VP & RPTP SCIENCE COLLEGE

Vallabh Vidyanagar

BSc [First Semester] Subject: Physics

Course Code Number: US01CPHY03

PRACTICAL RECORD BOOK

Name:____

Roll No:_________ **Batch:**_______ **Division:** _____

Day:_________**and** ________ **Timing:** __________**to**________

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I hear, and I forget. I see, and I remember. I do, and I understand.

-- *Confucius*

One of the best ways to understand something is to get your hands on it and actually experiment with it.

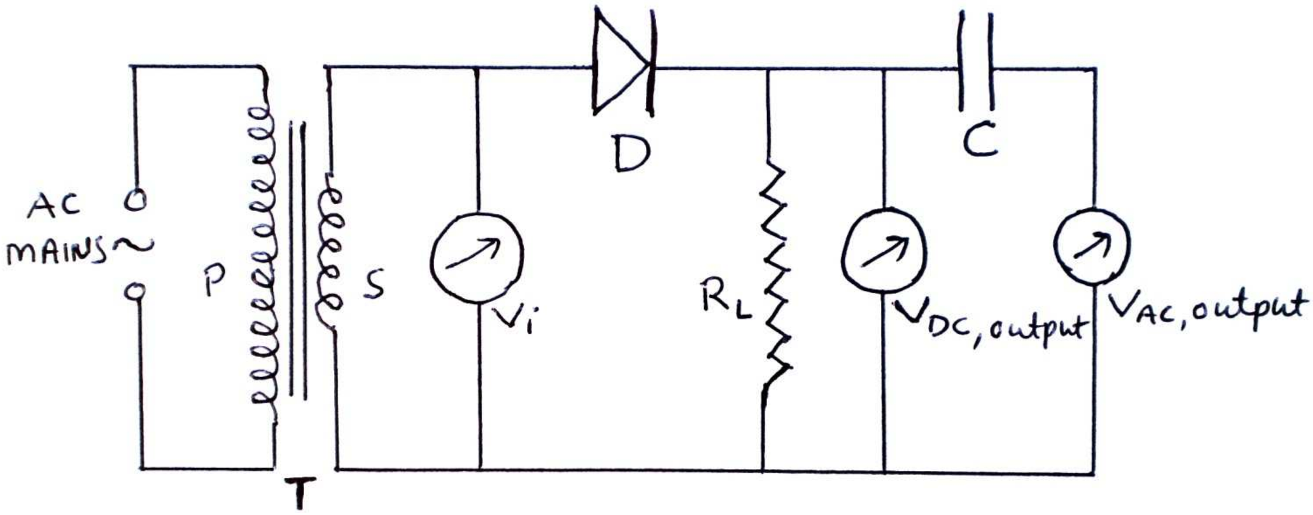
Experiment No- ____	**Date ___-___-201__**

Half Wave Rectifier [AC Component]

Aim: To study the half-wave rectifier circuit.

Apparatus: Step-down Transformer (0-24V), AC Voltmeter (0-25V), DC Voltmeter (0-15V), Diode, Load Resistance, Capacitor

Circuit Diagram:



Here

T	→ Step-down Transformer (0-24V)	**D**	→ Diode
P	→ Primary Coil	**S**	→ Secondary Coil
$\mathbf{V_{AC}}$	→ AC Voltmeters (0-25V)	**C**	→ Capacitor
$\mathbf{V_{DC}}$	→ DC Voltmeter (0-15V)	$\mathbf{R_L}$	→ Load Resistance

Procedure:

1. Connect the circuit as shown in the circuit diagram.
2. Now switch on the power supply. Select the value of AC input voltage, using the given transformer and measure it [$\mathbf{V_i}$]. Note the corresponding AC output voltage [$\mathbf{V_{AC,\ output}}$] and DC output voltage [$\mathbf{V_{DC,\ output}}$].
3. Now change the value of AC input voltage and measure it. Also note the corresponding output AC and DC voltage.
4. Repeat the experiment for six different values of input AC voltage.
5. Find out the ripple factor [η] of the circuit and calculate theoretical DC voltage [$\mathbf{V_{DC}}$] using given formula and verify the formula.

Observation Table:

Obs. No.	Input AC voltage V_i volt	Output DC voltage $V_{DC, output}$ volt	Output AC voltage $V_{AC, output}$ volt	Ripple factor $\eta = \frac{V_{AC, output}}{V_{DC, output}}$	Theoretical Output DC voltage $V_{DC} = \frac{\sqrt{2}\,Vi}{\pi}$ volt
1	10				
2	12				
3	14				
4	16				
5	18				
6	20				
7	22				
8	24				
			Mean η		

Graph:

Plot a graph of V_{AC} output against V_{DC} output and find out slope of the graph which gives value of ripple factor.

Calculation: [For any one reading]

Ripple factor

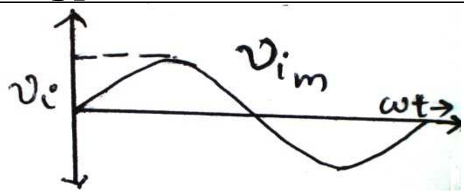
$$\eta = \frac{V_{AC}\text{ output}}{V_{DC}\text{ output}}$$

=________________

=________________

$$V_{DC} = \frac{\sqrt{2}\,Vi}{\pi} = \_\_\_\_\_\_\_\_\_\_\_\_$$

=__________volt



Theoretically the output voltage

$$V_{DC} = \frac{V_{im}}{\pi}$$

Where V_{im} is the peak AC input voltage

But $V_{im} = \sqrt{2}\,Vi$

$$\therefore\ V_{DC} = \frac{\sqrt{2}\,Vi}{\pi}$$

Results:

[1] The value of ripple factor [η] is as under:

Method	Using formula	Using graph
Experimental value of ripple factor		
Theoretical value of ripple factor	**1.21**	

[2] Form the observation table, we can conclude that the theoretically DC output voltage is nearly equal to measured DC output voltage and hence given theoretical formula for output DC voltage is verified.

Teacher's Signature	**Date :**					**1**	

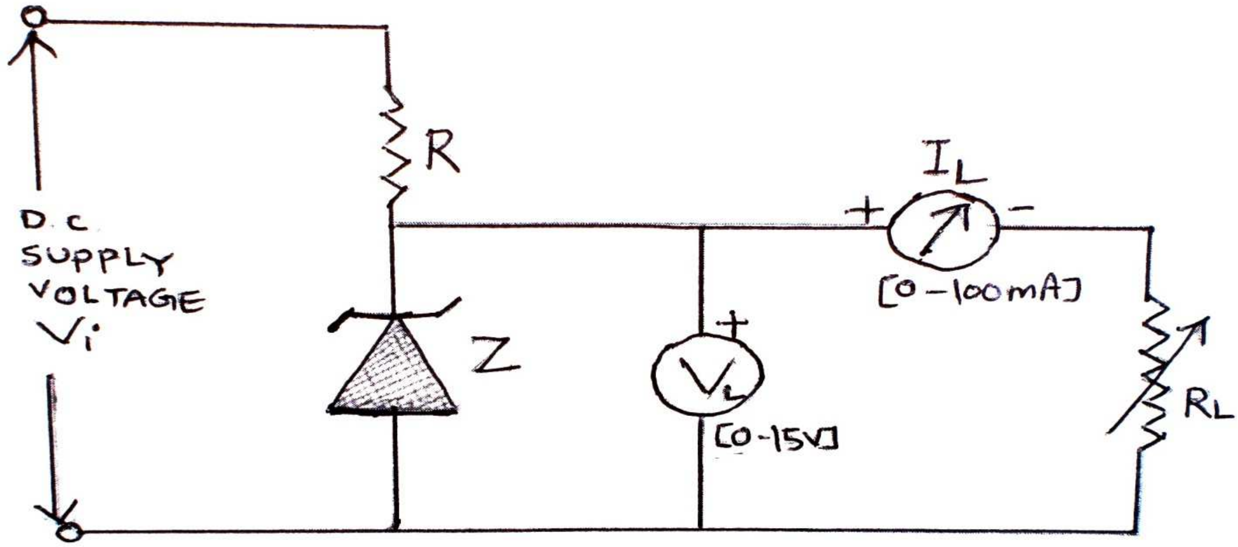
Experiment No- ____ **Date ___-___-201__**

Zener Diode Characteristics

Aim: To study the characteristic of a Zener Diode.

Apparatus: Power Supply, Experimental Circuit Board, Voltmeter, Ammeter

Circuit Diagram:



Here,

V_i	→	**Input DC Supply Voltage**	**Z**	→	**Zener Diode**
R	→	**Resistor**	**V_L**	→	**DC Voltmeter (0-15 V)**
R_L	→	**Potentiometer**	**I_L**	→	**DC Milliammeter (0-100mA)**

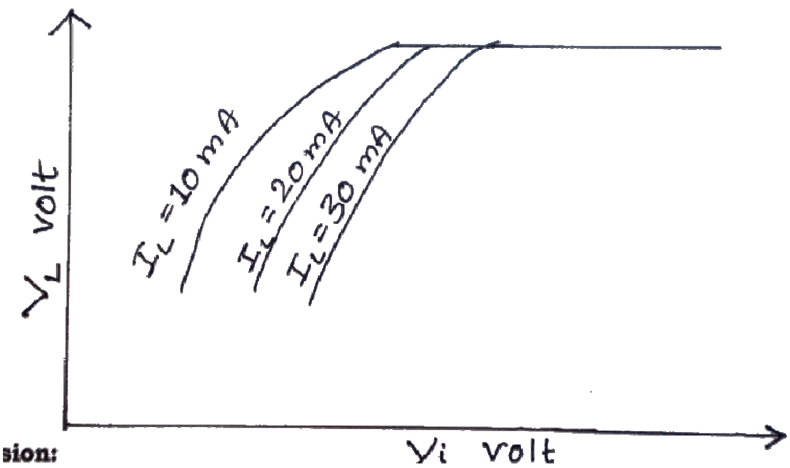
Procedure:

1. Setup the circuit as shown in figure.
2. Take suitable value of supply voltage. (V_i = 8V) Adjust load current I_L to a fixed value (I_L = 10 mA). Measure load voltage V_L.
3. Now adjust load current I_L to 20 mA and 30 mA for same value of supply voltage i.e. V_i = 8V and measure corresponding load voltage V_L.
4. Increase input voltage in small steps of 2V. Measure voltage across load in each case for different fixed load current.
5. Plot V_L versus V_i for all three values of I_L. Find minimum values of V_i for which V_L becomes almost constant.

Observations Table:

Obs. No.	Input Voltage V_i volt	Voltage across load V_L volt		
		I_L = 10 mA	I_L = 20 mA	I_L = 30 mA
1	8			
2	10			
3	12			
4	14			
5	16			
6	18			
7	20			
8	22			
9	24			
10	26			
11	28			
12	30			

Graph: Plot V_L (in volt) versus V_i (in volt) for all three values of I_L (in mA).



sion:

Conclusion:
Form the graph we can conclude that the Zener Diode can be used to regulate the output voltage.

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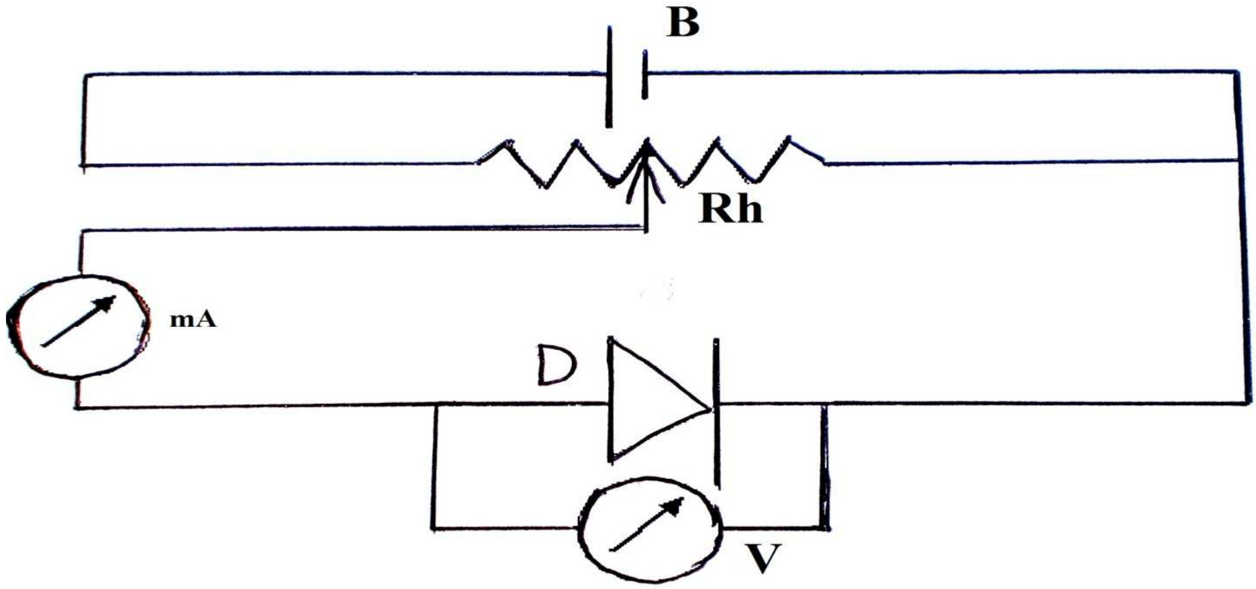
Experiment No- ____ **Date ___-___-201__**

Characteristics of Forward Biased PN - Junction Diode

Aim: To draw forward biased characteristic curve of semiconductor diode and to determine its forward resistance.

Apparatus: Circuit Board, Power Supply (0-15 volt), DC-Voltmeter (0-1 volt) Milliammeter (0-50 mA)

Circuit Diagram:



Here

B	→	Battery Eliminator	**Rh**	→	Potentiometer
D	→	PN Junction Diode	**V**	→	Voltmeter (0 -1 V)
mA	→	Milliammeter (0-50 mA)			

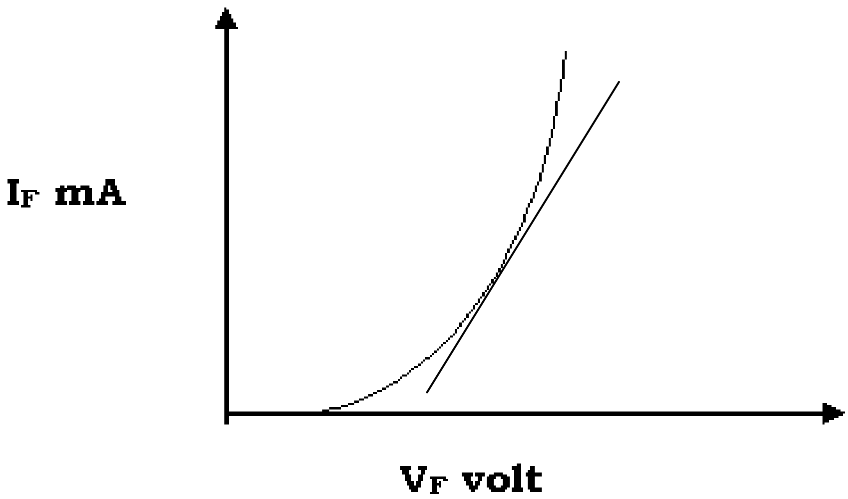
Procedure:

1. The connections are made as shown in circuit diagram. In this experiment connect any one diode parallel to voltmeter.
2. Switch on the power supply.
3. With the help of the potentiometer increase the voltage slowly.
4. Note down the milliammeter and voltmeter readings. Tabulate your observations.
5. Draw a graph between forward voltage [$\mathbf{V_F}$] and forward current **[$\mathbf{I_F}$]** and find out slope of the graph.

Observation Table:

Sr. No.	Forward Voltage [V_F] in volt	Forward Current [I_F] in mA
1		
2		
3		
4		
5		
6		
7		
8		

Graph:



From Graph:

Forward resistance

$[r_d] = \frac{1}{slope}$

= __________Ω

Result:

[1] The V-I characteristic of forward biased diode is as shown in the graph.

[2] The forward resistance of the given diode is ____________________________Ω.

Teacher's Signature

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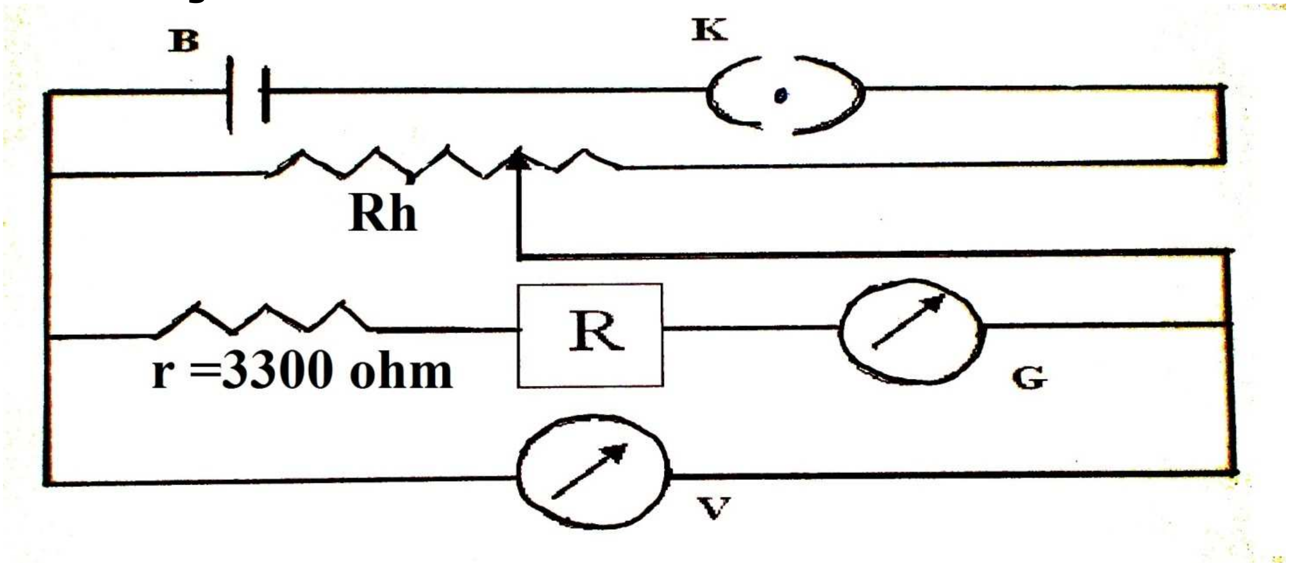
Experiment No- ____	Date ___-___-201__

Conversion of Galvanometer into Voltmeter

Aim: To convert a galvanometer into a voltmeter of given ranges and to calibrate it.

Apparatus: Voltmeter, Galvanometer, Resistance boxes, Plug key, Potentiometer and Battery

Circuit Diagram:



Here

B	→	Battery Eliminator	**K**	→	Simple key
Rh	→	Potentiometer	**R**	→	Resistance box
V	→	Voltmeter (0 – 15 volt)	**G**	→	Galvanometer
r	→	Fixed resistor (=3300 Ω)			

Procedure:

1. Connect voltmeter [V], resistance box (R) and Plug key [K] as shown in circuit diagram.

2. Calculate proper values of R_s for different suitable ranges of voltmeter, Say 5V, 7.5V and 10V and also calculate value for deflection of one division of galvanometer for respective ranges.

3. Applying different voltages and measure the deflection produced in terms of number of divisions in galvanometer and hence calculate the applied voltage.

Observations:

[1] Resistance of the given galvanometer [$\mathbf{R_G}$] = 70 Ω

[2] Current for full scale deflection [$\mathbf{I_{FSD}}$] = 1 mA = 10^{-3} A

Observations Table:

Obs. No.	Range of voltmeter volt	$R_S = \frac{V - I_{FSD} \times R_G}{I_{FSD}}$ Ω	Applied voltage volt	Calculated voltage =(No. of division) × (Value of one division) volt
1	0 to 7.5 Volt	R_s = ____________ Ω	2 Volt	
2			4 Volt	
3			6 Volt	
4		∴ R = ___________Ω	7.5 Volt	
1	0 to 10 Volt	R_s = ____________ Ω	2.5 Volt	
2			5 Volt	
3			7.5 Volt	
4		∴ R = ___________Ω	10 Volt	

Calculations:

For 0 to 7.5 V

$$R_S = \frac{V - I_{FSD} \times R_G}{I_{FSD}}$$

where Take V = 7.5 volt

R_S =

R_S = ________________________ Ω

Total divisions on Galvanometer = 25

25 divisions = **7.5** volt

∴Value of 1 division = $\frac{7.5}{25} = 0.3$ volt

For 0 to 10 V

$$R_S = \frac{V - I_{FSD} \times R_G}{I_{FSD}}$$

where Take V = 10 volt

R_S =

R_S = ________________________ Ω

Total divisions on Galvanometer = 25

25 divisions = **10** volt

∴Value of 1 division = $\frac{10}{25} = 0.4$ volt

Conclusion: Measured voltage is nearly equal to applied voltage.

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Frequency of AC by Sonometer

Aim: To determine the frequency of AC by sonometer.

Apparatus: Sonometer, Step-down Transformer, Two Bar Magnets etc.

Procedure:

1. Connect the secondary of the step down transformer through a sonometer wire.
2. Place the magnets below the wire and its one pole towards it.
3. Start the current in the circuit by taking certain tension T.
4. Adjust [L_1] of the sonometer wire by adjusting the movable bridge so that wire starts vibrating. The wire should vibrate forming one good loop which can see very easily.
5. Measure the length of the wire between the bridges. Repeat again two more times and find the mean of the three lengths.
6. Repeat the experiment for different tension and find the corresponding resonating lengths.

Observations:

[1] Mass per unit length of wire [**m**]= 0.0155 gm/cm

[2] Mass of pan [$\mathbf{m_0}$]= _____________ gm

Observation Table:

Obs. No.	Mass in pan m_1 gm	Total Mass on the hanger $M=m_0+m_1$ gm	Tension in wire T=Mg dyne	Length of the wire			Mean Length L cm	Frequency of AC Hz
				L_1 cm	L_2 cm	L_3 cm		
1								
2								
3								
4								
5								
6								

Calculation: [show calculation only for one reading]

$$N = \frac{1}{2L}\sqrt{\frac{T}{m}} =$$

Result: Frequency of AC =_____________Hz.

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Torsional Pendulum

Aim: To determine
(i) restoring couple per unit twist in a wire and
(ii) Moment of Inertia of irregular ring using given Torsional Pendulum.

Apparatus: Disc, Regular Ring, Irregular Ring, Stop Watch, etc.

Procedure:

1. First of all oscillate the disc horizontally. The amplitude of oscillation should be small.

2. Measure accurately the time for 10 oscillations thrice. Find mean time T and hence periodic Time [$\mathbf{T_1}$].

3. Now oscillate disc and regular disc simultaneously and find out periodic time of such system [$\mathbf{T_2}$].

4. Finally, suspend the irregular ring and the disc simultaneously and find out periodic time of such system [$\mathbf{T_3}$].

5. Calculate the restoring couple and moment of inertia of the irregular ring using given relations.

Observations:

[1] Moment of Inertia of the given disc = [$\mathbf{I_d}$] = ____________________gm cm^2

[2] Moment of Inertia of the given regular ring = [$\mathbf{I_r}$] =______________gm cm^2

Observations Table:

Obs. No.	Suspended body	Time for 10 Oscillations in sec.			Mean time t sec.	Periodic Time T = t/10 sec.	T^2 sec^2
		t_1	t_2	t_3			
1	Disc					T_1	
2	Disc+ Regular Ring					T_2	
3	Disc+ Irregular Ring					T_3	

Calculations:

[1] The Restoring Couple per unit twist

$C_1 = \frac{4\pi^2 I_d}{T_1^2}$ = ____________________ = _______________________________dyne-cm

$C_2 = \frac{4\pi^2 (I_d + I_r)}{T_2^2}$ = __________________ = ________________________ dyne-cm

Mean value of the Restoring Couple per unit twist

$C = \frac{(C_1 + C_2)}{2}$ ________________ =______________________dyne cm

[2] Calculated Moment of Inertia of the given Disc

$I_d = \left[\frac{T_1^2}{T_2^2 - T_1^2}\right] \times I_r$ = _____________________________

= ________________________ gm cm^2

[3] Moment of Inertia of the given Irregular Disc [Take given value of I_d]

$I_{irregular} = \left[\frac{T_3^2 - T_1^2}{T_1^2}\right] \times I_d$ = ______________________

= __________________________ gm cm^2

Results:

[1] Restoring Couple per unit twist [C] = _______________________dyne cm

[2] Moment of Inertia of the given Irregular Ring

$[I_{irregular}]$=_________________________________gm cm^2

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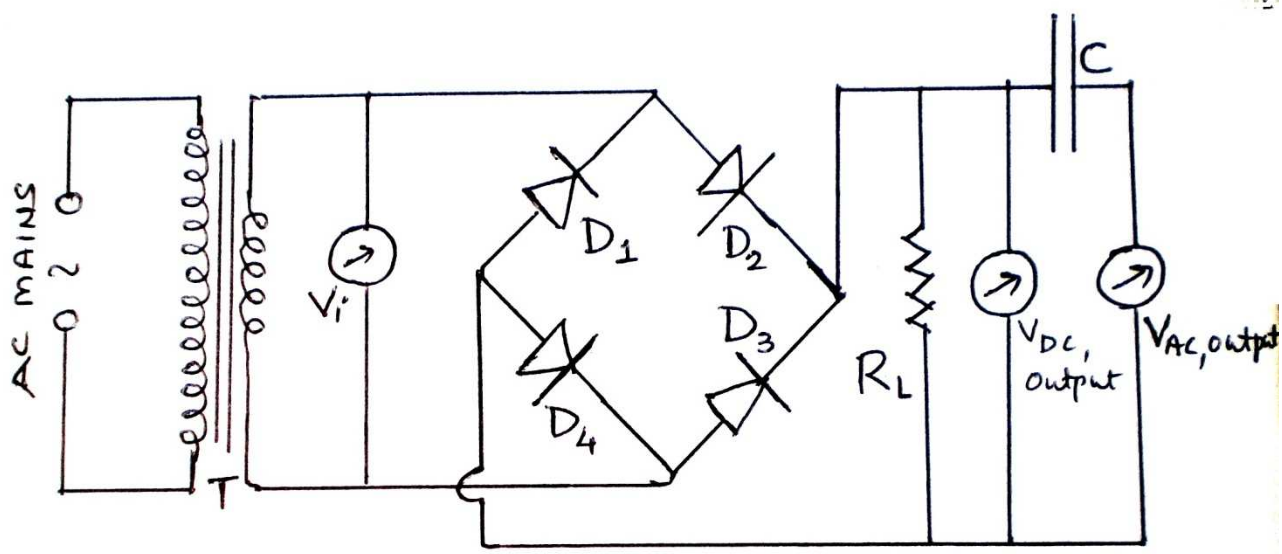
Full-Wave Rectifier [AC Component]

Aim: To study the full-wave rectifier circuit.

Apparatus: Step-down Transformer (0-24V), AC Voltmeter (0-25V), PN junction Diode, Load Resistance, Capacitor

Circuit Diagram:



Here

T → Step-down Transformer (0-24V), **V_{DC}** → DC Voltmeter (0-15V),
V_{AC} → AC Voltmeters (0-25V), (0-15 V),
C → Capacitor **R_L** →Load Resistance
D_1, D_2, D_3 and D_4 → PN junction Diodes

Procedure:

1. Connect the circuit as shown in the circuit diagram.

2. Now switch on the power supply. Select the value of AC input voltage, using the given transformer and measure it [$\mathbf{V_i}$]. Note the corresponding AC output voltage [$\mathbf{V_{AC,\ output}}$] and DC output voltage [$\mathbf{V_{DC,\ output}}$].

3. Now change the value of AC input voltage and measure it. Also note the corresponding output AC and DC voltages.

4. Repeat the experiment for six different values of input AC voltage.

5. Find out the ripple factor [η] of the circuit and calculate theoretical DC voltage [$\mathbf{V_{DC}}$] using given formula and verify the formula.

Observation Table:

Obs. No.	Input AC voltage V_i volt	Output DC voltage $V_{DC,\ output}$ volt	Output AC voltage $V_{AC,\ output}$ volt	Ripple factor $\eta = \frac{V_{AC,\ output}}{V_{DC,\ output}}$	Theoretical Output DC voltage $V_{DC} = \frac{2\sqrt{2}\ V_i}{\pi}$ volt
1					
2					
3					
4					
5					
6					
7					

Calculation: [For any one reading]

[1] Ripple factor [η] $= \frac{V_{AC,\ output}}{V_{DC,\ output}}$ = =

[2] Theoretically the output DC voltage = $V_{DC} = \frac{2V_{i_m}}{\pi}$

Where V_{im} is the peak AC input voltage = $V_{i_m} = \sqrt{2}V_i$

$\therefore\ V_{DC} = \frac{2\sqrt{2}\ V_i}{\pi}$ = ____________ = ______________________

= ____________ volt

Graph: Plot a graph of $V_{AC,\ output}$ against $V_{DC,\ output}$ and also calculate ripple factor.

Results:

[1] The value of ripple factor [η] is as under:

Method	Using formula	Using graph
Experimental value of ripple factor		
Theoretical value of ripple factor	**0.48**	

[2] From the observation table, we can conclude that the theoretically DC output voltage is nearly equal to measured DC output voltage and hence given theoretical formula for output DC voltage is verified.

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Poisson's Ratio for Rubber

Aim: To determine the Poisson's Ratio for Rubber for a given rubber tube.

Apparatus: About One Meter Long Rubber Tube, Burette, Weight, Scale, Pan, Vernier Calipers

Procedure:

1. Suspend vertically a hollow rubber tube having a burette fitted at the upper end from a rigid support. Here the cycle tube is used.
2. Fill the tube along with the burette with water so as to have water level upto the middle of the burette. Attach a pan with pointer arrangement at the lower end of the rubber tube.
3. The pointer can move over a vertical scale. See that there is no air bubble in the tube.
4. Measure the diameter of the rubber tube at various points along its length with the help of vernier calipers.
5. Keep different weights in the pan increasing in the steps of 100 gm or 200 gm. Note the position of the pointer on the scale and the level of water in the burette.
6. Similarly, take the readings of the pointer and the level of water in the burette for unloading in the same step.
7. The reading of the water level in the burette gives the volume V. The position of pointer on the scale gives the length L for the tube.
8. The reading of the pointer and that of the water level in burette should be noted accurately. The tube should not be disturbed while loading and unloading the pan. Tabulate your observation in the tabular form.

Observation:

$$\text{Least count of vernier callipers} = \frac{\text{value of the smallest division on main scale}}{\text{Total no. of division on vernier scale}}$$

$$\text{LC of vernier callipers} = \frac{0.1\,\text{cm}}{10} = 0.01\,\text{cm}$$

Diameter of the Tube

(i) _______________cm (ii)________________cm (iii)______________cm

Mean D ___________________ cm

[2] Radius of the tube [R] = $\frac{D}{2}$ = _________________ cm

[3] Area of cross section of the tube = [**A**]= $A = \pi R^2$

[**A**]= ______________________cm^2

Observation Table:

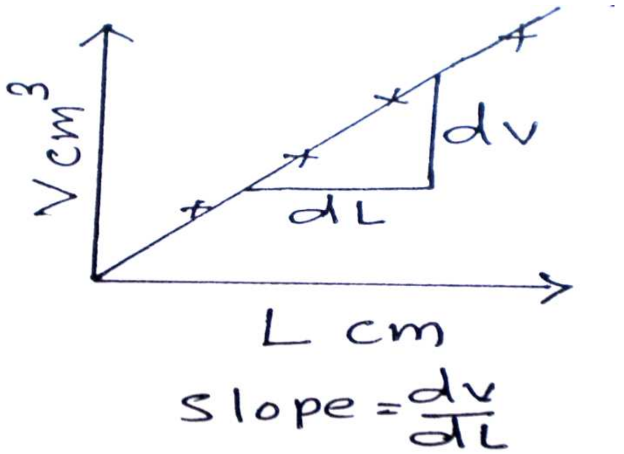
Obs. No.	Weight in Pan gm	Reading of the burette			Reading on the Scale		
		V_1 cm^3	V_2 cm^3	mean V $V = \frac{V_1 + V_2}{2}$ cm^3	L_1 cm	L_2 Cm	mean $L = \frac{L_1 + L_2}{2}$ cm
1							
2							
3							
4							
5							
6							

Graph:
Plot a graph of V against L. The graph will be a straight line. Find the slope (dV/dL) of the graph.

Calculation:

Poisson's ratio $\sigma = \frac{1}{2}\left(1 - \frac{1}{A} \times \frac{dV}{dL}\right)$

$$\therefore \sigma = \frac{1}{2}\left(1 - \frac{1}{A} \times \text{slope}\right)$$



Result: The Poisson's Ratio for Rubber of a given rubber tube is______________.

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Experiment No- ____	**Date ___-___-201__**

'η' by Statical Method

Aim: To determine the coefficient of rigidity of the material of the given rod.

Apparatus: Statical Apparatus, Micrometer Screw, Weights, Thread, Meter scale.

Procedure:

1. In this apparatus the rod whose modulus of rigidity is to be measured is kept horizontal one end of the rod is fixed and the wheel or pulley is attached to the other end of the rod. A pointer with circular scale measures an angle or twist in degree. The pointer can slide on the rod.
2. A force is applied at outer edge or wheel it produces couple called applied couple. The rod is twisted under the action of this applied couple. Generally a force is produced by suspending mass so here the mass is suspended at the edge of wheel on hook. This is taken as zero mass. (Dead mass & the pointer is adjusted on zero of circular scale.
3. A suitable mass is placed on hook & the reading of pointer is noted. This measure an angle of twist in degree.
4. Increase the step by step & the corresponding angle of twist is noted. (Loading)
5. In next step the mass is decreased step by step and the corresponding angle of twist is also noted (unloading). The mean value of angle of twisted is considered for calculation.
6. In twisted position of the rod, the restoring couple is equal to the applied couple. The restoring couple = Cθ, where C is the restoring couple per unit twist.

Observations:

$$LC\ of\ Micrometer\ Scerw = \frac{Pitch\ (p)}{Total\ nos\ of\ divisions\ on\ head\ scale} = \frac{0.1\ cm}{100}$$
$$= 0.001\ cm$$

Zero error = ± ________________________cm

Diameter of the rod using micrometer screw

(i) ______________cm (ii) ______________ cm (iii) ______________ cm

Mean diameter [**d’**] = ______________cm

Mean corrected diameter [d] = d’ ∓ Zero error = ______________cm

Radius of the rod = r = d/2 = ______________cm

Circumference of the wheel or pulley [S]= ______________cm

Diameter of the wheel or pulley = D = S/π =______________cm

Observation Table:

Sr No	Length of the rod from fixed end	Applied mass M gm	Reading of the pointer in degree		Mean angle $\theta = \frac{[a+b]}{2}$ in degree	Angle of twist for 500 gm in degree	Mean angle of twist for 500 gm
			loading [a]	unloading [b]			
1							
2							
3	l_1						θ_1
4							
5	=_______cm						=________°
6							
1							
2							θ_2
3	l_2						
4	=______cm						=__________°
5							
6							

Calculations:

[1] $\eta = \frac{180MgD}{\pi^2 r^4} \times \frac{l_1}{\theta_1}$

= ____ dyne/cm^2

[2] $\eta = \frac{180MgD}{\pi^2 r^4} \times \frac{l_2}{\theta_2}$

= ____ dyne/cm^2

Find Mean η =

Result: The coefficient of rigidity of the material of the given rod [η] is found to be ____ dyne/cm^2.

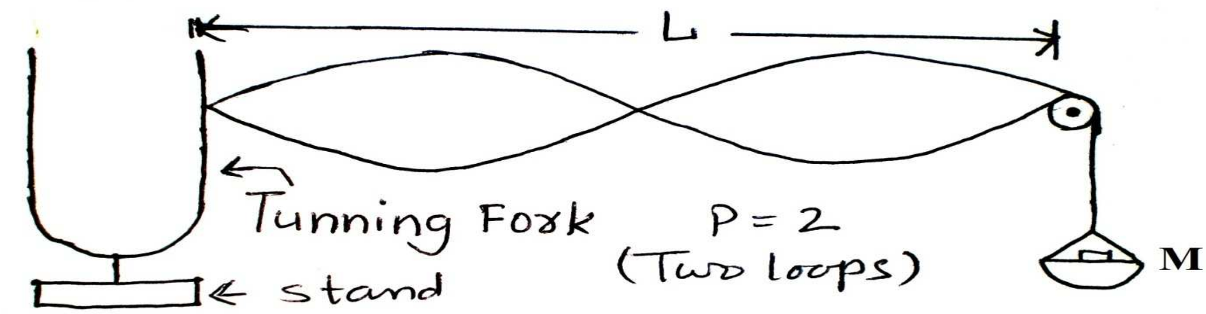
Teacher's Signature	**Date :**					**1**	

Experiment No- ____ Date ___-___-201__

Melde's Experiment [$\frac{P}{L}$ = constant]

Aim: To verify the law of vibration of stretched strings
($P \propto L$ or $\frac{P}{L} = Constant\ if\ T = Constant$)

Apparatus: Melde's Apparatus, Hammer, Light Pan, Meter Scale and String



Procedure:

1. Find the mass [$\mathbf{m_0}$] of the pan.

2. Adjust the tuning fork in A position. (i.e. parallel to vibrating string) Put some mass [$\mathbf{m_1}$] in the pan. Calculate tension [**T**][= $(m_0 + m_1)g$] in the string.

3. Keep the fork near the pulley. Strike the hammer against one of the prong of the fork, so that the prongs vibrate in their plane.

4. Adjust the length of the string in such a way that a one well defined loop is seemed, which last over a long period are obtained.

5. Measure the length [$\mathbf{L_1}$] of the string between the fork and the centre of the pulley.

6. In a similar manner, determine the length L_2 and L_3 for one loop and hence obtain the average L of L_1, L_2 and L_3.

7. Keeping the same tension, determine the average length for 2, 3 and 4 loops.

8. Now adjust the fork B (i.e. in perpendicular position) and repeat the experiment with the same tension and same number of loops.

Observations:

1 Mass of the pan = m_0 = ________________ gm

2 Mass in the pan = m_1 = ________________ gm

3 Total mass in the pan = $M = m_0 + m_1$ = ______________________ gm

4 Mass per unit length of the given string = $m = 4.1 \times 10^{-4}$ gm/cm

Observation Table:

Position of the fork	No. of loop P	Vibrating length of the string			Average length of the string L cm	$\frac{P}{L}$ cm^{-1}	Mean $\frac{P}{L}$ cm^{-1}
		L_1 cm	L_2 cm	L_3 cm			
A Parallel position	1						
	2						
	3						
	4						
	5						
B Perpendicular position	2						
	3						
	4						
	5						

Calculations:

<table>
<tr>
<td rowspan="2">[only for any one reading]

$T = (m_0 + m_1)g$

= _______________dyne

$\sqrt{\frac{T}{m}}$ =________________

=______________</td>
<td>Frequency of the fork (in A position)
$N = \left(\frac{P}{L}\right)_{Mean}\sqrt{\frac{T}{m}}$

= ____________________vibrations/sec</td>
</tr>
<tr>
<td>Frequency of the fork (in B position)
$N = \frac{1}{2}\left(\frac{P}{L}\right)_{Mean}\sqrt{\frac{T}{m}}$

= _________________ vibrations/sec</td>
</tr>
</table>

Results:

The frequency of the given tuning fork (N) for A position = ________________ vibrations/sec and for B position = _______________ vibrations/sec.

Teacher's Signature	Date :					1	

Experiment No- ____ **Date ___-___-201__**

'Y' by Cantilever

Aim: To determine Young Modulus of a beam of a rectangular bar in the form of cantilever.

Apparatus: Rectangular Bar Strip, C-clamp, Weight Box, Pointer, Meter Scale, Vernier Calipers, Micrometer Screw, Stand

Procedure:

1. Measure the length of a beam [**L**] forming a cantilever between the point of support and the end of a beam.
2. Measure breadth of the given beam [**b**] by means of vernier calipers and thickness of the beam [**d**] by means of micrometer screw.
3. The beam is rigidly fixed at one end by means of C-clamp. The other end is loaded with different masses. First observation for zero mass should be taken without hanger. Second observation for 50 gm should be taken with only hanger.
4. The depression is measured directly by means of pointer attached at the end of a beam on the scale placed beside the pointer.
5. The readings on the scale are noted while loading and unloading find the depression [**e'**] for different masses.
6. Draw a graph of masses [**M**] against depression [**e'**]. Find slope of the graph and hence calculate the young modulus [**Y**].

Observation:

$$\text{Least count of vernier callipers} = \frac{\text{value of the smallest division on main scale}}{\text{Total no. of division on vernier scale}}$$

$$\text{LC of vernier callipers} = \frac{0.1\ \text{cm}}{10} = 0.01\ \text{cm}$$

Breadth of the given beam using Vernier Calipers':

(1) ______________cm (2) ______________ cm (3) ______________ cm

Mean breadth [b]= ______________ cm

$$\text{LC of micrometer screw} = \frac{\text{Pitch}}{\text{Total no. of divisions on head scale}} = \frac{p}{n} = \frac{0.1\text{cm}}{100} = 0.001\ \text{cm}$$

Zero error = ± ______________ cm

Thickness of beam using micrometer screw

(i) ______________ cm (ii) ______________ cm (iii) ______________ cm

Mean thickness [**d'**] = ______________ cm

Mean corrected thickness [d] = d' ∓ Zero error = ______________ cm

[C] Measure the length of given cantilever [L] = ______________ cm

Observation Table:

Obs. No.	Load M gm	Reading of the pointer on the scale while		Mean $= \frac{x+y}{2}$ cm	Depression for same load [e] cm	Depression for different loads e' cm
		Loading cm 'x'	Unloading cm 'y'			
1	0			a	-	-
2	50			b	a~b	a~b
3	100			c	b~c	a~c
4	150			d	c~d	a~d
5	200			e	d~e	a~e
6	250			f	e~f	a~f
7	300			g	f~g	a~g

Calculations:

[1] Numerical Method [From Table mean e ____________________cm]

[From Table, $\left(\frac{M}{e}\right)_{mean} = \frac{50\ gm}{mean\ \ e}$ = _______________ gm/cm]

$$Y = \frac{4\,g\,L^3}{b\,d^3} \times \left(\frac{M}{e}\right)_{mean} =$$

= ____________________________________dyne/cm^2

[2] Graphical Method

[Draw a graph of M ⟶ e' and find slope of the graph.

From Graph, Slope = m/e' = ______________________________ gm/cm

$$Y = \frac{4\,g\,L^3}{b\ \ d^3} \times \text{slope} =$$

= ____________________________________dyne/cm^2

Results:

The Young Modulus of material [Y] of the given rectangular bar is equal to _________________dyne/cm^2 [From Numerical Method] and _______________ dyne/cm^2 [From graphical method] in this experiment.

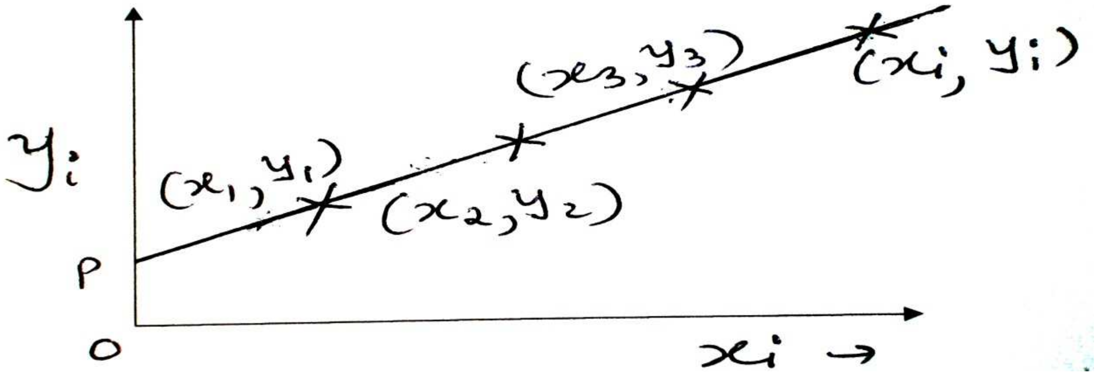
Teacher's Signature **Date :** | | | | | 1 | |

Experiment No- ____ **Date ___-___-201__**

Linear Least Square Fitting Method

Aim: To determine slope and intercept on y-axis of the given linear data using the least square fitting method.

Theory: The least square method is a standard statistical method. Suppose there are n pairs of measurements (x_1, y_1), (x_2, y_2), (x_3, y_3)… (x_i, y_i)..(x_n, y_n). Let us consider a curve passing through these points in a straight line.



The general form of equation of a straight line is

$$y = m x + c \quad \textbf{(1)}$$

Where c represents the intercept along y-axis and m is the slope of the line, respectively.

For a given pair of data (x_i, y_i), the best-fitted values of m and c are given by

$$m = \frac{\sum d_i y_i}{\sum d_i^2} \quad \text{and} \quad c = \overline{y} - m\,\overline{x} \quad \textbf{(2)}$$

Where, deviation in individual measurement = $d_i = x_i - \overline{X}$ **(3)**

$$\overline{X} = \text{Average value of } x_i = \overline{X} = \frac{\sum x_i}{n} \quad \text{and} \quad \textbf{(4)}$$

$$\text{Average value of } y_i = \overline{Y} = \frac{\sum y_i}{n} \quad \textbf{(5)}$$

Method:

Suppose there are n pairs of measurements in which nature of the graph is linear. For example, in the experiment of flywheel, angular acceleration for different ten values of applied couple. Take y_i **=** angular acceleration and x_i = applied couple. Using equation (2) calculates the values of slope (m) and intercept on y-axis (c), which are moment of inertia and frictional couple of the flywheel.

Observation Table:

Obs No.	x_i	y_i	$d_i = x_i - \overline{x}$	$d_i\ y_i$	d_i^2
1	0.1	8675			
2	0.2	9632			
3	0.3	10589			
4	0.4	11789			
5	0.5	12589			
6	0.6	13654			
7	0.7	14563			
8	0.8	15547			
9	0.9	16987			
10	1	18267			
n=10	$\sum x_i =$ ____ $\overline{X} = \frac{\sum x_i}{n}$ =__________	$\sum y_i =$ ______ $\overline{Y} = \frac{\sum y_i}{n}$ =__________		$\sum d_i y_i =$ ____	$\sum d_i^2 =$ ______

Graph: Plot a graph of $y_i \rightarrow x_i$ and find out slope and intercept on y-axis.

Calculations:

	Using Computation	**From Graph of $y_i \rightarrow x_i$**
Moment of Inertia of the fly-wheel	$m = \frac{\sum d_i y_i}{\sum d_i^2}$ = =_________	Slope =AB/BC =________________ =______________gm cm^2
Frictional couple	$c = \overline{Y} - m\ \overline{X}$ =__________ dyne-cm	Intercept on Y-axis OP =________________dyne-cm

Numerical DATA

Set-I

Obs No.	x_i	y_i
1	0.1	7564
2	0.15	9435
3	0.2	10438
4	0.25	12627
5	0.3	14253
6	0.35	16620
7	0.4	18246
8	0.45	20357
9	0.5	22654
10	0.55	24357

Set-II

Obs No.	x_i	y_i
1	0.1	7564
2	0.2	9435
3	0.3	10438
4	0.4	12627
5	0.5	14253
6	0.6	16620
7	0.7	18246
8	0.8	20357
9	0.9	22654
10	1	24357

Results: The following results are obtained in this experiment:

	The least square fitting method	**The graphical method**
Moment of Inertia of the flywheel		
Frictional Couple		

Teacher's Signature	**Date :**					**1**	

VP & RPTP Science College, Vallabh Vidyanagar
BSc [Semester-I] Subject: Physics Course Number: US01CPHY03
Viva-Voce

Section	Name of the experiments
Electronics and Electricity	**1.** PN junction diode (Forward Bias) **2.** Half Wave Rectifier [AC Component] **3.** Full Wave Rectifier [AC Component] **4.** Zener Diode characteristics **5.** Frequency of AC by Sonometer **6.** Conversion of Galvanometer into Voltmeter
General Physics	**7.** Melde's Experiment [$\frac{P}{L} = \text{cons tan t}$]
Elasticity	**8.** 'η' by Statical Method **9.** Poisson's Ratio for rubber **10.** 'Y' by Cantilever **11.** Torsional pendulum
Numerical	**12.** Least Square Fitting Method

ELECTRONICS-General Questions

What is Electronics?

The word 'ELECTRONICS' is derived from ELECTON mechanICS.

"The electronics means the study of the behavior of an electron under different conditions of externally applied fields".

OR

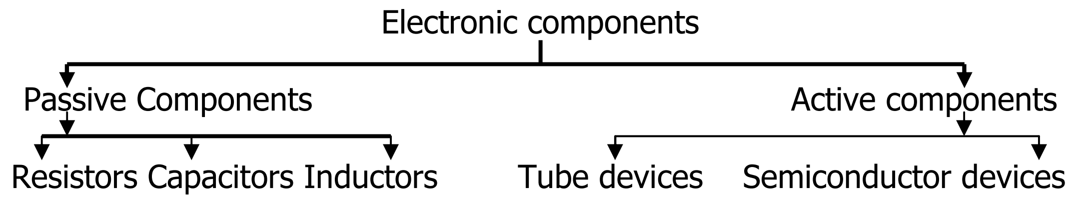
"The field of science and engineering which deals with electron devices and their utilization".

What are the applications of Electronics?

The major fields of application of electronics are Communications and Entertainment, Defense (Radar, Guided missiles, Coded communications), Industry (Automatic control system, Heating and Welding , Computers), Medical (X-rays, EM), Instrumentation (precision measuring instruments, VTVM, CRO, pH meter).

COMPONENTS OF ELECTRONIC CIRCUIT

What are the basic components of any electronic circuit?



Define Passive Components? Give examples.

The components of the circuit, which are not capable of amplifying or processing electrical signals by themselves. e.g. Resistor, Inductor, Capacitor etc.

What are active components in a circuit?

The components of the circuit which can process or amplify the input signal are called active components.

Give some examples of active components of the circuit?
Tube device such as Gas diode, Vacuum triode, Vacuum pentode, Vacuum diode
Semiconductor device such as PN junction diode, Zener diode, Transistor

RESISTORS - PASSIVE COMPONENTS

Electrical Resistance: The natural property of a substance which opposes the flow of current through it is called resistance. It is measured in ohm.

Electrical resistivity: A measure of materials ability to oppose the flow of an electric current. The resistivity of materials is given by $\rho = \frac{R\,A}{l}$, where R is the resistance of uniform specimen of the materials having length (l) and cross sectional area (A). It is measured in ohm – meter.

Electrical conductivity: It is reciprocal of the electrical resistivity (σ).

State Ohm's law.

The ratio of the potential difference between two ends of a conductor to the current flowing through it is constant. This constant is the resistance of the conductor. i. e.

$$R = \frac{V}{I} \quad \text{measured in} \quad \frac{\text{Volt}}{\text{Ampere}} = \text{ohm}\,.$$

Where V is the potential difference in Volt, I is the current in Ampere and R is the resistance in Ohm.

One ohm: If one ampere of current flow through a circuit at an applied e. m. f. of one volt, the resistance of the circuit is said to be one ohm.

CAPACITOR - - PASSIVE COMPONENT

Capacitor: A capacitor is basically meant to store electrons (or electrical energy), and release whenever desire.

- It is a device in which a large amount of charge can be stored.
- It consists of two metal plates placed parallel to each other at a short distance. The intermediate space is filled with some dielectric.

Capacity of a capacitor: Capacitance of a capacitor is ratio of electric charge on it to it's electric potential due to that charge. $C = \frac{Q}{V} \frac{\text{Coulomb}}{\text{Volt}}$

One farad: Capacitance of a capacitor is said to be 1 farad if one Coulomb of charge raises it's potential through 1 volt. $1\,\text{farad} = \frac{1}{1} \frac{\text{Coulomb}}{\text{Volt}}$

- Farad is a big unit. Smaller units generally used are:
- 1 micro-farad (μF) = 10^{-6} farad
- 1 micro-micro-farad (μμF) = 1 pF = 10^{-12} farad

On what factors the capacity of a capacitor depends?

It depends upon the following three factors

Area of the plate, capacity increases with the increase of area.

Distance between the plates, capacity increases when the distance between the plates is decreased.

Dielectric constant of the medium, greater the value of the dielectric constant, greater the capacity.

What is the function of the dielectric in the capacitor?

- It increases the capacity of the capacitor.

Dielectric constants of the materials: The ratio of the capacitance with and without the dielectric between the plates is called dielectric constant of the material used.

- **Which is the best dielectric and why?**

- **Mica** is the best dielectric because its value is high and the dielectric strength is several kilovolts per mm i. e. its insulation does not break even if high potential difference is applied on its coating. It is used in all good standard capacitor.

Types of capacitors: The type of capacitor is usually denoted by the name of the dielectric used in the capacitor such as paper, mica, ceramic, electrolytic, air, oil etc.

INDUCTOR - - PASSIVE COMPONENT

Inductors: When current flow through a wire that has been coiled, it generates a magnetic field. This magnetic field reacts so as to oppose any change in current. This reaction of magnetic field, trying to keep the current flowing at a steady rate, is known as 'inductance'. The force is developed is called 'inductor'.

Self induction. For medium with constant permeability, magnetic flux linked with the circuit is proportional to current flowing through it. $\phi \; \alpha \; i$ or $\phi = Li$, L is self inductance.

[if $i=1$ then $\phi = Li$]

Self induction is defined as flux linked with coil when unit current flows through it.

OR $\varepsilon \; \alpha \; -\frac{di}{dt}$ or $\varepsilon = -L\frac{di}{dt}$ if $\frac{di}{dt}=1$ then $\varepsilon = L$

Self inductance is defined as emf induced in the circuit when the rate is of change of current is unity.

What is the unit of self inductance? It is measured in henry.

Define one henry. The inductance of a coil is said to be 1 henry if emf of 1 volt is induced when current in it changes at the rate of 1 ampere per second.

ACTIVE COMPONENTS

SEMICONDUCTORS- SEMICONDUCTOR DIODE-ZENER DIODE

What is a semiconductor ? A semiconductor is a solid material whose electrical resistivity is higher than that of a conductor and lower than that of an insulator.

Name at least two conductors, two insulators and two semiconductors?

Define intrinsic and extrinsic semiconductors?

Define doping. It is the process of adding impurity (trivalent or pentavalent) to pure semiconductor in desired quantity to alter its properties.

Define N-type semiconductor (donor type semiconductor).
An impurity semiconductor is said to be of donor type or N-type, if the impurity has valency of five.
Define P-type semiconductor (accepter-type semiconductor).
Explain what is a hole?
Explain why pentavalent impurity atom is known as donor-type impurity?
Explain why trivalent impurity atom is known as acceptor-type impurity?

What is PN Junction diode?
What is forward biased diode?
What is reverse biased diode?
What are the applications of PN junction diode? Ans In a rectifier, detector circuits and switching circuits

RECTIFIER- HALF- WAVE RECTIFIER AND FULL- WAVE RECTIFIER CIRCUITS

Define rectifier. Rectifier is a circuit which converts AC into DC.

Define AC. An electrical current that reverse it direction with a constant frequency.

Define DC. An electrical current in which net flow of charge is in one direction only.

Define rectification. Rectification is a conversion of AC into DC.

Name the device or element that is used as rectifier.

Define half wave rectifier.

When a single diode is used as a rectifier, it rectify only half cycle of an input AC signal. This is known as half wave rectifier.

Define full wave rectifier.

When a pair of diode (or four diodes) is used as a rectifier, it rectify both cycle of an input AC signal. This is known as full wave rectifier.

Define construction of Full wave Rectifier?

Full wave rectifier is a circuit which rectifies both half cycles of the AC when P of 1st diode is positive, the 1st diode is forward biased and will conduct. Now the 2nd diode will not conduct as it is reverse biased. In all the half cycles either of the two diodes will be conducting. The efficiency of a full wave rectifier is about 81.2 %, twice the efficiency of a half wave rectifier.

What are the merits of Full Wave Rectifier?

Major advantage of full-wave and bridge rectifiers over half-wave rectifiers is the ease of filtering their output voltages. You can now see the reason for this. The ripple frequency is doubled; therefore, the time period the capacitor is allowed to discharge is cut in half. This means that the capacitor discharges less. Thus, ripple amplitude is less, and a smoother output voltage occurs.

What are the major disadvantages of Full Wave Rectifier?

The only disadvantage is that the peak voltage in a full-wave rectifier is only half the peak voltage in a half-wave rectifier. This is because the secondary of the power transformer in a full-wave rectifier is center tapped; therefore only half the source voltage goes to each diode.

What is a filter circuits? Explain importance of the filter circuit in the rectifier circuit.

The output of the rectifier circuit is unidirectional but varies with time i. e. it is not a steady direct current. The filter circuit is used to obtain steady dc or to removes ripples from the output of a rectifier circuit.

Give name of the different filters.

Shunt Capacitor Filter, Series Inductor Filter, LC Filter Circuit and π - Filter Circuit

ZENER DIODE

What is a zener diode?

A heavily doped P-N junction which has a sharp breakdown voltage is called as a zener diode.

What is diode? The diode is a device which has two electrodes.

On what factor does the breakdown voltage of a zener diode depends?

The breakdown voltage of a zener diode depends upon the amount of doping. If the diode is heavily doped, the depletion layer will be thin and consequently the breakdown of the junction will occur at a lower reverse voltage.

What is breakdown voltage?

When the reverse bias on a zener diode is increased, a critical voltage is reached at which the reverse current increases sharply to a high value. This critical voltage is called breakdown voltage.

What is the difference between an ordinary diode and a zener diode?

- A zener diode is like an ordinary diode except that it is properly doped so as to have a sharp break down voltage.
- It has a sharp breakdown voltage called zener voltage
- When forward biased, zener diode characteristics are just that of ordinary diode
- A zener diode is always reverse biased.

Why zener diode is always reverse biased?

Because it utilize reverse characteristics for acting like a voltage regulator.

Mention the uses of zener diode.

A zener diode is used as a voltage regulator to provide a constant voltage from a source whose voltage varies over sufficient range.

What do you mean by voltage regulations?

The variation in output of a rectifier with changes in load current is known as voltage regulations of the circuit. The voltage regulation is defined as the ratio of voltage at no load minus voltage at full load divided by voltage at full load.

CONVERSION OF GALVANOMETER INTO VOLTMETER

1. Explain basic principle of the experiment.
2. Explain construction and working of galvanometer.
3. Explain construction and working of Voltmeter.
4. What is the use of a galvanometer?
5. What is the use of a voltmeter?
6. Compare voltmeter and ammeter.
7. What is the basic Principle of the experiment?

Frequency of AC by Sonometer

What is meant by electric current? The flow of electrons.

What are AC and DC? Alternating current (AC) changes its direction with a definite frequency. The direct current (DC) flows in one direction only.

What is meant by frequency? Number of vibrations per sec.

What is the frequency of AC in INDIA? Ans. 50 cycles/s.
What types of waves are produced in the thread? Ans. Transverse stationary waves.
What kind of vibrations are produced in the thread? Ans. Forced vibrations.

If the tension (T or Mg) is increased by four times what will be the effect on the length of one loop?
Ans. The relating f = 1 √Mg/m shows that length of the loop (l) will increase by two times.

What will happen if supply DC current?

Ans. The rod will not vibrate because the soft iron piece will be magnetized in one direction only.

What is the frequency of DC? Ans. Zero.

Why the wire is vibrating? Ans. The magnetic field produced by soft iron strip reverses its direction 50 times in each second.

What do you mean by stationary or standing waves?
Ans. When two exactly similar waves (same amplitude, frequency and time period) traveling in opposite directions with equal velocity superpose on one another in a confined medium (say pipe), the resultant wave obtained is called stationary or standing wave.

What type of waves are formed in the string?
Ans. Transverse stationary waves are formed in the string.

Define Sonometer.

General Physics Melde's Experiment [$\frac{P}{L} = \text{constant}$]

Statement of the law that you going to prove by Melde's Experiment?
Define Stationary waves
Define Transverse wave
What is sound? Ans. Physically the compressional waves produced in a material medium. Psychologically the sensation or hearing produced in the brain.

What is the relation between the velocity of sound and the temperature?
Ans. $V \propto \sqrt{T}$
For 1°C rise of temperature the velocity of sound increases by 0.6 m/s.

What is the fundamental frequency?
Ans. The minimum frequency that can produce resonance.

Define time period. Ans. It is the time required to complete one vibration or oscillation. It is reciprocal of frequency and measured in seconds.

What is resonance? Ans. Resonance is a phenomenon in which there is a marked increase in the amplitude of a vibrating, body by the influence of a second vibrating body having the same time period as the first.

OR

When the frequency equal to natural frequency of the body is given to it then the body started oscillating with very high frequency. This phenomenon is called resonance.

Elasticity General Questions

1. **Define elasticity.** It is a property of materials body to regain their original length, volume or shape after the deforming force has been removed.

2. **Define plasticity.**

3. **Define Stress.** The restoring force per unit area set up inside the body which is under the influence of deforming force.

4. **Define Strain.** The ratio of change in length (L), volume (V) or shape to the original length (L) volume (V) or shape.

5. What are the different types of stress and strain?

6. **State Hooke's Law.** If the deforming force is not greater than elastic limit, the strain is directly proportional to the stress. Stress α Strain **or** Stress = E Strain
   Here constant 'E' is called "MODULUS OF ELASTICITY".

7. **What is elastic limited?** The maximum value of stress beyond which stress is not proportional to strain. (Beyond elastic limit strain is rapid).

8. **What are the units of (a) Stress and (b) Strain?**
   Ans. (a) newton / meter^2 or dyne / cm^2
   (b) No units since if the ratio between the similar quantities

9. **Gases and liquids have elasticity or not?** Yes, they have.

'Y' BY CANTILEVER

1. Define Young's Modulus (Y). **Ans:** The ratio of linear stress to the linear strain.
2. Define cantilever.
3. What is axis of bending and bending moment?
4. Which are the two methods to determine Y?
5. Which factors affect the final result of your experiment?
6. How will be the value of Y change with a change in *l*, *b* or *d* of the beam?
7. In this experiment which quantities should be measured accurately? Why?

'η' by STATICAL METHOD

1. Define Modulus of Rigidity (η).
2. What are its units?
3. Is there any change in the angle of twist if the diameter of the cylinder is changed?
4. How do you change η change with the change in the length and radius of the wire?
5. Which are two method of determination of Modulus of Rigidity (η) ?

POISSON'S RATIO FOR RUBBER

1. Define Poisson's Ratio (σ).
2. Define lateral and linear strain.
3. State the limiting values of σ ?
4. Which factors affect the final result of your experiment?

TORSIONAL PENDULUM

5. What is Torsional pendulum?
6. State two applications of this experiment.
7. Define period time.
8. Which factors affect the final result of your experiment?

9. Define Moment of Inertia and radius of gyration.
10. Which factors affect the Moment of Inertia?
11. Define Couple/torque.

NUMERICAL - LEAST SQUARE FITTING METHOD

1 Explain the basic principle of this experiment.
2 Why this method of computation is called as least square fitting method?
3 Define error.
4 What is significance of error in science?
5 What is an equation of straight line?