APPLIED PHYSICS FOR ENGINEERS
PH-127
PRACTICAL WORKBOOK

FOR

First Year

Batch: _______

NAME OF STUDENT: ____

CLASS ROLL NO.:__________________**SECTION:** ________________

DISCIPLINE: ____

SEMESTER: ____

DEPARTMENT OF PHYSICS

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY,

KARACHI, PAKISTAN.

PRACTICAL WORK BOOK

For The Course

APPLIED PHYSICS FOR ENGINEERS

(PH-127)

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Approved By:

The Board of Studies of Department of Physics

CERTIFICATE

Certified that Mr./ Ms.____of class **First year** Bearing Seat No: ________________________ Department___________________________has completed the course **Applied Physics for Engineers Practical** as prescribed by the NED University of Engineering & Technology, Karachi for the Academic Session: ____________________________

Date:________________

____

Lab. Teacher

Applied Physics for Engineers Practical

Name of Student: ____

Class Roll No.:____________________DISCIPLINE: _______________

S. No.	Description	Page #	Psychomotor Taxonomy Level	Remarks	Signature & Date
1.	To study the spectral characteristics of photocell and determine the Planck's constant.	08	P3		
2.	To determine the ionization potential of mercury using a gas filled diode.	15	P3		
3.	To determine the velocity of wave propagation in stretched string by using sonometer.	22	P3		
4.	To determine the Horizontal component of Earth magnetic field strength "H" by Tangent Galvanometer	28	P3		
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Physics an Experimental Science:

Science is based on observation and experiment. We have to measure quantities to compare our theories with reality. **Accuracy** indicates how close the measured value is to the true value. And no measurement is exact. There will always be some uncertainty in the result. If you say that a table is 2.50 m long, you are implying that its length is probably between 2.495 m and 2.505 m, i.e., you know the uncertainty in length is about ± 0.005 m. if in place of a meter stick with centimeter marking you use the one with millimeter markings and measure the length of the table carefully, you could measure the length to ± 0.5 mm rather than the previous case ± 0.5 cm. You would indicate this precision with four digits, such as 2.503 m. As another example consider that you measure the time of a runner in the 100-meter dash. It turns out to be 9.84 s. If your measurement is accurate to plus minus 0.05 s, the actual time can be anywhere between 9.84 - 0.05=9.79 s and 9.84+0.05 =9.89 s. You would write your answer as

$$9.84 \pm 0.05 \text{ s}$$

The percent uncertainty would be .05/9.84 x100 =0.5%.

Significant digits and experimental accuracy:

Suppose you quote your result that x = 3m. This implies that you know x to be between 2 m and 3 m. However, if you say that x = 3.1415 then you are implying that x is known to you with greater precision. It lies somewhere between 3.14158 m and 3.14160 m. In the first case x is known to only one significant figure whereas in the second case it is known to six significant figures.

Rules to be followed in deciding how many significant figures there are in any operation carried out with numbers.

1. Count from the left and ignore all leading zeros, keep all digits up top the first doubtful one. x = 3m has one significant figure, the value expressed as x=0.003km also implies one significant figure. Similarly, if you write x = 0.0030 km again you have two significant figures. Be a bit careful. If you say x = 300 m then it does not indicate how many significant figures there are as there is no decimal here. It is better to express in this situation in the scientific notation as $x = 3 \times 10^2$ would indicate one significant figure and $x = 3.00 \times 10^2$ would indicate three.
2. When multiplying or dividing, keep a number of significant figures in the product or quotient no greater than the number of significant figures in the least precision of the factors. Thus

$$2.8 \times 3.14159 = 8.8$$

Sometimes you make a judgment as for instance you express

$$9.8 \times 3.04 – 10.2$$

Although 9.8 has only two digits it is so close to 10.0 which is a number with three significant digits, that is we express the final answer as three significant digits in place of two.

(i) In adding or subtracting the least significant digit (the one on the right most Position), of the sum or the difference occupies the same relative position as the lest significant digit of the quantities being added or subtracted. In this the number if significant figures are not important; it is the position of the least significant digit that is important. The least significant figures are in boldface in the example below.

$$
\begin{array}{r}
103.9 \\
2.10 \\
\underline{0.319} \\
106.319
\end{array}
$$

You should write the final result as 106.3 since you should include only one least significant digit. The least significant digit is also called the doubtful digit.

Errors associated with observations:

One should be able to distinguish between *mistakes and errors.* The term mistake indicates a fault in the measurement, which can be avoided by care on part of the observer. An example is recording of a wrong number, which means not noting down the value on the scale but writing a different value. On the Other hand, an error can occur in even the most careful observation. As in the case of careful use of equipment, this has an error in graduation. We consider below the various types of error.

Constant errors are those, which affect the result of a series of experiment by the same amount. For instance, a scale in which the length of a centimeter is given not as 1 cm but as 0.99 cm. Such a scale will constantly give a larger value of length. Such deviation is difficult to detect. A measurement of the same quantity by a different method may make it possible to detect the constant error. and to rectify it. *Systematic errors are* those that occur according to same definite rule. If for example if the pointer is not pivoted at the center, then an error can occur. Systematic error can be avoided once the source is detected. *Personal errors* came arise from the fact that the person is not making the recording correctly. For instance, in noting the time when the pendulum crosses the center, the observer may note it late. This can be avoided if the observer is vigilant or the has a bad eyesight get it corrected.

Even when all the above three mentioned errors do not exist, errors still occur. These are called *random errors.* These cannot be traced to any cause. One can illustrate the random by firing of shots at the target. Even if the rifleman is fully trained and excellent at this, all his shorts will not hit the target. The shots will be scattered around the target point. This would be due to the consequence of taking the aim.

In order to arrive at a result close to the true value, one has to take a large number of measurements. The larger the number of observations the better the result. Let there are "such measurements $x_1, x_2, \ldots x_n$. Then the mean value *X* is obtained from the following relation,

$$\bar{x} = \frac{x_1 + x_2 \ldots\ldots\ldots x_n}{n}$$

If the true value is x_1, then the percentage error can be obtained as,

$$\%Error = \frac{|\ x - x_1\ |}{x_1} * 100$$

To gain some insight on to the selection of tools for measurements consider measuring the volumetric density of mass *M* and sides length a,b and c. Let these have the values 50 gm, 10 cm, 5 cm, l mm respectively. If you can measure the mass up to a milligram and have a vernier calipers of least count 0.1 mm and the micrometer screw gauge with a least count of 0.01 mm, you can get the percentage accuracies with which the corresponding quantities can be measured. They are $\frac{1}{50}, \frac{1}{10}, \frac{1}{5}$ and 1. The influence of these on the final measurement of density can be obtained by noting that the density $\rho = \frac{1}{abc}$. The error of ρ in terms of the variation in other quantities is

$$\frac{\delta\rho}{\rho} = \frac{\delta M}{M} - \frac{\delta a}{a} - \frac{\delta b}{b} - \frac{\delta c}{c}$$

The maximum error will be if we take all positive, hence

$$\frac{\delta\rho}{\rho} = \frac{\delta M}{M} + \frac{\delta a}{a} + \frac{\delta b}{b} + \frac{\delta c}{c}$$

In this case the fraction $\frac{\delta c}{c}$ corresponds to 1 percent and the other contributions $\frac{\delta c}{\rho}$ are

insignificant. This is particularly the case in the determination of the mass. It is not worthwhile to exercise great care in the determination of mass of 50 gm to an accuracy of 1 mg.

EXPERIMENT # 01

OBJECT:

To study the spectral characteristics of photocell and determine the Planck's Constant.

APPARATUS:

A photocell, A DC micrometer, A reversing key, a rheostat, DC power supply, filters of different colors and Halogen tungsten lamp.

THEORY:

When light falls on certain materials like selenium etc. (which has low work function.). Electrons are emitted from their surfaces. These electrons are called *"Photo-Electrons"* and the phenomenon governing such an emission is called the photo-electric effect the material is said to be *"Photo-sensitive material"*.

In a photo-cell the photo-electric effect is utilized. It is used to convert light energy into electrical energy. The emission of photoelectrons depend upon the frequency which is proportional to the energy of the incident radiation, so by changing the frequency, the energy of the incident light can be changed which can be done by taking filters of different colors(wavelength) .

According to their construction the photoelectric cells are of three types:

(i) Photo emissive cell (ii) Photo Conductive cell (iii) Photo Voltaic cell

A phototube or photoelectric cell is a type of gas-filled or vacuum tube that is sensitive to light. Such a tube is more correctly called a 'photo emissive cell' to distinguish it from photovoltaic or photoconductive cells. Phototubes operate according to the photoelectric effect: Incoming photons strike a photocathode, generating electrons, which are attracted to an anode. Thus, current flow is dependent on the frequency and intensity of incoming photons. The light wavelength range over which the device is sensitive depends on the material used for the photo emissive cathode. A cesium-antimony cathode gives a device that is very sensitive in the violet to ultra-violet region with sensitivity falling off to blindness to red light. Cesium on oxidized silver gives a cathode that is most sensitive to infra-red to red light, falling off towards blue, where the sensitivity is low but not zero

WORKING FORMULA:

According to Einstein Photoelectric Effect Equation We have

$$hf = \emptyset + eV_o$$

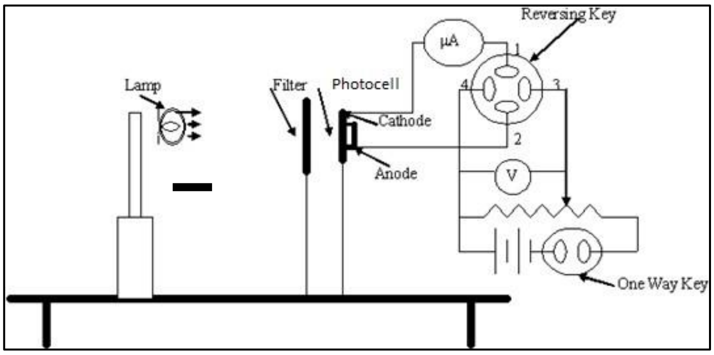
$$V_o = \frac{h}{e}f - \frac{\emptyset}{e}$$

PROCEDURE:

1. Slide light source to 25cm position, turn on the power after 5 minutes of pre-heating time. Set current multiplier at "x1" position.
2. Insert the red color filter (635nm) into drawtube, set light intensity adjustor at stronger light, voltage direction switch at "-", display mode switch at current display. Adjust the Accelerating voltage to about 0V and set the current multiplier at "x0.001". Increase the accelerating voltage to decrease the photocurrent to zero, note this accelerating voltage which is the stopping potential Vo for 635nm wavelength.
3. Get the stopping potential Vo of other four wavelength (570nm,540nm,500nm and 460nm).
4. Plot a graph between stopping potential and frequency by using recorded data and determine the Planck's constant.

PHOTOGRAPH OF APPARATUS AND CIRCUIT DIAGRAM:

(a)



(b)

Figure-1: a) Photograph of Planck's constant apparatus b) Circuit diagarm

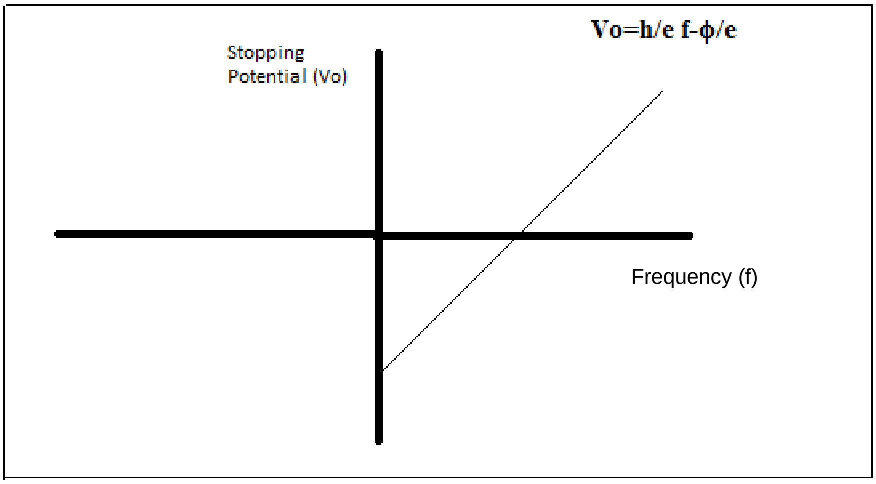


Figure-2: Graph between frequency and stopping potential

OBSERVATIONS:

Position of the lamp:____________cm
Position of the cell:____________cm

S.No	Colour of filter	Wavelength(λ) m	Frequency(f) Hz	Stopping Potential (Vo) Volt

CALCULATIONS:

RESULT:

The value of Planck's constant is__________________________.
The percentage error in observed value is___________________.
The work function of cathode material is___________________.

PRECAUTIONS:

1. The solar cell should be exposed to the sun light before using it in the experiment.
2. The light from the lamp should fall normally on the cell.
3. To avoid the over overheating the solar cell, the lamp should be switched off during the observations.
4. The connections should be tight.

Graph Paper

Questions

Q1: Explain the construction and working of photocell.

Q2: What sensitive material is used when the cell is to be used for a visible light?

Q3: What is threshold frequency?

Q4: What is photo-electric work function?

Q5: How will you determine the stopping potential?

Q6: Does the violet light have more energy than red light?

Q7: What is the effect of intensity on photoelectric current?

Q8: What is the order of current in photocell?

NED University of Engineering & Technology

Department of ____

Course Code and Title: Applied Physics for Engineers (PH-127)

Object: To study the spectral characteristics of photocell and determine the Planck's Constant.

Psychomotor Domain Assessment Rubric-Level P3					
Skill Sets	Extent of Achievement				
	0	1	2	3	4
Equipment Identification Sensory skill to ***identify*** equipment and/or its component for a lab work.	Not able to identify the equipment.	--	--	--	Able to identify equipment as well as its components.
Equipment Use Sensory skills to ***describe*** the use of the equipment for the lab work.	Never describes the use of equipment.	Rarely able to describe the use of equipment.	Occasionally describe the use of equipment.	Often able to describe the use of equipment.	Frequently able to describe the use of equipment.
Procedural Skills ***Displays*** skills to act upon sequence of steps in lab work.	Not able to either learn or perform lab work procedure.	Able to slightly understand lab work procedure and perform lab work.	Able to somewhat understand lab work procedure and perform lab work.	Able to moderately understand lab work procedure and perform lab work.	Able to fully understand lab work procedure and perform lab work.
Response Ability to ***imitate*** the lab work on his/her own.	Not able to imitate the lab work.	Able to slightly imitate the lab work.	Able to somewhat imitate the lab work.	Able to moderately imitate the lab work.	Able to fully imitate the lab work.
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Safety Adherence Adherence to ***safety*** procedures.	Doesn't adhere to safety procedures.	Slightly adheres to safety procedures.	Somewhat adheres to safety procedures.	Moderately adheres to safety procedures.	Fully adheres to safety procedures.
Equipment Handling ***Equipment care*** during the use.	Doesn't handle equipment with required care.	Rarely handles equipment with required care.	Occasionally handles equipment with required care.	Often handles equipment with required care.	Handles equipment with required care.
Group Work Contributes in a group-based lab work.	Never participates.	Rarely participates.	Occasionally participates and contributes.	Often participates and contributes.	Frequently participates and contributes.

Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

EXPERIMENT # 02

OBJECT:

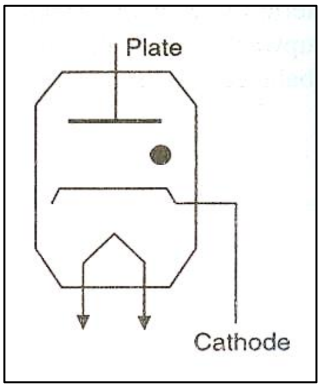
To find the ionization potential of mercury using a gas filled diode.

APPARATUS:

A gas filled (mercury vapors) diode, a D.C, power supply, a voltmeter, micro-ammeter, a potentiometer.

THEORY:

Ionization potential: *The least energy required to remove the most loosely bound electron from an isolated free neutral atom is known as the ionization potential of the atom.*



Ionization potential of mercury: The ionization potential of mercury can be determined by introducing mercury vapor at a low pressure of 10 mm to 50 mm of mercury column in an evacuated tube fitted with a cathode and an anode. A mercury vapor filled gas diode is the most suitable for the purpose. The cathode of the gas diode may be directly or indirectly heated type. A hot cathode gas filled diode is known as a *phanotron* [Incidentally a gas filled triode is known *as a Thyratron*] A gas filled diode is symbolically represented as shown in Fig. The **dot** in the tube shows the presence of the gas (or vapor).

When the anode or plate of the gas filled diode is at a positive potential with respect to the cathode, electrons move across the tube from the cathode to the anode. This electronic current depends upon two factors:

(i) The number of electrons emitted per unit area from the cathode and its temperature.
(ii) *The effect of space-charge* – the negatively charged region containing the electron cloud due to the accumulation of electrons emitted by the cathode.

As the plate potential is increased the plate current slowly increases. But when the plate potential is increased beyond a particular value the plate current increases. But when the plate potential is increased beyond a particular value the plate current increases much more rapidly than it does below that critical value. This is because when the plate potential approaches this critical value the electrons arriving at the anode gain enough energy to knock out the electrons from the atoms of the gas close to the anode. These electrons are also attracted by the anode causing an increase in plate current and the positive ions neutralize some of the space charge, which further helps to increase the kinetic energy of the thermo-electrons. This potential is equal to the ionization potential of the gas (or vapor) and for this value of plate potential there is a marked increase in plate current.

If a graph is plotted between plate potential and plate current (for a constant value of filament current) the plate current at first increases slowly for a given increase in plate voltage and when the plate potential is equal to or greater than the ionization potential there is a greater increase in plate current for the same increase in plate potential.

The change in slope is, however, not very abrupt but there is a short-curved portion within which the change in plate current goes on becoming more and more rapid.

To find the value of ionization potential the two straight portions *AB* and *CD* of the graph are produced to meet at a point *E*. If we draw a perpendicular *EF* on the *X*-axis, then *OF* represents the ionization potential.

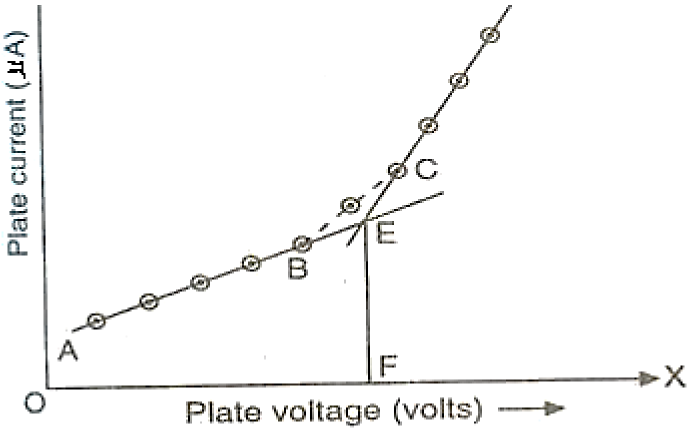


Figure-1: Graph between plate voltage and plate current

PROCEDURE:

1. Make the circuit connection as shown in circuit diagram.
2. Switch on the power supply. The filament is heated in a short time to become red hot.
3. Adjust the voltmeter reading to 0.5 volt and note the corresponding value of the current in the micro-ammeter.
4. Increase the plate potential by 0.5 volt and note the voltmeter reading as well as the micro-ammeter reading. Proceed till the plate potential is about 15 volts.
5. Taking the plate voltage along the *X*-axis and plate current along the *Y*-axis plot a graph between plate current and plate voltage as shown in above Fig. Draw the straight line *AB* between the first few points and the straight line *CD* between the last few points and produce *AB* and *DC* to meet at *E*. Draw *EF* perpendicular to the *X*-axis, then *OF* gives the value of ionization potential of mercury.

OBSERVATIONS:

S.No.	***Plate voltage volts***	***Plate current μA***
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

CALCULATIONS:

$$Percentage\ error\ = \left|\frac{Obs.\ value - s\tan d.value}{stand.value}\right| \times 100$$

RESULTS:

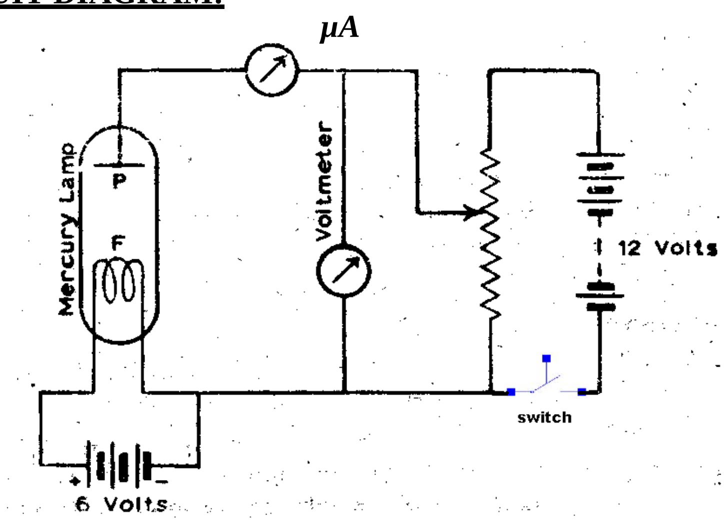
Ionization potential of mercury from the graph =..................Volts
Standard value of ionization potential = ...Volts
Percentage error = ...%

Graph paper

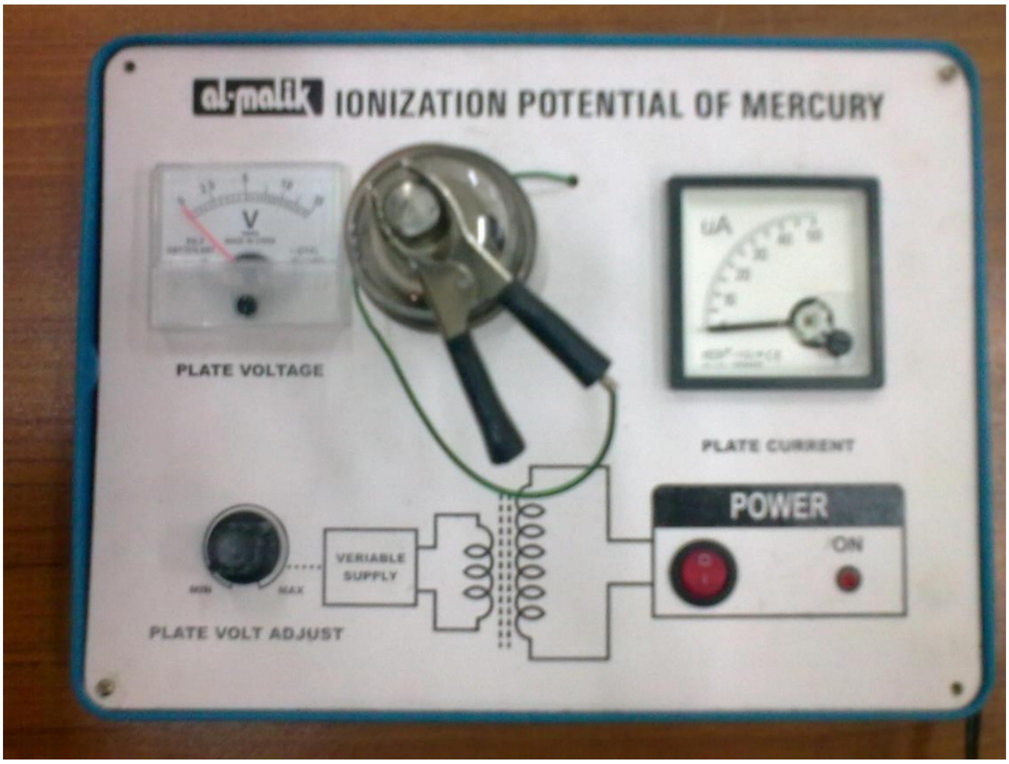
PRECAUTIONS AND SOURCES OF ERRORS:

1. A gas filled mercury vapor diode must be used.
2. The positive of the voltmeter as also that of the micro-ammeter must be connected to the positive of the *D.C.* supply.
3. The plate potential should not exceed 15 volts.
4. To find the exact position of ionization potential two straight lines joining the first few points and the last few points should be produced to meet. A smooth curve joining all the points should not be drawn.
5. For accurate measurement of voltage, a *V.T.V.M* may be used in place of an ordinary voltmeter.

CIRCUIT DIAGRAM:



PHOTOGRAPH OF THE APPARATUS



Questions

Q.1 What is the object of your experiment?

Q.2 What are ions?

Q.3 What do you mean by ionization?

Q.4 What is excitation?

Q.5 What is ionization potential?

Q.6 Differentiate between excitation and ionization potential?

NED University of Engineering & Technology

Department of ____

Course Code and Title: Applied Physics for Engineers (PH-127)____

Object: To find the ionization potential of mercury using a gas filled diode.

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Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

EXPERIMENT # 03

OBJECT:

To determine the velocity of wave propagation in stretched string by using sonometer.

APPARATUS:

WA-9611 Sonometer, WA-9613 Driver/Detector Coils, Function Generator, Dual trace oscilloscope, Mass and mass hanger.

THEORY:

When two exactly same waves (i-e.same amplitude, frequency and time period) travel in opposite direction with same velocity superimpose on one another the resultant wave obtained is called *standing* or *stationary wave*.
Hence, we can say that the wave length of standing wave in a vibrating string may be a function of the tension, liner mass density of string, frequency and the velocity of the wave.
If λ is the wavelength of standing wave and υ is their velocity, the frequency of the vibration f can be determined by the relation.

$$\upsilon = f\lambda \qquad \text{(}i\text{)}$$

The velocity of transverse wave in a string is

$$v = \sqrt{\frac{T}{\mu}} \qquad \text{(}ii\text{)}$$

T is the tension applied to the string and **μ** is the liner mass density. Substituting the above value of υ from (*i*) to (*ii*)

$$f\lambda = \sqrt{\frac{T}{\mu}}$$

$$f = \frac{1}{\lambda}\sqrt{\frac{T}{\mu}}$$

whereas the distance *l* between successive nodes on string give the wavelength of string waves. *When string is vibrating in one loop we have*

$$l = \lambda/2$$

$$\lambda = 2l$$

and

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

The above equation gives the frequency of transverse wave in a staring.

$$\mu = \frac{1}{4L^2}\frac{T}{f^2}$$

PROCEDURE:

1. Set up the Sonometer as shown in Figure.
2. Set the bridges 60cm apart. Use any of the included strings and hang a mass of approximately 1 kg from the tensioning lever. Adjust the string knob so that the tensioning lever is horizontal. Position the driver coil approximately 5 cm from one of the bridges and position the detector coil near the center of the wire.
3. Set the signal generator to produce a sine wave.
4. Slowly increase the frequency of the signal driving the driving coil, starting with a frequency of 1 Hz. Determine the lowest frequency for a given tension at which resonance occurs. Record this value in table.
5. Record the string tension (T) in the table. Note the distance between the two wedges.
6. Repeat steps (4) and (5) for different values of tension in the string.
7. Plot a graph between f^2 and tension T.
8. Calculate slope of the graph and find out linear density of string by using

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

9. Take one value of tension of string from graph paper and determine velocity of waves in string by

$$v = \sqrt{\frac{T}{\mu}}\ .$$

OBSERVATIONS:

Length of string between two bridges: L= ______________________

S.No.	Tension Dyne	Fundamental Frequency(f) Hz	f^2 Hz^2
1			
2			
3			
4			
5			

Graph Paper

CALCULATIONS:

$$\boldsymbol{\mu = \frac{1}{4L^2}\,\frac{T}{f^2}}$$

$$v = \sqrt{\frac{T}{\mu}}$$

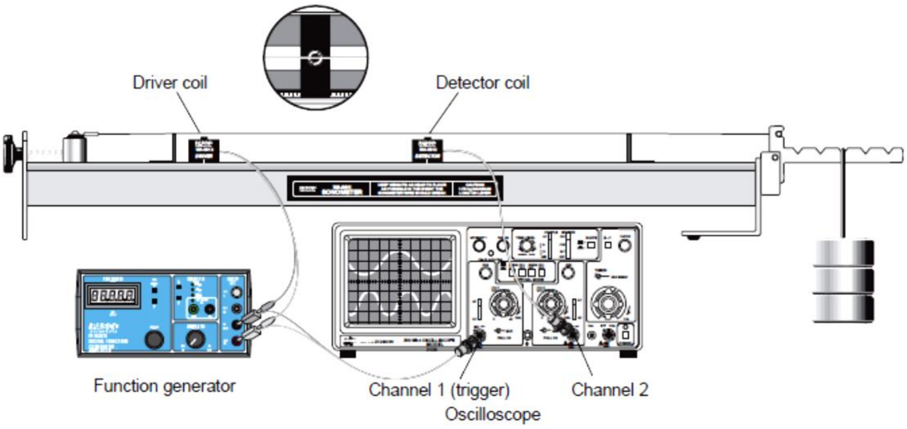
RESULT:

The velocity of vibrating string at tension ___________ is found to be________

PRECAUTIONS AND SOURCES OF ERRORS:

1. The wire should be of uniform cross-section, free from kinks and should be tight.
2. If detector is placed too close to the driver, it will pick up some interference. You can check for this interference by observing the waveform from the detector on an oscilloscope; when they are too close, the trace will change shape. For beat results keep the detector at least 10 cm apart from the driver.
3. The weight of the hanger should be included in the load.
4. The wire may not be uniform and form kinks.
5. The friction of the pulley may decrease the value of the applied tension.

PHOTOGRAPH OF THE APPARATUS



Questions

Q.1 What is the object of your experiment?

Q.2 What is sonometer?

Q.3 What type of waves is produced on the string?

Q.4 What are nodes and antinodes?

Q.5 Why the sonometer does consists of a hollow wooden box?

Q.6 What do you mean by stationary or standing waves?

Q.7 What is the function of bridges in sonometer?

Q.8 What is resonance?

NED University of Engineering & Technology

Department of _______________________________________

Course Code and Title: Applied Physics for Engineers (PH-127) _____

Object: To determine the velocity of wave propagation in stretched string by using sonometer.

Psychomotor Domain Assessment Rubric-Level P3					
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Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

EXPERIMENT # 04

OBJECT:

To determine the horizontal component of Earth Magnetic field strength "H_{ex}" by *Tangent Galvanometer.*

APPARATUS:

Tangent galvanometer, coil, rheostat, reversing key, connecting wires and ammeter.

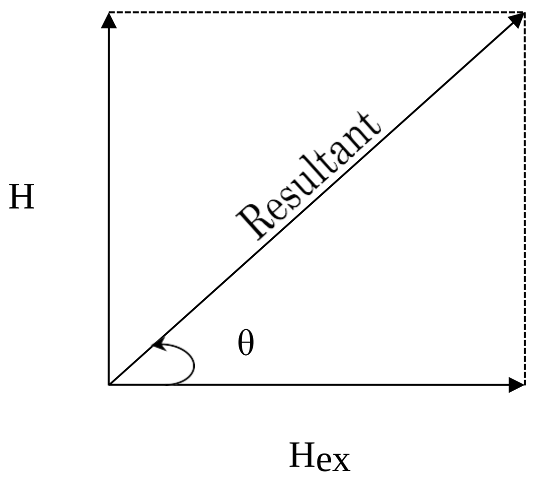
THEORY:

Two magnetic fields can be compared by means of tangent galvanometer, which consist of a magnet pivoted on a vertical axis and carrying a light pointer which can move over a circular scale. Normally one of the field is the earth horizontal component and other field is arranged to be at right angle to this. The pivoted magnet sets itself along the resultant of the two fields at an angle θ to its direction when it is in the earth magnetic field alone. If H_e is magnetizing force of the earth horizontal component and H is the magnetizing force of the other field (Coil).

$$H = H_{ex} \tan\theta \text{ --------------------(1)}$$

The magnetizing force at the center of a circular coil of known radius and known number of turns, when a measured current is passing through the coil, can be calculated. This can be compared by means of tangent galvanometer, with the horizontal component of the earth's magnetizing force, enabling the latter to be determined.

If n is the number of turns in the coil, r meter is its radius, I amp is the current, and H amp per meter the magnetizing force at the center of the coil.



$$H = \frac{nI}{2r} \text{ (amp per meter)}$$

Using equation (1)

$$H = H_{ex} \tan\theta$$

$$H_{ex} = \frac{H}{\tan\theta}$$

$$H_{ex} = \frac{nI}{2r \tan\theta}$$

1 amp per meter = 0.01256 oersted

PRODEDURE:

1. Connect the circuit as shown in figure.
2. Using leveling screw adjust dial of magnetometer, so that needle could not strike the dial.
3. Adjust the needle of tangent galvanometer so that, the needle is perpendicular to the circular coil.
4. Set rheostat for minimum current (i-e Max resistance), turn on the circuit and give 10^o, 15^o, 20^o, 25^o and 30^o clockwise deflection to magnetometer needle by increasing the current with rheostat.
5. Reverse the keys of reversing switch and repeat the step 4 in anticlockwise direction.
6. Note down the corresponding current for each deflection.
7. Plot a graph between I and tanθ, which will be a straight line of slope I/tanθ.
8. Knowing also N and r, H_{eX} can be calculated.

OBSERVATIONS:

No. of turns in the coil = n =_____________turns

Radius of the coil = r =_____________m

S.No.	***Angle θ Deg***	**Current in mA**			
		Clock Wise Reading I_1 mA	***Anti-Clock Wise Reading I_2 mA***	***Mean $I=(I_1+I_2)/2$ mA***	***tanθ***
01					
02					
03					
04					
05					

CALCULATION:

$$H_{ex} = \frac{nI}{2r\tan\theta} \text{ amp per meter}$$

1 amp per meter = 0.01256 oersted.

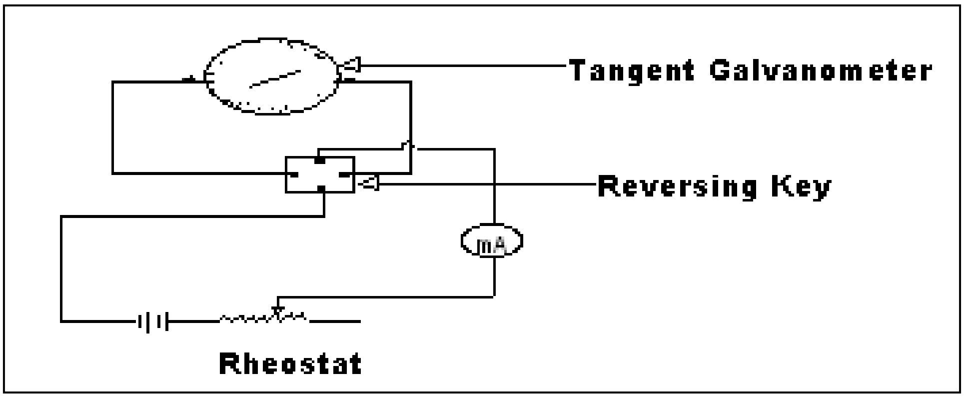
RESULT:

The value of H_{ex} is found to be = ...(Oersted)

PRECUTIONS:

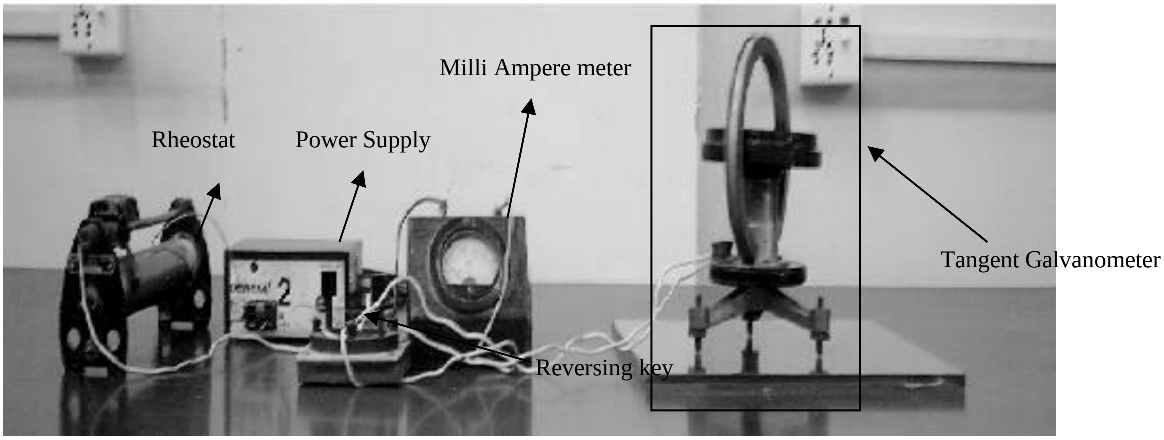
1. Connections should be tight.
2. Angle should be adjusted with care
3. Dial of galvanometer should be leveled properly.
4. Keep Metallic Material away from magnetic dial.

CIRCUIT DIAGRAM:



"H" by Tangent Galvanometer

PHOTOGRPAH OF THEAPPARATUS



Graph Paper

Questions

Q.1 What is the object of your experiment?

Q.2 What is the tangent galvanometer?

Q.3 What are the main parts of tangent galvanometer?

Q.4 What is the function of rheostat in this experiment?

Q.5 What is the geomagnetism?

Q.6 What is the formula for finding the horizontal component of earth magnetic field?

Q.7 Why needle of tangent galvanometer move with increasing or decreasing current?

Q.8 What is tangent law?

Q.9 What is the function of reversing key in this experiment?

Q.10 Why the tangent galvanometer is set into magnetic meridian?

NED University of Engineering & Technology

Department of ____

Course Code and Title: Applied Physics for Engineers (PH-127_____

Object: To determine the horizontal component of Earth Magnetic field strength "H_{ex}" by *Tangent Galvanometer.*

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Remarks	
Instructor's Signature with Date:	

EXPERIMENT # 05

OBJECT:

To study the characteristics of an acceptor circuit and determine unknown inductance.

APPARATUS:

Resistance, capacitors, inductor, a frequency generator/oscillator, an Oscilloscope, connecting wires, A.C. supply etc.

THEORY:

Acceptor Circuit:

When the resistor R, inductor L and capacitor C are connected in series with a source of emf E, the circuit is known as the RLC-series or series resonant or series tuned circuit as shown in figure.
The total opposition offered by the RLC circuit in flow of current is called impedance Z. it depends on frequency of AC signal applied and given by

$$Z = \sqrt{R^2 + (X_L - X_c)^2}$$

Where $X_L = \omega L$ and $X_c = \frac{1}{\omega C}$ are inductive and capacitive reactance of inductor and capacitor respectively

In A.C. circuits the voltage and the current are usually not in phase. Across the inductor, the current lags behind the voltage by 90^0, whereas across the capacitor, the current leads the voltage by 90^0. But across the resistor the voltage and current both are in phase. At particular frequency the capacitive reactance Xc and the inductive reactance X_L become equal and cancel effect of each other and circuit behave as purely resistive circuit. Under this condition, the voltage and current are in phase, even though the circuit consists of L, C and R. This phenomenon is called resonance and the frequency is known as resonant frequency.

$$X_L = X_c$$

$$\omega L = \frac{1}{\omega C}$$

$$\omega = 2\pi f = \frac{1}{\sqrt{LC}}$$

$$f = \frac{1}{2\pi\sqrt{LC}}$$

This is an acceptor circuit, that means it allows maximum current to flow through it at this particular (resonant) frequency and at all other frequencies it allows less current.

We see that at resonate frequency inductive reactance cancels the capacitive reactance and the current are then entirely determined by the resistive element R of the circuit.

Hence at resonance maximum current is given by:

$$I_o = \frac{E_o}{R}$$

At this frequency the impendence is minimum and it is equal to R and the current is in phase with the applied voltage.

If the frequency of the applied voltage is further increased beyond the resonant frequency, than the inductive reactance will increase and so the current will go on decreasing.

Such a circuit is called a series resonant or most commonly an acceptor circuit.

<u>WORKING FORMULA:</u>

Inductance is given as

$$L = \frac{1}{4\,\pi^2 f^2\, c}$$

<u>PRODEDURE:</u>

1. Make the circuit connections as shown in circuit diagram i.e. take a resistor, an inductor and a capacitor of suitable values connect them with each other in series and connect them across a frequency generator and cathode ray oscilloscope (CRO).
2. Apply a signal of certain voltage by the oscillator at a certain frequency say 10 kHz and note down the amplitude of output signal from CRO.
3. Now start increasing frequency of input signal (keeping the voltage constant) step by step, each time note down the amplitude of the output signal. We will see that amplitude of the output signal will first increase steadily, reaches a maximum value and then start decreasing.
4. Plot a graph b/w frequency (f) on x-axis and the corresponding amplitude of the signal on y-axis for each set of observation on one graph paper.
5. From graph calculate resonant frequencies for capacitor at which amplitude of signal is maximum.
6. Calculate the inductance with the help of resonant frequencies obtained through graph.

OBSERVATIONS:

Capacitance of capacitor C= ....μF.

S. No.	*Frequency* **f** *kHz*	*Amplitude of Signal division*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Graph paper

CALCULATIONS:

From Graph:

1- Value of resonant frequency f = ...kHz.

$$L = \frac{1}{4\pi^2 f^2 c}$$

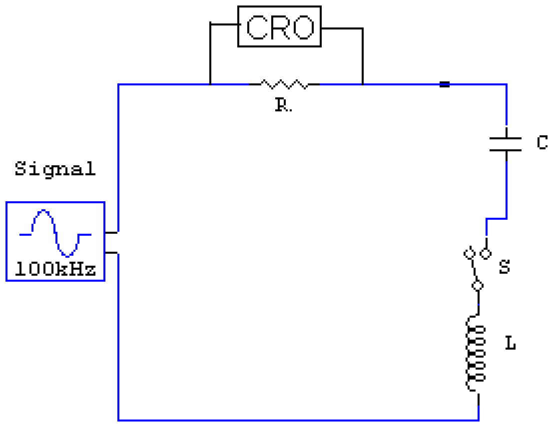
RESULT:

1. Characteristics of a acceptor circuit studied. It is seen that at resonant frequency the output signal is ***maximum / minimum***.
2. The value of inductance is found L = ---------------- Henry.

PRECAUTIONS AND SOURCES OF ERROR:

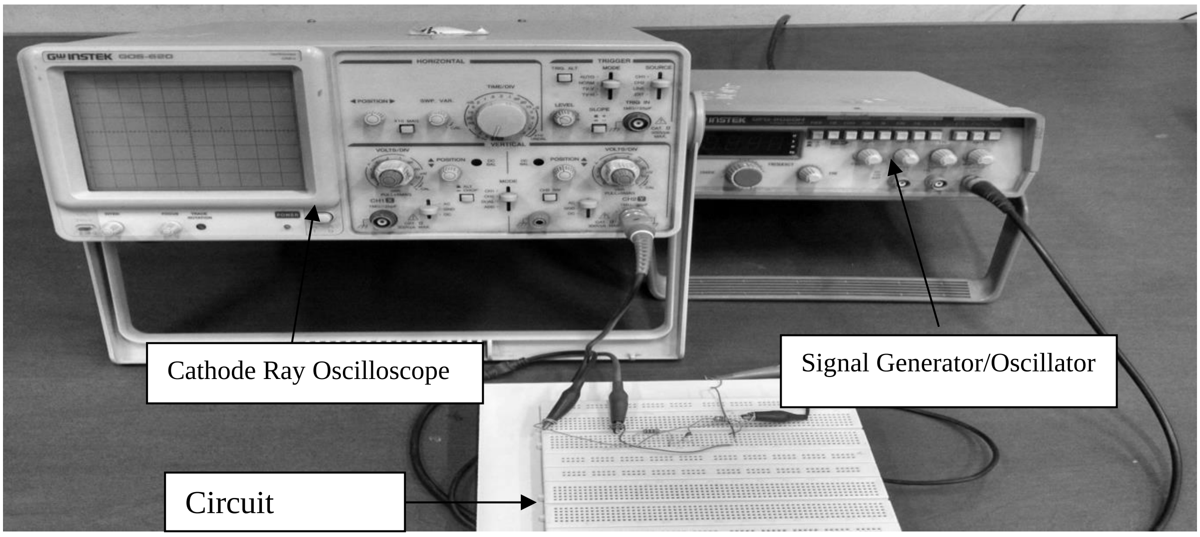
1. Before switching on, get connections checked by teacher.
2. The amplitude of the signal at resonant frequency may not be exactly zero, which is due to the presence of the resistance.
3. Choose proper combinations of L, C & R

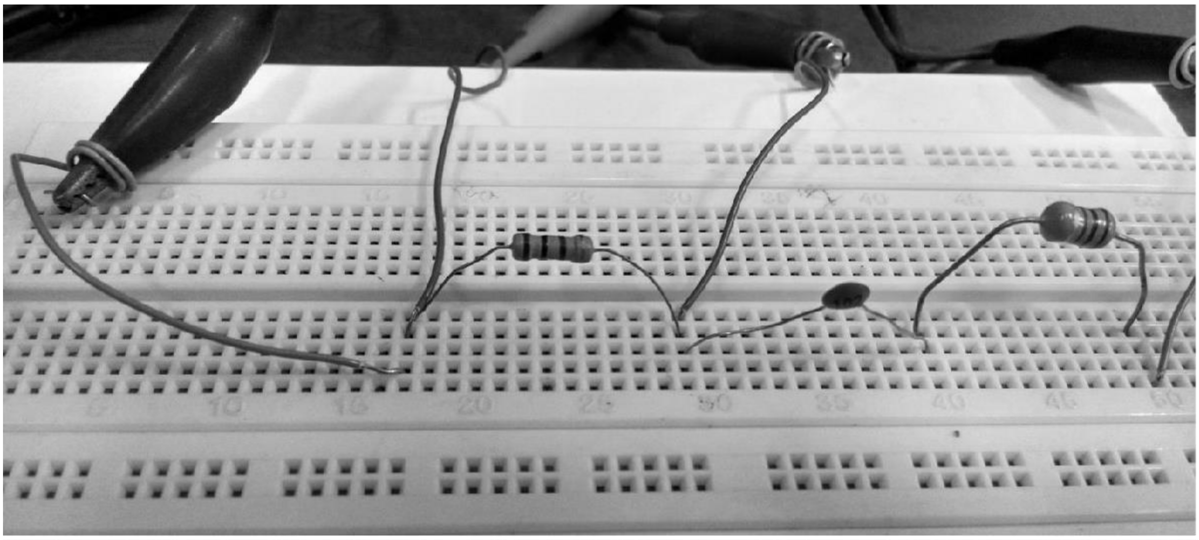
CIRCUIT DIAGRAM:



ACCEPTOR CIRCUIT .

PHOTOGRAPH OF THE APPARATUS





Questions

Q.1 What is the object of your experiment?

Q.2 What is an acceptor circuit?

Q.3 What are the applications of a acceptor circuit.

Q.4 What is resonant frequency?

Q.5 How the resonant frequency varies with capacitance and inductance.

Q.6 What is inductive reactance?

Q.7 What is capacitive reactance?

Q.8 What is impedance?

Q.9 What is the phase angle?

Q.10 What is the phase difference between voltage and current at resonance?

Q.11 What are the units of inductance or self-inductance?

Q.12 What is the energy stored in the magnetic field of the inductor?

Q.13 What is the energy stored in the electric field of a capacitor?

Q.14 What is the natural frequency of an accepter or a rejecter circuit?

Q.15 What is the equivalent of self-inductance in mechanics?

Q.16 What is non-inductive winding of a wire resistor?

Q.17. What is self-induction?

Q.18 How the inductance of a coil can be changed without changing its dimension or number of turns?

Q.19 What do mean by inductance of 1.0 Henry of a coil?

Q.20 What are the uses of an inductor?

NED University of Engineering & Technology

Department of ____

Course Code and Title: Applied Physics for Engineers (PH-127_____

Object: To study the characteristics of an acceptor circuit and determine unknown inductance.

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Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

EXPERIMENT # 06

OBJECT:

To determine the unknown high resistance by Neon Flash lamp Apparatus.

APPARATUS:

Neon lamp, known and unknown high resistance, a capacitor of suitable value, stops watch and power peck etc.

THEORY:

Flashing and quenching of a neon bulb. A neon bulb is placed in parallel with a capacitor and connected to D.C. supply which can be continuously increased from 0 to 150 volt through a high resistance of about 1MΩ. The voltage is slowly increased to a value say $V_1$when the lamp flashes and begins to glow. As soon as the neon lamp flashes, it becomes conducting and the capacitor begins to discharge through it. It continues to do so until the extinction (or quenching) potential V_2 is reached when the neon lamp ceases to glow and stops conducting. The capacitor then again beings to charge till the flashing potential V_1 is reached when again the lamp flashes and begins to glow. The process is repeated, During the time the capacitor is charging the neon lamp does not glow. In other words, the total time t between two consecutive flashes is equal to the time taken by the voltage first to fall from the flashing potential V_1 to quenching potential V_2 (discharge) and then to rise from V_2 to V_1 (charging). This flashing and quenching time can be determined by noting the time taken by the lamp to produce say 20 consecutive flashes and quenches. If t_1 is the time taken by the capacitor voltage to fall from V_1 to V_2 and t_2 is the time taken by the voltage to rise from V_2 to V_1, then

V_2 for charging of capacitor, $V_2 = V_1 e^{-t_1/RC}$

$$t_1 = -CR \log_e \frac{V_2}{V_1}$$

V_2 for discharging of capacitor, $V_2 = V_1 \left(1 - e^{-t_2/RC}\right)$

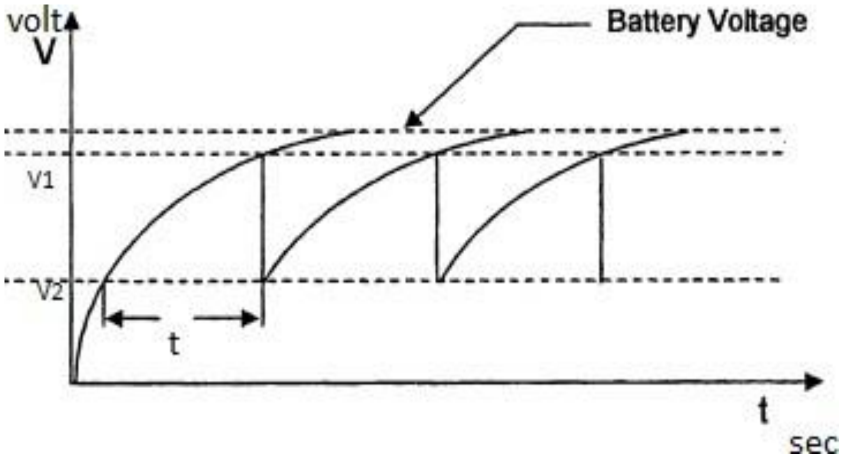
$$t_2 = -CR \log_e \left(1 - \frac{V_2}{V_1}\right)$$

$$t = t_1 + t_2 = R\left[-C \log_e \frac{V_2}{V_1} - C \log_e \left(1 - \frac{V_2}{V_1}\right)\right]$$

As C, V_2 and V_1 have constant fixed values, the function within brackets is a constant., Let it be = k

$$\therefore \; t = kR$$

$$t \propto R$$



PROCEDURE:

1. Make circuit connection as shown in circuit diagram.
2. Connect first known valued resistance (say 1 M Ω) and switch on the circuit neon .
3. Note down time of 10 consecutive flashes.
4. Now increase the resistance R and again note down time for 10 flashes.
5. We will observe that the interval between two flashes increases with the increase of resistance.
6. In this way note down the time taken for 10 flashes corresponding to different known resistors and also for unknown resistance R_1 and R_2 in the circuit.
7. Plot a graph b/w resistance R and corresponding time for 10 flashes when the unknown resistance is in the circuit so from the graph read the value of resistance, which correspond to the time for 10 flashes for the unknown resistance.

Graph paper

OBSERVATIONS:

The capacitance of the capacitor =................... μF

S.No.	*Resistance R MΩ*	*Time for Ten flashes Seconds*			*Mean Time t Seconds*	*Time for one flash T=t/10(sec)*
		t_1	t_2	t_3		
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

RESULT:

From Graph:

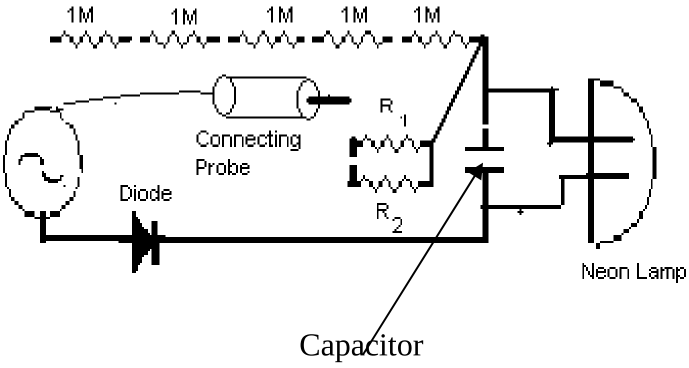
The value of unknown resistance from the graph R_{1}=................................... MΩ.
The value of unknown resistance from the graph R_{2}=................................... MΩ.

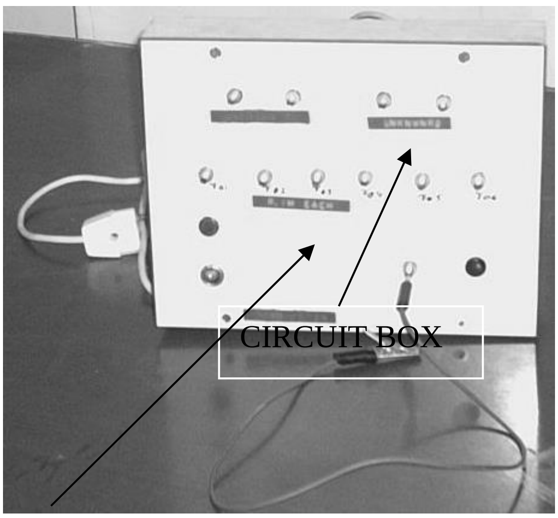
PRECAUTIONS AND SOURCES OF ERROR:

1. Don't touch naked wires.
2. The applied voltage must be uniform and must be kept constant throughout the experiment.
3. Note the time for flashes carefully.

PHOTOGRAPH OF THE APPARATUS

CIRCUIT DIAGRAM:





CIRCUIT BOX

Questions

Q.1 What is the object of your experiment?

Q.2 What is neon lamp?

Q.3 On what principle this experiment based?

Q.4 What is the time constant?

Q.5 How the time constant vary with the resistance and capacitance?

Q.6 Why it is not possible to determine the value of low resistance using this experiment?

Q.7 What is the striking potential?

Q.8 What is quenching potential?

Q.9 Can you find out the capacitance of a capacitor?

Q.10 What causes the neon lamp to give flashes?

NED University of Engineering & Technology

Department of ____

Course Code and Title: Applied Physics for Engineers (PH-127_____

Object: To determine the unknown high resistance by Neon Flash lamp Apparatus.

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Weighted CLO (Psychomotor Score)	
Remarks	
Instructor's Signature with Date:	

OPEN ENDED LAB

OBJECT:

APPARATUS:

WORKING FORMULA:

GRAPH PAPER

OBSERVATIONS:

CALCULATIONS:

RESULT:

PRECAUTION AND SOURCES OF ERROR

NED University of Engineering & Technology

Department of ____

Course Code and Title: Applied Physics for Engineers (PH-127____

Object: ____

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