# VP & RPTP Science College

**Vallabh Vidyanagar-388120**

**BSc [Semester- Second] Physics Practical Record Book**

**Course Number: US02CPHY03**

**Name:**_______________________________________________

**Roll No:**________ **Division:** ____ **Batch:**_______

**Day:** ____**day and** ______**day** **Timing:** _________**to**________

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

*Confucius*

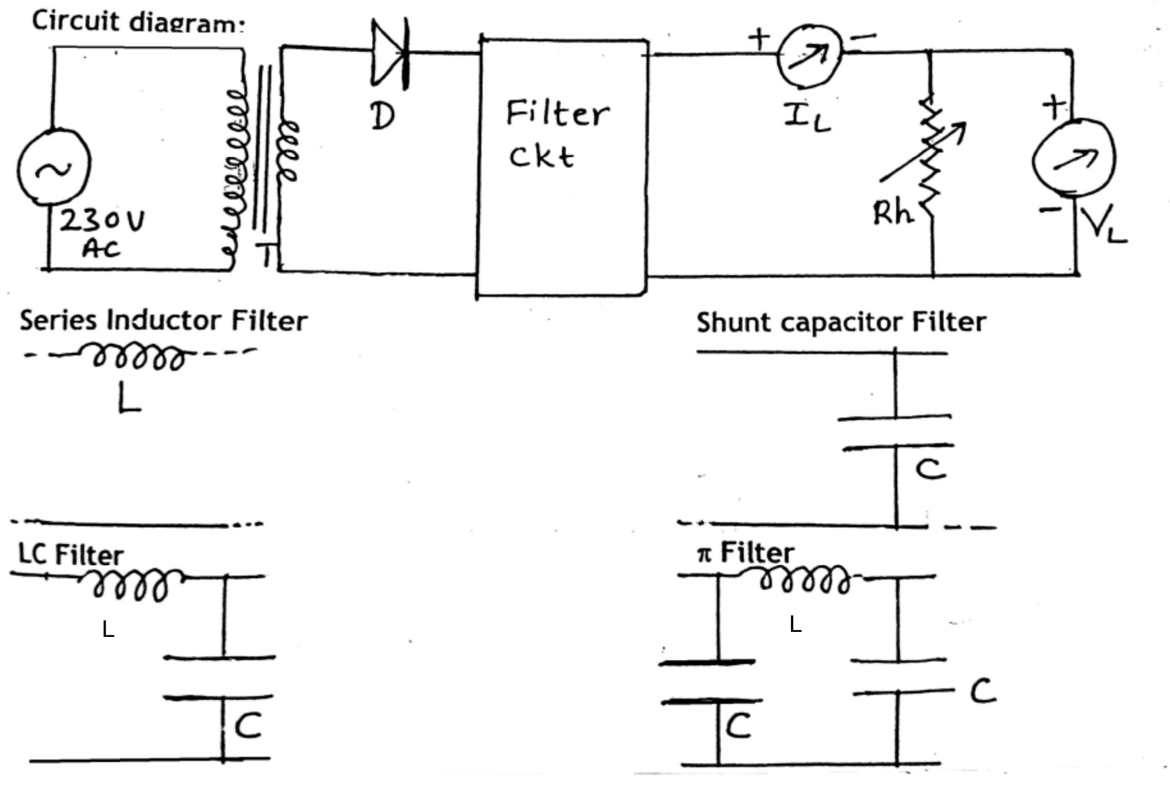
One of the best ways to understand something is to get your hands on it and actually experiment with it.

# Half Wave Rectifier with Filters

**Aim:** To study the filter circuits with half wave rectifier.

**Apparatus:** Experimental Circuit Board, DC Voltmeter (0-15V), DC Milliammeter (0-100 mA)

**Circuit diagram:**

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| | | | | | |
|---|---|---|---|---|---|
| **D** | → | **Diode** | **$V_L$** | → | **DC Voltmeter (0-15V),** |
| **$I_L$** | → | **DC Milliammeter (0-100 mA)** | **C** | → | **Capacitor** |
| **T** | → | **Step down Transformer** | **L** | → | **Inductor** |
| **Rh** | → | **Potentiometer** | | | |

**Procedure:**

**[1]** Connect half wave rectifier with milliammeter in series and voltmeter across load resistance. The inductor is connected in series (i.e. series inductor filter circuit). Observe proper polarity while working with DC meters.

**[2]** The load resistance is varied from maximum to minimum value. The output DC voltage (**$V_L$**) and output DC current (**$I_L$**) are measured in each case. Take at least six observations.

**[3]** Repeat the experiment with shunt capacitor filter in which short the inductor and shunt the capacitor and repeat the procedure.

**[4]** Similarly study the LC filter and $\pi$ filter.

**[5]** Plot a graph of $V_L$ versus $I_L$ for all filters on the same graph paper.

**Observation Table:**

**[1] Series Inductor Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Resistor $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**[2] Shunt capacitor Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Resistor $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**[3] LC Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Resistor $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**[4] $\pi$ Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Register $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**Calculation: Calculations: The voltage regulation in percentage**

## [1]For Series Inductor Filter

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

$=$ ________________ **%**

## [2] For Shunt capacitor Filter

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

$=$ ________________ **%**

## [3] For LC Filter

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

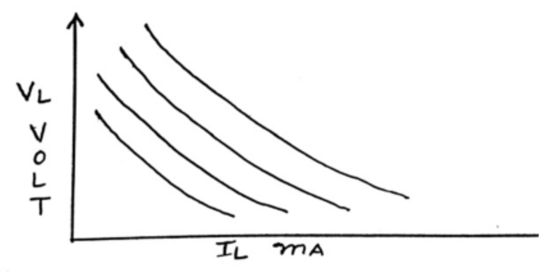
$=$ ________________ **%**

## [4] For $\pi$ Filter

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

$=$ ________________ **%**

**Graph**: Plot a graph of $V_L$ (in volt) versus $I_L$ (in mA) for all filter circuits.




**Results:** The following vales of voltage regulation in % are obtained ____________________% [Series Inductor filter], _______________% [Shunt Capacitor filter], _________________________% [LC filter] and _____________________% [$\pi$-filter].

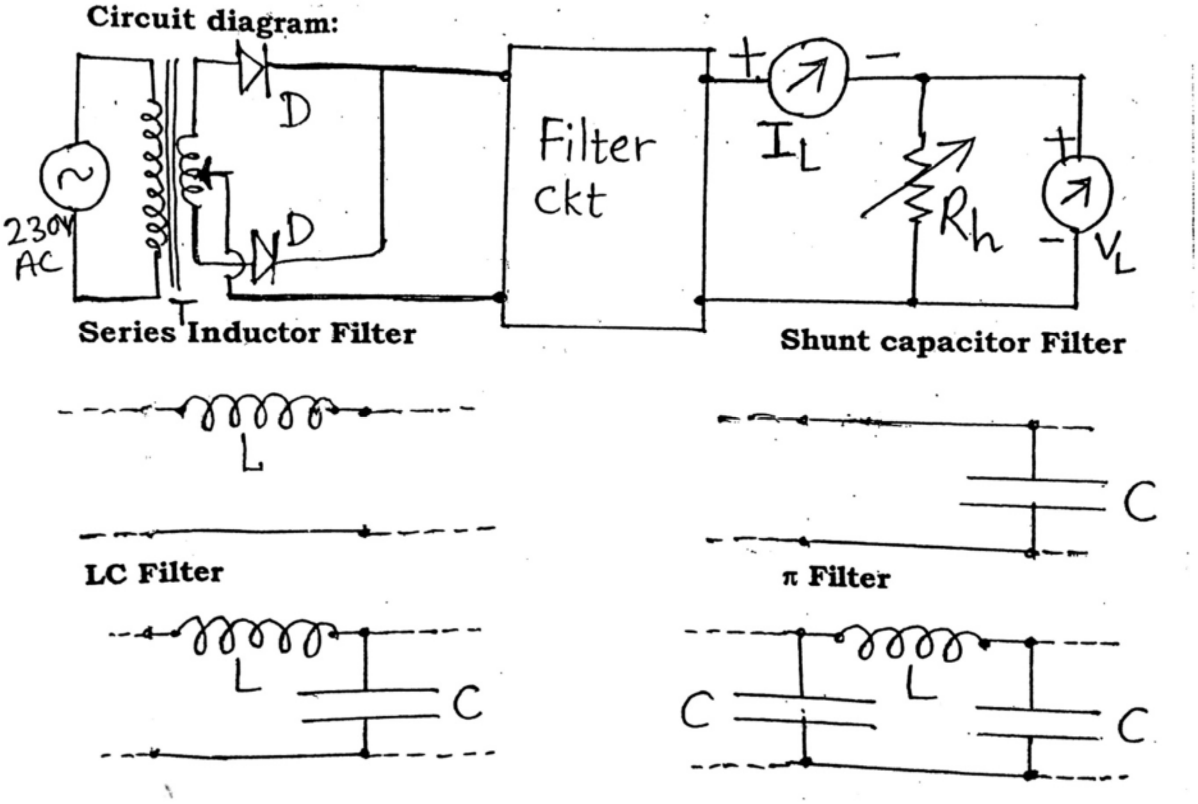
| Teacher's Signature | Date : | | | | | 1 | |
|---|---|---|---|---|---|---|---|

# Full Wave Rectifier with Filters

**Aim:** To study the filter circuits with full wave rectifier.

**Apparatus:** Experimental Circuit Board, DC Voltmeter (0-15V), DC Milliammeter (0-100 mA)

**Circuit diagram:**




**Here**

| | | | | | |
|---|---|---|---|---|---|
| **D** | → | **Diode** | **$V_L$** | → | **DC Voltmeter (0-15V),** |
| **$I_L$** | → | **DC Milliammeter (0-100 mA)** | **C** | → | **Capacitor** |
| **T** | → | **Step down Transformer** | **L** | → | **Inductor** |
| **Rh** | → | **Potentiometer** | | | |

**Procedure:**

**[1]** Connect full wave rectifier with milliammeter in series and voltmeter across load resistor. Connect series inductor filter circuit.

**[2]** Observes proper polarity while working with DC meters.

**[3]** The load resistance is varied from maximum to minimum value. The output voltage ($V_L$) and output current ($I_L$) are measured in each case.

**[4]** Take at least six observations.

**[5]** Repeat the experiments with other filter circuits. In the shunt capacitor filter, short the inductor and shunt the capacitor. Similarly study the LC filter and $\pi$ filter.

**[6]** Plot a graph of $V_L$ *vs* $I_L$ for all filters on the same graph paper.

**Observation Table:**

**[1] Series Inductor Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Resistor $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**[2] Shunt capacitor Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Resistor $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**[3] LC Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Resistor $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**[4] $\pi$ Filter**

| Obs. No. | Output DC voltage $V_L$ volt | Current through load Register $I_L$ mA |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

**Calculation: Calculations: The voltage regulation in percentage**

**[1]For Series Inductor Filter**

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

= ________________ **%**

**[2] For Shunt capacitor Filter**

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

= ________________ **%**

**[3] For LC Filter**

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

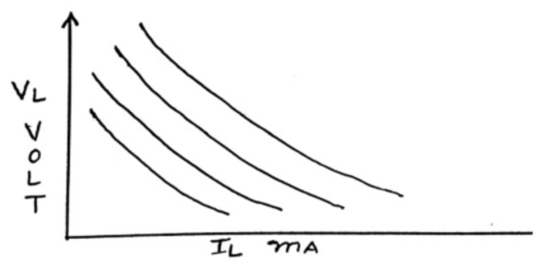
= ________________ **%**

**[4] For $\pi$ Filter**

$$\%\ \boldsymbol{of\ Voltage\ regulation} = \frac{\boldsymbol{V_{L\,(Max)} - V_{L\,(Min)}}}{\boldsymbol{V_{L\,(Max)}}}$$

= ________________ **%**

**Graph**: Plot a graph of $V_L$ (in volt) $\longrightarrow I_L$ (in mA) for all filter circuits.




**Results:** The following vales of voltage regulation in % are obtained __________________% [Series Inductor filter], ______________% [Shunt Capacitor filter], ______________________% [LC filter] and ___________________% [$\pi$-filter].

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

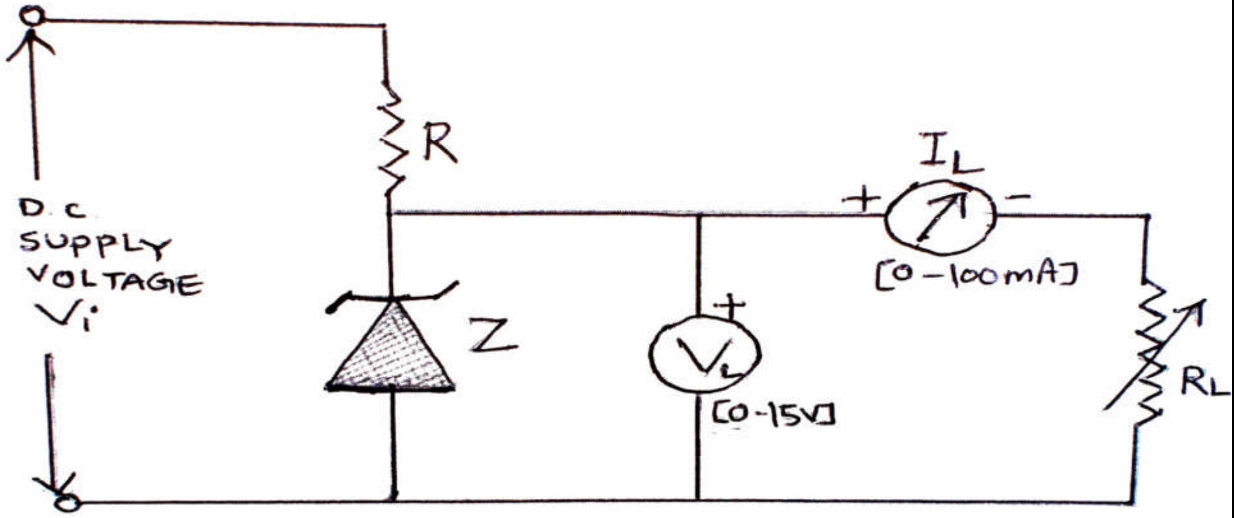
**Experiment No- ____** **Date ___-___-201__**

## Zener Diode as Voltage Regulator

**Aim:** To study the characteristic of a Zener Diode as voltage regulator.

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

**Circuit Diagram:**




**Here,**

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

**Procedure: [**Load regulation at a fixed input voltage**]**

**[1]** Set up the circuit as shown in Figure.

**[2]** Keep input DC voltage [**$V_i$**] on 30 V.

**[3]** Measure voltage across the load [**$V_L$**] for different values of load current [**$I_L$**]. The load current can be varied by changing the load resistance.

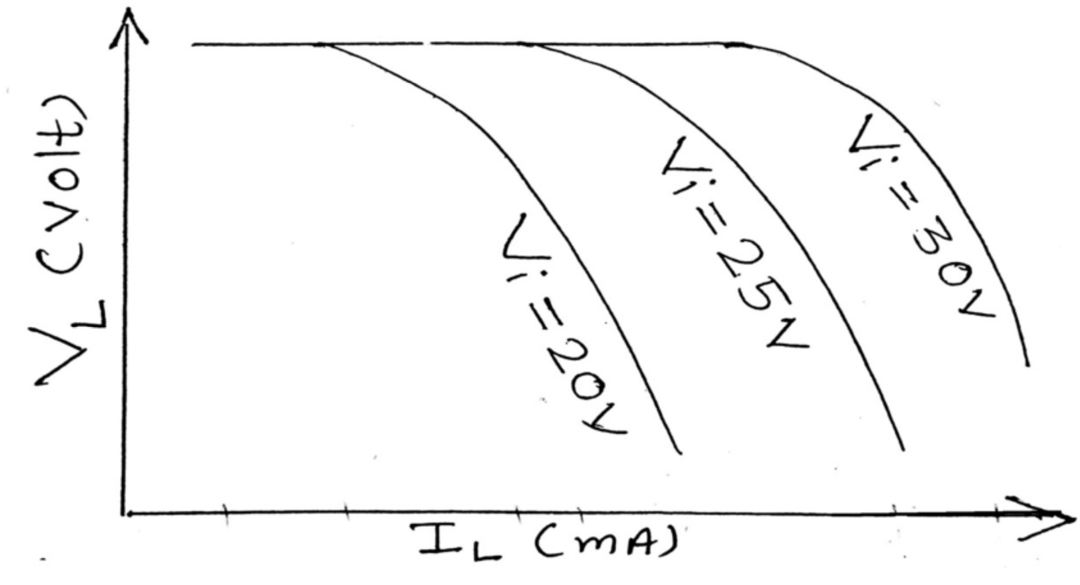
**[4]** Repeat the procedure for two more values of $V_i$, [$V_i$ = 25V and $V_i$ = 20V.]

**[5]** Plot a graph of voltage across the load [**$V_L$** in volt] versus load current [**$I_L$** in mA] for different values of input DC voltage [**$V_i$** in volt].

**Observations Table:**

| Obs. No. | Load Current $[I_L]$ mA | Voltage across load $[V_L]$ volt | | |
|---|---|---|---|---|
| | | Input Voltage $V_i$ =30 volt | Input Voltage $V_i$ =25 volt | Input Voltage $V_i$ =20 volt |
| **1** | | | | |
| **2** | | | | |
| **3** | | | | |
| **4** | | | | |
| **5** | | | | |
| **6** | | | | |
| **7** | | | | |
| **8** | | | | |
| **9** | | | | |
| **10** | | | | |
| **11** | | | | |
| **12** | | | | |

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




**Conclusion:** From the graph we can conclude that the Zener diode can be used to regulate the output voltage.

| **Teacher's Signature** | **Date :** | | | | | **1** | |
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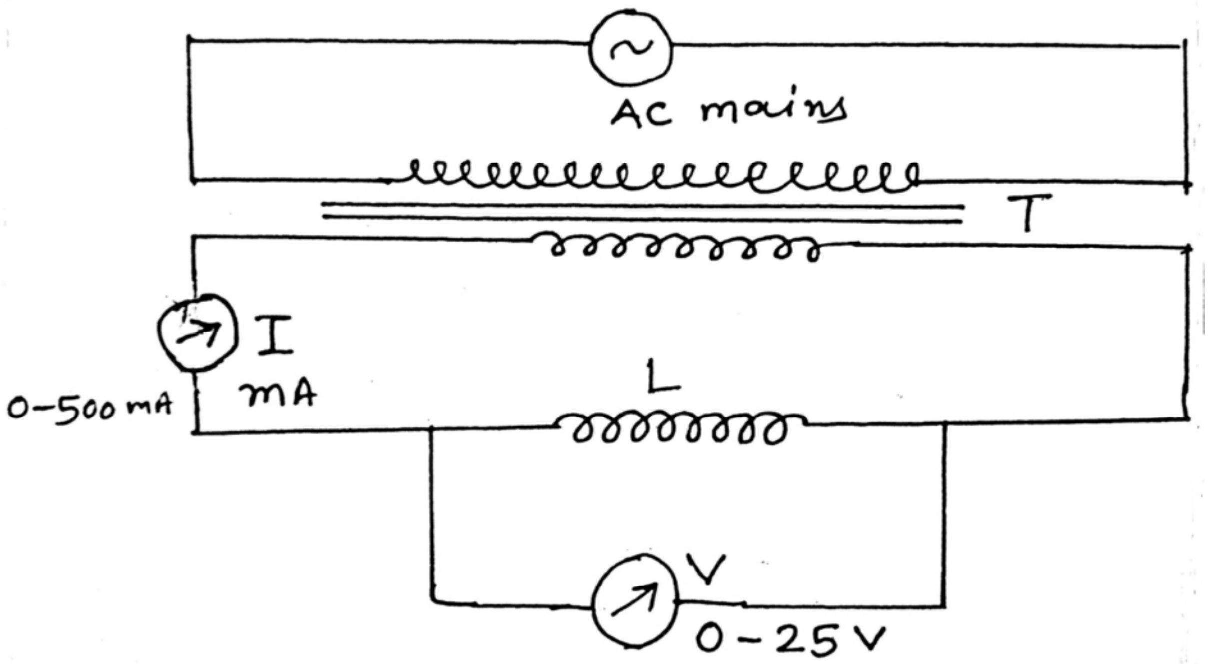
# Measurement of Self-Inductance

**Aim:** To determine the self-inductance of a given inductor.

**Apparatus:** Step-Down Transformer, Inductor, AC Milliammeter (0-500mA), AC Voltmeter (0-25V).

**Circuit diagram:**




**Here**

| | | |
|---|---|---|
| P | → | Primary Coil |
| S | → | Secondary Coil |
| T | → | Step-down Transformer |
| V | → | AC Voltmeter (0-25V). |
| mA | → | AC Milliammeter (0-500mA) |
| L | → | Inductor |

**Procedure:**

**[1]** Connect the apparatus as shown in circuit diagram.

**[2]** Apply AC voltage from transformer and measure its value across the inductor and also measure the value of current in milliammeter.

**[3]** Repeat the experiment for six more value of input AC voltages.

**[4]** Calculate inductive reactance [$X_L$] and hence inductance of the given inductor L.

**[5]** Plot the graph of V (in volt) *vs* I (in mA) and hence also calculate L from the slope of the graph.

**Observation:** Frequency of AC [f] = 50 Hz

**Observations Table:**

| Obs. No. | Voltage across the Inductor V volt | Current passing through Inductor [mA] | Current I in Amp | Inductive Reactance $X_L = \frac{\text{V in Volt}}{\text{I in Amp}}$ | Mean $X_L$ ohm |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Calculations:**

**[1] Tabular Method:** From Mean $X_L$ =__________________ohm

$$L = \frac{(X_L)_{mean}}{2\pi f} = \_\_\_\_\_\_\_\_\_\_ \text{henry} = \_\_\_\_\_\_\_\_\_\_\_\_ \text{mH}$$

**[2] Graphical Method:**

Draw a graph of V (in volt) ⟶ I (in Amp) and find slope of the graph

From graph $\text{slope} = (X_L)_{mean} = \_\_\_\_\_\_\_\_\_\_ \ \Omega$

$$L = \frac{\text{slope}}{2\pi f} = \_\_\_\_\_\_\_\_\_\_ \text{henry} = \_\_\_\_\_\_\_\_\_\_\_ \text{mH}$$

**Results:**

Self inductance [L] of the given inductor is equal to ________________mH [From Tabular Method] and ______________ mH [From graphical method] in this experiment.

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

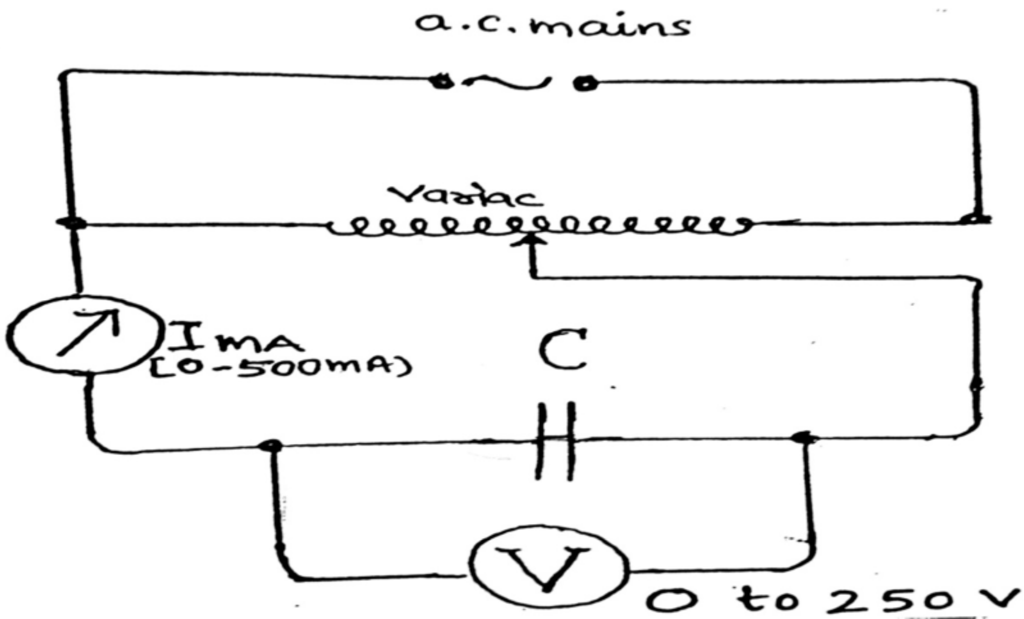
**Experiment No-** ____ **Date** ___-___-201__

# Measurement of Capacitance

**Aim:** To determine the capacitance of a given capacitor.

**Apparatus:** Variable AC voltage source [Variac], AC Milliammeter (0-500 mA), AC Voltmeter (0-250 V), Capacitor

**Circuit diagram:**




**Here,**

| | | |
|---|---|---|
| **Variac** | → | **Variable AC voltage source** |
| **V** | → | **AC Voltmeter (0-250 V)** |
| **mA** | → | **AC Milliammeter (0-500 mA)** |
| **C** | → | **Capacitor** |

**Procedure:**

**[1]** Connect the apparatus as shown in circuit diagram.

**[2]** Apply small AC voltage from variac and measure its value across the capacitor and also measure the value of current passing through capacitor.

**[3]** Repeat the experiment for six more values of input AC voltage.

**[4]** Calculate capacitive reactance [$X_C$] and hence capacitance of the given capacitor C.

**[5]** Plot the graph of V (in volt) *vs* I (in Amp) and hence also calculate $X_C$ from the slope of the graph and hence capacitance of the given capacitor C.

☠**Caution:**

- **Do not touch any live terminal while the power is on.**
- **Voltage across capacitor should not be more than 150 Volts.**

**Observation Table:**

| Obs. No. | Voltage across the capacitor V volt | Current passing through capacitor [mA] | Current I in Amp | Capacitive Reactance $X_C = \frac{\text{V in Volt}}{\text{I in Amp}}$ | Mean $X_C$ ohm |
|---|---|---|---|---|---|
| **1** | | | | | |
| **2** | | | | | |
| **3** | | | | | |
| **4** | | | | | |
| **5** | | | | | |
| **6** | | | | | |
| **7** | | | | | |
| **8** | | | | | |

**Calculations:**

**[1] Tabular Method: [**From Table, Mean $X_C$ =__________________ohm**]**

Take frequency of AC [f] = 50 Hz

$$C = \frac{1}{2\pi \text{ f } (X_C)_{mean}} = \_\_\_\_\_\_\_\_\_\_\_\_ \text{farad} = \_\_\_\_\_\_\_\_\_\_ \mu\text{F}$$

**[2] Graphical Method**

Draw a graph of V (in volt) ⟶ I (in Amp) and find slope of the graph

From graph slope $= (X_C)_{mean}$ =__________________________________ohm

$$C = \frac{1}{2\pi \text{ f slope}} = \_\_\_\_\_\_\_\_\_\_\_\_ \text{farad} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \mu\text{F}$$

**Results:** The following results are obtained in this experiment:

| | **Tabular Method** | **Graphical method** |
|---|---|---|
| Capacitance [C] of the given capacitor in μF | μF | μF |

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

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

# Fly-wheel

**Aim:** To determine the moment of inertia and frictional couple of the given flywheel.

**Apparatus:** Fly-wheel, Weight-box, Stop-watch, Vernier Calliper, Pan, Flexible thread

**Procedure:**

**[1]** Determine the least-count of the Vernier-Calliper.
**[2]** Measure diameter of the axle of the given fly-wheel.
**[3]** Using platform balance find out mass of pan.
**[4]** Suspend the pan from the peg of the axle.
**[5]** Rotate the wheel such that 10 complete turns [$n_1$] of thread are wound on the axle.
**[6]** Put some mass in the pan.
**[7]** Allow the pan to descend.
**[8]** Count number of revolution [$n_2$] which the fly-wheel makes after the thread is detached.
**[9]** Also measure the time [$t_2$] taken for these $n_2$ revolutions.
**[10]** Repeat the observations for different mass in Pan.

**Observations:**

[1]

$$\text{Least count of Vernier } \textit{Callipers} = \frac{\text{Value of the smallest division on main scale}}{\text{Total no. of divisions of Vernier Scale}}$$

$$= \frac{0.1cm}{10} = 0.01\ cm$$

[2] Diameter of axle of the fly wheel

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

[3] Mean diameter of axle [d]_______________ cm.

[4] Radius of the axle [**r**]= _________________ cm

[5] Number of rotations [$\mathbf{n_1}$] would on the axle = 10

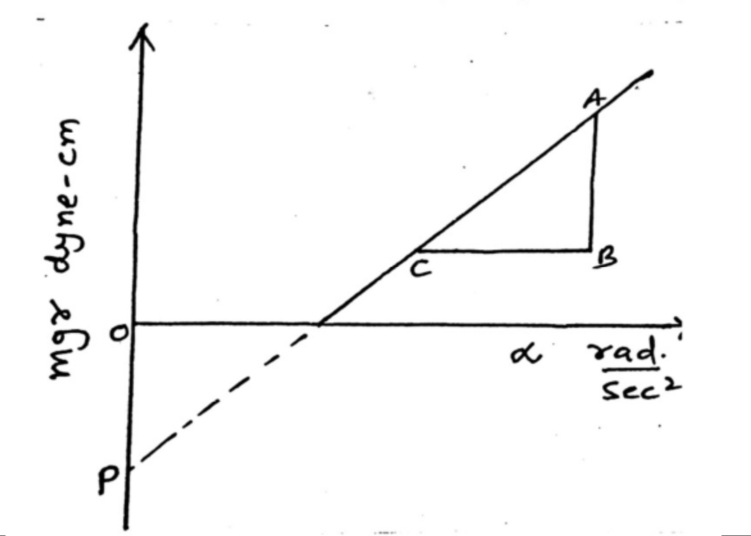
[6] Mass of the Pan [$\mathbf{m_1}$] = _______________ gm

[7] Acceleration due to gravity [**g**]= 980 cm/sec$^2$

**Observations Table:**

| Obs. No. | Mass in Pan $m_2$ gm | Total mass $m=m_1+m_2$ gm | Applied couple mg r dyne-cm | Number of rotations $n_2$ | | Mean $n_2$ | Time for $n_2$ rotations $t_2$ sec | | Mean $t_2$ | Angular acceleration $\alpha$ rad/sec$^2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $\times 10^4$ | 1 | 2 | | 1 | 2 | | |
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |

**Graph:** Plot a graph of Applied couple [m g  r] (in dyne x cm) against Angular Acceleration [$\alpha$] (in rad/sec$^2$). Find slope and intercept on y-axis.




**From Graph:**

[1] Moment of inertia of the fly-wheel

=Slope

=________________gm.cm$^2$

[2] Frictional couple

= Intercept on y-axis

=

OP =____________dyne-cm

**Calculations [show only one calculation]:**

Angular Acceleration $[\alpha] = \frac{4\pi}{n_1}\left(\frac{n_2}{t_2}\right)^2$ = ________________________rad/sec$^2$

**Results:** The following results are obtained in this experiment:

| | | | |
|---|---|---|---|
| **1** | **Moment of Inertia** | **=** | **gm cm$^2$** |
| **2** | **Frictional Couple** | **=** | **dyne cm** |

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

# Vibration Magnetometer

**Aim:** To compare the magnetic moments of the given two bar magnets.

**Apparatus:** Vibration Magnetometer, Two bar magnets, stop-watch

**Procedure:**

**[1]** With the help of compass needle set the vibration magnetometer in magnetic meridian.

**[2]** Place both the magnets simultaneously in the stirrup so that their like poles are one the same side.

**[3]** Oscillate the magnets by bringing another magnet near the box and then take it away. The amplitude of the oscillations must be small and see that during oscillations the magnet does not touch the walls of the magnetometer.

**[4]** Measure time for 10 oscillations. Repeat the procedure twice and find out mean time period [$T_1$].

**[5]** While measuring the period of one magnet the other magnet should be kept at a distance from the magnetometer.

**[6]** Now put in the stirrup of the magnetometer both the magnets simultaneously such that their unlike poles faces the same direction. Determine the periodic time [$T_2$] for this arrangement.

**Observations Table:**

| obs. No. | Magnets suspended | Time for 10 oscillations | | | Mean Time t sec. | Periodic Time $T = \frac{t}{10}$ sec | $T^2$ $Sec^2$ |
|---|---|---|---|---|---|---|---|
| | | $t_1$ sec | $t_2$ sec | $t_3$ sec | | | |
| 1 | Like Poles | | | | | $\mathbf{T_1 =}$ | $\mathbf{T_1^2 =}$ |
| 2 | Unlike Poles | | | | | $\mathbf{T_2 =}$ | $\mathbf{T_2^2 =}$ |

**Calculation:**

$$\frac{M_1}{M_2} = \frac{T_1^2 + T_2^2}{T_1^2 \sim T_2^2} =$$

**Result:** The ratio of magnetic moments of two bar magnets $\left(\frac{M_1}{M_2}\right)$ =____________

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

# 'Y' by Bending of a Beam

**Aim:** To determine Young Modulus of a beam of a rectangular bar using bending of a beam method.

**Apparatus:** Rectangular Bar Strip, Weight Box, Pointer, Meter Scale, Vernier Callipers, Micrometer Screw, Travelling Microscope, Knife edges

**Procedure:**

**[1]** Keep the length between two knife edges is equal to 90 cm keeping hanger in center of a beam [i.e. L = 90 cm].

**[2]** Measure breadth of the given beam [b] by means of Vernier callipers and thickness of the beam [d] by means of micrometer screw.

**[3]** Focus horizontal cross wire of travelling microscope to the image of the pointer and note down the travelling microscope reading.

**[4]** Add 50 gm on the pan and note down the reading of the travelling microscope reading from vertical scale.

**[5]** Add 100 gm, 150 gm,… on the pan and note down the reading of the travelling microscope reading.

**[6]** Now remove 50 gm from the pan and note down the reading of the travelling microscope reading.

**[7]** Find out depression for 50 gm as shown in Table.

**[8]** Also determine depression for different load [e']. Draw a graph of masses [M] against depression [e']. Find slope of the graph and hence calculate the young modulus [Y].

**Observation:**

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

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

**Breadth of the given beam using Vernier calliper:**

(i) ________________cm (ii) ________________cm (iii) ________________cm

Mean breadth [**b**]=________________________cm

**[B]**

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

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]** The length of given cantilever [**L**] = __________________ cm

**Observation Table:**

| Obs. No. | Load M gm | Reading of the pointer while | | Mean $= \frac{x+y}{2}$ cm | Depression for 50 gm [e] Cm | Mean e cm | Depression for different loads e' cm |
|---|---|---|---|---|---|---|---|
| | | Loading x cm | Unloading y cm | | | | |
| 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]** **Tabular Method** [From Table, $\frac{M}{e} = \frac{50\,gm}{mean\ \ e}$ ______________ gm/cm]

$$Y = \frac{4gL^3}{bd^3} x \left(\frac{M}{e}\right)_{mean} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

**[2]** **Graphical Method [**Draw a graph of M (in gm) $\longrightarrow$ e' (in cm) and find slope of the graph.**]**

Slope = m/e' = ______________ gm/cm

$$Y = \frac{4gL^3}{b\,d^3} xslope = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

**Results:**

The Young Modulus [**Y**] of material of the given rectangular bar is equal to _________________________dyne/cm$^2$ [From Tabular Method] and ________________________ dyne/cm$^2$ [From graphical method] in this experiment.

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

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

# Bar Pendulum

**Aim:** To determine the acceleration due to gravity using a Bar Pendulum.

**Apparatus:** Bar Pendulum, Stop Watch, Knife edge, Meter Scale etc.

**Procedure:**

**[1]** Determine the center of gravity (CG) of the bar pendulum by supporting it on a knife-edge. Measure the distance [L] between knife-edge and CG.

**[2]** Now suspend vertically the bar pendulum from the hole near one end on the horizontal knife-edge. Now oscillate the pendulum in vertical plane. The amplitude of the oscillation should be small.

**[3]** Measure accurately the time for 25 oscillations thrice. Find mean time [t ]and hence periodic Time [T].

**[4]** Determine the periodic time [T] for different distances L on either side of the CG of the bar.

**[5]** Plot a graph of T (in sec) $\rightarrow$ L (in cm) and find minimum time period [To] and the length of equivalent simple pendulum [L0] hence calculate the value of the acceleration due to gravity [g].

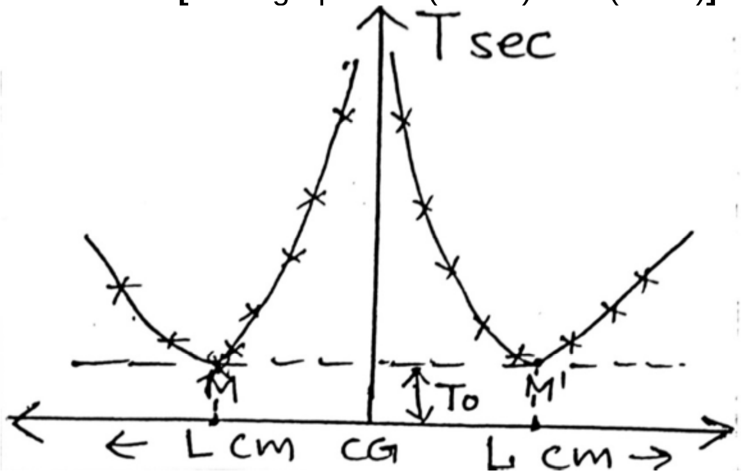
**[6]** Also plot graph of $L^2$ (in $cm^2$) $\rightarrow$ $LT^2$ (in cm-$sec^2$) and find slope of the graph and hence again calculate the value of **g**.

**Observation Table:**

| Obs. No. | Distance between the knife edge and CG L cm | Time for 25 oscillations in sec | | | Mean time t sec | Periodic Time $T = \frac{t}{25}$ sec | $L^2$ $cm^2$ | $LT^2$ cm-$sec^2$ |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | | | | |
| 1 | | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |

**Calculations:**

**Method – 1 [**From graph of T (in sec) $\rightarrow$ L (in cm)**]**




From Graph

(a) Length of equivalent simple pendulum [$L_0$]=______________ cm

(b) Minimum Periodic time [$T_0$]= _________________sec

$g = 4\pi^2 \frac{L_0}{T_0^2}$ = ______________________

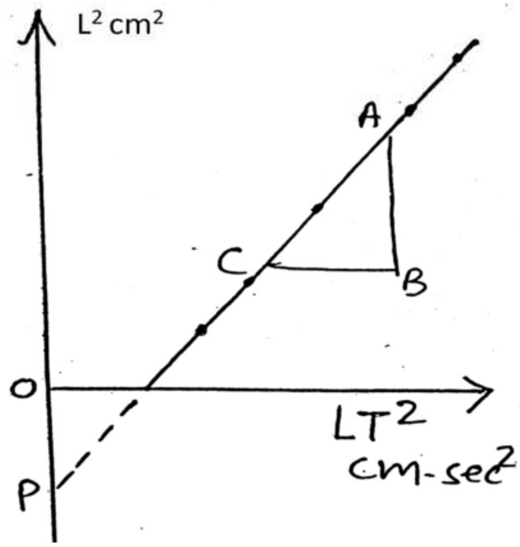
=__________________________________

=__________________________cm/sec$^2$

k = $\frac{L_0}{2}$

=______________________cm

**Method – 2 [**Plot a graph of $L^2$ (in $cm^2$) $\rightarrow$ $LT^2$ (in cm-sec$^2$)**]**




From Graph

Slope = _______________________

$\therefore$ g = 4 $\pi^2$ x slope

=__________________________cm/sec$^2$

Intercept on negative y-axis

[OP] =______________________cm$^2$

$\therefore$ k = $\sqrt{OP} = \sqrt{\ }$

=____________________________cm

**Results:**

| | **Method - 1** | **Method - 2** |
|---|---|---|
| Acceleration due to gravity [g] | cm/sec$^2$ | cm/sec$^2$ |
| Radius of gyration [k] | cm | cm |

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

# Measurement of '$\lambda$' of Spectral Lines

**Aim:** To determine unknown wave lengths of atomic spectral lines of (1) Hg (2) Fe and (3) Cu from known wavelength.

**Apparatus:** Meter Scale, Photo-Film of Atomic Spectra of Hg, Fe and Cu

**Procedure:**

**[1]** In photo-film of spectral lines first band contains only two lines of Hg, the second band contains spectral lines of Fe and the third band contains spectral lines of Cu.

**[2]** To calculate unknown wavelength '$\lambda$' of the atomic spectral line of 'Hg' spectra from known wavelength '$\lambda_0$,' note down positions of known [$D_0$] and unknown [D'] spectral lines by meter scale in cm

**[3]** Calculate scale reading difference [$S_0$] for different spectral lines of Hg, Fe and Cu as shown in table.

**[4]** Now calculate wavelength of each atomic spectral lines using given formula as shown in Table.

**Observations:**

[1] Dispersion = (D) = 73 A$^o$/cm

[2] Known wavelength of Fe ($\lambda_o$) = 4957.6 A$^o$

[3] Reading of standard wavelength line ($D_o$) = _______ cm

**Table – [I] For Hg spectral lines:**

| Atomic Spectral line no. | Meter Scale Reading D' cm | Scale Reading Difference $S_o$ = D' -$D_o$ Cm | S= $S_o \times$ D A$^o$ | Wave length of spectral line $\lambda = \lambda_o + S$ A$^o$ |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |

**Table – [II] For Fe spectral lines:**

| Atomic Spectral line no. | Meter Scale Reading D' cm | Scale Reading Difference $S_o$ = D' -$D_o$ Cm | S= $S_o \times$ D A$^o$ | Wave length of spectral line $\lambda = \lambda_o + S$ A$^o$ |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |

**Table – [III] For Cu spectral lines:**

| Atomic Spectral line no. | Meter Scale Reading D' cm | Scale Reading Difference So = D' -Do Cm | S= So $\times$ D Aº | Wave length of spectral line $\lambda = \lambda o + S$ Aº |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |

**Calculation: [**Sample Calculation for any one reading**]**

[1] Meter Scale Reading D' =________________cm

[2] Scale Reading Difference $S_o$ = D' - $D_o$ = ____________________cm

[3] S= $S_o \times D$ = _________________________Aº

[4] Wave length of spectral line $\lambda = \lambda_o + S$ =_________________________Aº

**Result:** The last column of the observation table represent the wavelength of unknown spectral lines.

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

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

## Study of Probability Distribution for Two Options System

**Aim:** Verification of law of probability distribution by throwing coin like object (for two options system).

**Apparatus:** A tray, plastic tumbler, 26 identical coins, tumbler

**Procedure:**

**[1]** Take n identical coins and put these in the tumbler. Shake it well and throw these coins in the tray.

**[2]** Count the number of heads up. Repeat the process a large numbers of times (N=100) and collect the data in Table 1.

**[3]** For a particular set of N and n, write the number of heads up in ascending order in Table 2. Calculate the corresponding values of tails up (n-r).

**[4]** Record the observed frequencies of heads up F(r) from Table 1.

**[5]** Calculate the expected frequency of r heads up NP(r) using the formula and compare the observed and corresponding expected frequencies (derived using the formula).

**Observations:**

Number of trials [**N**] = 100 Number of coins thrown together [**n**] =26

**Observation Table 1**

| Trial Number | Number of heads up | Trial Number | Number of heads up | Trial Number | Number of heads up | Trial Number | Number of heads up |
|---|---|---|---|---|---|---|---|
| 1 | | 26 | | 51 | | 76 | |
| 2 | | 27 | | 52 | | 77 | |
| 3 | | 28 | | 53 | | 78 | |
| 4 | | 29 | | 54 | | 79 | |
| 5 | | 30 | | 55 | | 80 | |
| 6 | | 31 | | 56 | | 81 | |
| 7 | | 32 | | 57 | | 82 | |
| 8 | | 33 | | 58 | | 83 | |
| 9 | | 34 | | 59 | | 84 | |
| 10 | | 35 | | 60 | | 85 | |
| 11 | | 36 | | 61 | | 86 | |
| 12 | | 37 | | 62 | | 87 | |
| 13 | | 38 | | 63 | | 88 | |
| 14 | | 39 | | 64 | | 89 | |
| 15 | | 40 | | 65 | | 90 | |
| 16 | | 41 | | 66 | | 91 | |
| 17 | | 42 | | 67 | | 92 | |
| 18 | | 43 | | 68 | | 93 | |
| 19 | | 44 | | 69 | | 94 | |
| 20 | | 45 | | 70 | | 95 | |
| 21 | | 46 | | 71 | | 96 | |
| 22 | | 47 | | 72 | | 97 | |
| 23 | | 48 | | 73 | | 98 | |
| 24 | | 49 | | 74 | | 99 | |
| 25 | | 50 | | 75 | | 100 | |

**Observation Table 2**

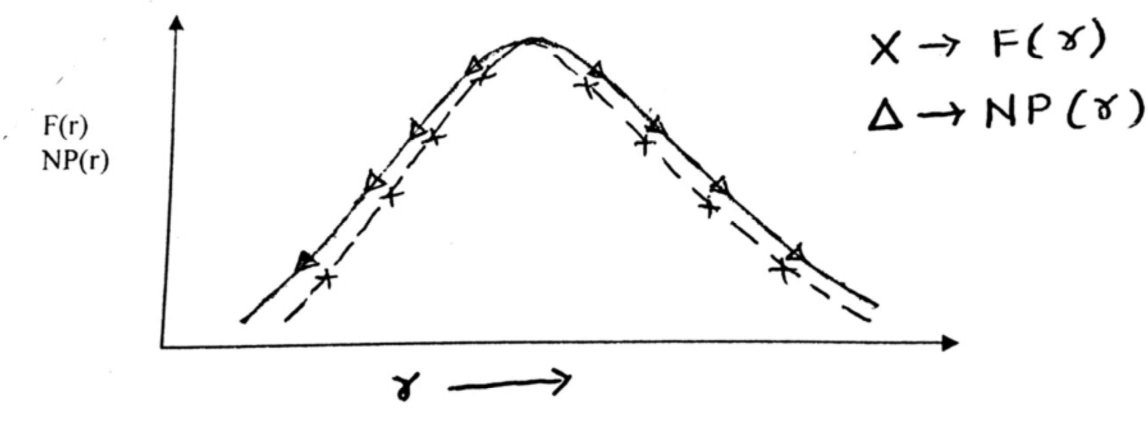
| No | Number of heads up r | r ! | Number of tails up n-r | (n-r) ! | Theoretical Frequency NP(r) | Observed Frequency F(r) |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |

**Calculation: [For any one reading]**

$$NP(r) = \frac{N\,n!}{2^n\, r!\,(n-r)!} = \frac{100 \times 26!}{2^{26}\, r!\,(n-r)!} = \frac{6.0095 \times 10^{20}}{r!\,(n-r)!} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

=______________________________

**Graph:**[Plot two graphs on the same graph paper]




**Conclusion:** The observed and theoretical frequencies match fairly well hence the law of probability distribution for two options system is verified.

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

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

# Simulation of Radioactive Decay

**Aim:** To study simulation of nuclear radioactive decay.

**Apparatus:** Scientific calculator [For generating of random number]

**Procedure:**

**[1]** Consider a radioactive decay process and initialize time t=0 second. Choose initial number of parent nuclei, say $N_0$=25 and the number of daughter nuclei say $D_0$=0.

**[2]** To determine the status of the process after a time interval of 1 second follow the procedure explained next.

**[3]** Generate a random number (between 0 and 1) using a calculator. Assign this value of random number as a decay probability [r] of the $N_0$ nuclei. Tabulate this value in Table 1.

**[4]** In this way assign the values of decay probability to each of the remaining nuclei by generating a sequence of random numbers on the calculator. Tabulate these values in the Table 1.

**[5]** In Table 1, compare the given probability of decay [p] with the assigned probability [r]. The nuclei with r < p can be considered as decayed (daughter nuclei).Write Y against that nuclei.

**[6]** The nuclei with r > p or r = p can be considered as decayed parent nuclei. Now count the number of parent (decayed) nuclei.

**[7]** Now take time t = 2 second and repeat the procedure (step 4 to 6) for the number of decayed nuclei (*i. e.* 25-number of nuclei decayed in Table 1) to prepare Table 2.

**[8]** This process is repeated for successive intervals (upto t = 8 second), each beginning with the number of parent nuclei left decayed after the preceding time interval.

**[9]** As shown preparer the final Table 9 showing number of daughter nuclei at different time intervals.

**[10]** Plot the graph as shown. The value of time t at which the number of parent nuclei becomes half of the initial one is called half-life [$\tau_{\frac{1}{2}}$] of the element. From the graph determine the value of half life [$\tau_{\frac{1}{2}}$]. Calculate the value of decay constant [λ]using the relation, [$\lambda = \frac{0.693}{\tau_{\frac{1}{2}}}$]

**[11]** Verify your simulation results of decay process using the formula $N = N_0 e^{-\lambda t}$ for different values of t, here N is the number of parent nuclei present at time t. Tabulate your results as shown.

**Observations:**

Given: Initially at t=0, $N_0$ = 25 and probability decay p = 0.25

**Table 1 [t = 1 second]**

| Number of Nuclei | Random number (Assigned Probability) r | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| 1 | | | 14 | | |
| 2 | | | 15 | | |
| 3 | | | 16 | | |
| 4 | | | 17 | | |
| 5 | | | 18 | | |
| 6 | | | 19 | | |
| 7 | | | 20 | | |
| 8 | | | 21 | | |
| 9 | | | 22 | | |
| 10 | | | 23 | | |
| 11 | | | 24 | | |
| 12 | | | 25 | | |
| 13 | | | | | |

**Table 2 [t = 2 second]**

| Number of Nuclei | Random number (Assigned Probability) R | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Table 3 [t = 3 second]**

| Number of Nuclei | Random number (Assigned Probability) R | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Table 4 [t = 4 second]**

| Number of Nuclei | Random number (Assigned Probability) R | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Table 5 [t = 5 second]**

| Number of Nuclei | Random number (Assigned Probability) R | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Table 6 [t = 6 second]**

| Number of Nuclei | Random number (Assigned Probability) r | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

**Table 7 [t = 7 second]**

| Number of Nuclei | Random number (Assigned Probability) r | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

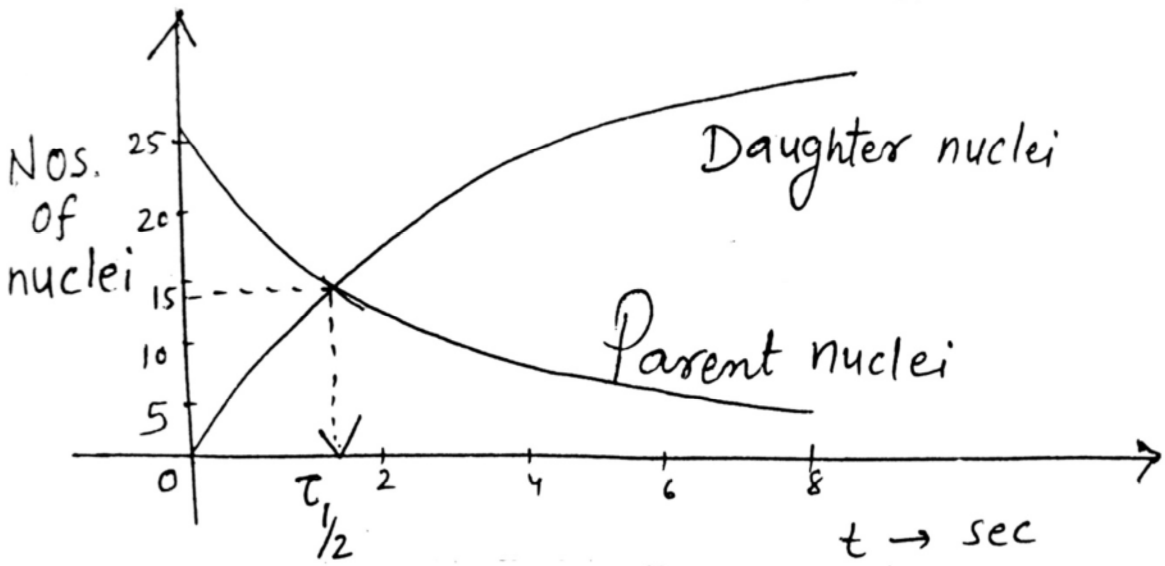
**Table 8 [t = 8 second]**

| Number of Nuclei | Random number (Assigned Probability) r | Does a nucleus decay? (If r<p then nuclei decays, write Y) | Number of Nuclei | Random number (Assigned Probability) r | Does nuclei decay? (If r<p then nuclei decays, write Y ) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |

**Table 9**

| Time sec | From simulation | | From formula $N = N_0 e^{-\lambda t}$ | |
|---|---|---|---|---|
| | No of parent nuclei decayed | No of daughter nuclei | No of parent nuclei decayed | No of daughter nuclei |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |

**Graph**




**Result:** Decay constant = ________________________________ $sec^{-1}$

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