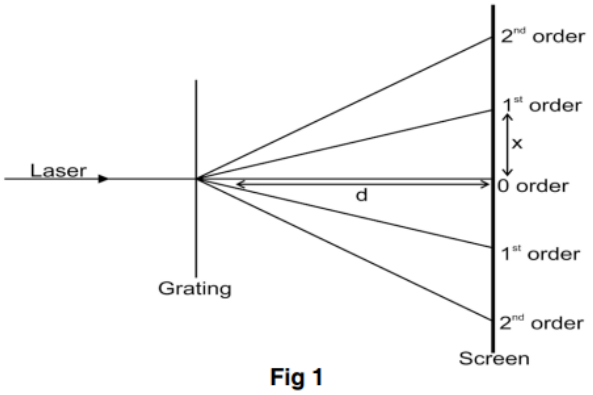


Fig 1

P16.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Diffraction gratings of different grating element (100, 300 & 600 lines/mm), grating stand	01			
2	Meter scale	01			
3	Helium Neon / Diode laser	01			

P16.7 Precautions

1. Do not see laser directly with naked eye.
2. Handle the instrument carefully.
3. Take the distance between two orders carefully.

P16.8 Suggested Procedure

1. Set the laser such that it spot on the white paper screen, placed at 1- 1.5 m meters away.
2. Mark the position of the observed spot on the paper.
3. Place the 100 lines/mm diffraction grating in front of the laser beam.
4. Measure the distance between the screen and grating.
5. Measure the distance between the zero order maxima and consecutive maxima formed on screen.
6. Repeat the steps 3 to 5 for the other two diffraction gratings i.e. 300 lines/mm and 600 lines/mm on the slide.
7. Calculate the diffraction angle and Wavelength of Laser.

P16.9 Observations and Calculations

1. Grating element = 100 lines/mm, Distance between screen and grating (D) =

S. No.	Diffraction order Maxima (n)	Distance from zero order maxima (x)	Diffraction angle = x/D
1	First order (n = 1)		
2	Second order (n = 2)		
3	Third order (n = 3)		
4	Fourth order (n = 4)		

2. Grating element = 300 lines/mm, Distance between screen and grating (D) =

S. No.	Diffraction order Maxima (n)	Distance from zero order maxima (x)	Diffraction angle = x/D
1	First order (n = 1)		
2	Second order (n = 2)		
3	Third order (n = 3)		

3. Grating element = 600 lines/mm, Distance between screen and grating (D) =

S. No.	Diffraction order Maxima (n)	Distance from zero order maxima (x)	Diffraction angle = x/D
1	First order (n = 1)		
2	Second order (n = 2)		

Mean of wavelenght (λ) =

P16.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P16.11 Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P16.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Give reasons for observing a smaller number of order, when grating element decreases.
2. Can this experiment be perform by using any other light source?
3. Give the source of errors in present experiment.

P16.13 Suggested Learning Resources

- https://vlab.amrita.edu/index.php/index.php?sub=1&brch=189&sim=334&cnt=4

Practical 17 - Optical Fibre

P17.1 Practical Statement

To measure numerical aperture (NA) of an optical fiber.

P17.2 Practical Significance

Numerical aperture of optical fiber is the light gathering ability of optical fiber. IF numerical aperture is more than more light rays can travel through fiber This experiment will help student to measure the Numerical aperture of given optical fiber.

P17.3 Relevant Theory

Section 7.2 of unit 7 Modern Physics

P17.4 Practical Outcomes (PrO)

The practical outcomes are derived from the curriculum of this course:

PrO1: Find Numerical aperture of a given fiber.

P17.5 Practical Setup (Drawing/Sketch/Circuit Diagram/Work Situation)

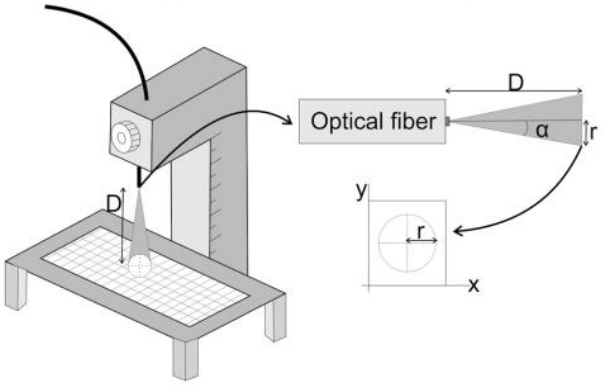


Fig 1

Numerical Aperture,

$$NA = \sin\alpha = \frac{r}{\sqrt{r^2 + D^2}}$$

r is radius of circle and D is distance between graph paper and optical fiber.

P17.6 Resources Required

Sr. No	Suggested Resources required Machines/Tools/ Instruments with vital specifications	Qty	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Remarks (if any)
			Make	Details	
1	Optical fiber (length one meter)	01			
2	Wooden stand for height variation	01			
3	Helium Neon / Diode laser	01			
4	Graph paper	01			

P17.7 Precautions

1. Do not see laser directly with naked eye.
2. Handle the instrument carefully.
3. Fiber should be stable while measurement.

P17.8 Suggested Procedure

1. Mount one end of optical fiber in wooden stand as shown in figure.
2. Place He-Ne /Diode laser as source very closed to other end of fiber.
3. The emitted light comes in the form a cone as shown in figure.
4. Measure the radius of circle formed on graph paper.
5. Measure the distance (D) between the fiber and graph paper.
6. Repeat the steps 4 and 5 by varying the D.
7. Use formula as given above for calculations.

P17.9 Observations and Calculations

S.No.	Distance between fiber and graph paper (cm)	Radius of circle (r)	Numerical aperture
1			
2			
3			
4			
5			

Mean NA =

P17.10 Results and/or Interpretation

(to be filled by student)

1. .....
2. .....

P17.11 Conclusions and/or Validation

(to be filled by student)

1. .....
2. .....

P17.12 Practical related Questions

(Use separate sheet for answer)

Note: Below given are few sample questions for reference. Teachers must design more such questions in order to ensure the achievement of pre-defined course outcomes.

1. Is the acceptance angle varies by varying distance between the screen and optical fiber?
2. Can this experiment be perform by using any other light source?
3. Give the source of errors in present experiment.

P17.13 Suggested Learning Resources

- https://vlab.amrita.edu/index.php/index.php?sub=1&brch=189&sim=334&cnt=4

Practical 18 - Optical Projection system

(Suggestive template for project report)

P18.1 Title

Study of an optical projection system (OHP/LCD).

P18.2 Rationale

(Importance of LCD projector and reason for doing project in 100-150 words)

P18.3 Literature Review

(Existing status, knowledge required to complete the chosen task in about 200 to 500 words)

P18.4 Methodology

(Procedure to be followed in brief in about 200 to 500 words)

P18.5 Resources used

Sr. No	Actual Resources used Machines/Tools/ Instruments with broad specifications (to be filled by the student)		Qty	Remarks (if any)
	Make	Details		
1				
2				
3				
4				

P18.6 Outcomes (presentation of collected data, findings etc.)