Ref No:

Sri Krishna Institute of Technology
Bengaluru

LABORATORY PLAN

Academic Year 2019-2020

Program:	B E
Semester :	2
Course Code:	18PHYL26
Course Title:	Engineering Physics Lab
Credit / L-T-P:	2 / 0-0-2
Total Contact Hours:	42
Course Plan Author:	Arun Kumar A M

Academic Evaluation and Monitoring Cell

INSTRUCTIONS TO TEACHERS

- Classroom / Lab activity shall be started after taking attendance.
- Attendance shall only be signed in the classroom by students.
- Three hours attendance should be given to each Lab.
- Use only Blue or Black Pen to fill the attendance.
- Attendance shall be updated on-line & status discussed in DUGC.
- No attendance should be added to late comers.
- Modification of any attendance, over writings, etc is strictly prohibited.
- Updated register is to be brought to every academic review meeting as per the COE.

Table of Contents

Note : Remove "Table of Content" before including in CP Book
Each Laboratory Plan shall be printed and made into a book with cover page
Blooms Level in all sections match with A.2, only if you plan to teach / learn at higher levels

A. LABORATORY INFORMATION

1. Laboratory Overview

Degree:	BE	*Program:*	All
Year / Semester :	1 / 1	*Academic Year:*	2019-20
Course Title:	Engineering Physics Lab	*Course Code:*	18PHYL16
Credit / L-T-P:	01 / 2-0-0	*SEE Duration:*	120 Minutes
Total Contact Hours:	62 Hrs	*SEE Marks:*	60 Marks
CIA Marks:	40	*Assignment*	1 Assignment / Experiment
Lab. Plan Author:	Arun Kumar A M	*Sign*	Dt :
Checked By:	Ravi S	*Sign*	Dt :

2. Laboratory Content

Expt.	Title of the Experiments	Lab Hours	Concept	Blooms Level
1	Radius of curvature of plano convex lens using Newton's rings.	2	Radius of Curvature	L3
2	Calculation of Dielectric constant by RC charging and Discharging	2	Dielectric Constant	L3
3	Determine Wavelength of semiconductor laser using Laser diffraction by calculating grating constant.	2	Wavelength	L3
4	Study Series and parallel LCR resonance and hence Calculate inductance, band width and quality factor using series LCR Resonance	2	Band Width and Quality Factor	L3
5	Estimation of Fermi Energy of Copper	2	Fermi Energy	L3
6	Study of Rigidity modulus by Torsional pendulum.	2	Rigidity Modulus	L3
7	Study of input and output Transistor characteristics and hence calculate input resistance, Output Resistance, alpha and beta	2	Transistor Characteristics	L3
8	Study of photo diode characteristics.	2	Photo diode Characteristics	L3
9	Young's modulus of a beam by Single Cantilever experiment.	2	Young's Modulus	L3
10	Determination of spring constants in Series and Parallel combination	2	Spring Constant	L3
11	Determination of Magnetic field intensity at the center of a circular coil carrying current .	2	Magnetic Field	L3
12	Determine Acceptance angle and Numerical aperture of an optical fiber	2	Acceptance angle and Numerical Aperture.	L3

3. Laboratory Material

Books & other material as recommended by university (A, B) and additional resources used by Laboratory teacher (C).

Expt.	Details	Expt. in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	-	-
1	Text books		In Lib / In Dept
	V K Mehta – Text Book on Electronics		
			-
2	Reference books		
	S P Basavaraju – Text Book on Engineering Physics		In Lib / In Dept
			-
3	Others (Web, Video, Simulation, Notes etc.)		
D	**Software Tools for Design**	-	-
E	**Recent Developments for Research**	-	-
F	**Others (Web, Video, Simulation, Notes etc.)**	-	-
1	NPTEL: https://www.youtube.com/watch?v=h0Y9jDKqScQ&list=PLgMDNELGJ1CaNcuuQv9xN07ZWkXE-wCGP		
2	NPTEL: Theory of Elasticity https://youtu.be/eICv1p8WjgI		
3	Motion : https://youtu.be/5nhVNKg-6K4 HC Verma		
4	Optical Fiber: https://youtu.be/jnjjWI1s9_s		

4. Laboratory Prerequisites:

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Expt.	Lab. Code	Lab. Name	Topic / Description	Sem	Remarks	Blooms Level
1	18PHYL16	Engineering Physics Lab	The student should have acquired the knowledge of Basic laws, theories, phenomenon, definitions, expressions, advanced research in formations and techniques required in modern Physics and material science	Lower Standards		Knowledge L1

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Expt.	Topic / Description	Area	Remarks	Blooms Level
1				

B. Laboratory Instructions

1. General Instructions

SNo	Instructions	Remarks
1	Observation book and Lab record are compulsory.	
2	Students should report to the lab as per the time table.	
3	After completion of the Experiments, certification of the concerned staff in-charge in the observation book is necessary.	
4	Should enter the readings / observations into the observation book while performing the experiment.	
5	The record of observations along with the detailed experimental procedure of the experiment in the Immediate last session should be submitted and certified staff member in - charge.	
6	When the experiment is completed, should disconnect	

	the setup made by them, and should return all the components/instruments taken for the purpose.	
7	Any damage of the equipment or burn-out components will be viewed seriously by putting penalty	
8	Completed lab assignments should be submitted in the form of a Lab Record in which you have to write the Aim, apparatus, procedure, circuit diagram, Observations, calculations and results.	

2. Laboratory Specific Instructions

SNo	Specific Instructions	Remarks
1	Should be dressed in Lab Uniform	
2	Enter in Lab Login Register	
3	Setup the Experiments	
4	Make the circuit connection	
5	Calculations and getting it mandatory	
6	Scientific calculator and graphs are compulsory	
7	Write the Record	

C. OBE PARAMETERS

1. Laboratory Outcomes

Expt.	Lab Code #	COs / Experiment Outcome	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
-	-	**At the end of the experiment, the student should be able to . . .**	-	-	-	-	-
1	18PHYL16	Students should be able to- Apply the knowledge of oscillations, frequency and resonance concept and their practical	4	Oscillations	Experiment	Slip Test	L3

		applications					
2	18PHYL16	Use and identify the Elastic moduli and Moment of inertia of given materials	4	Elasticity	Experiment	Slip Test	L3
3	18PHYL16	Understand and apply the concept of Interference of light, Diffraction of light, Fermi energy and magnetic effect of current.	8	Physical optics and Electromagnetic theory.	Experiment	Slip Test	L3
4	18PHYL16	Understand and use the principles of operations of optical fibers and semiconductor devices using a simple circuits.	8	Material physics	Experiment	Slip Test	L3
-		**Total**	24	-	-	-	-

Note: Identify a max of 2 Concepts per unit. Write 1 CO per concept.

2. Laboratory Applications

Expt.	Application Area	CO	Level
1	Used in Clocks, Fax Machine and Radio Stations.	CO1	L3
2	Resonators are used in particle accelerator, photonic devices, cars.	CO1	L3
3	The elastic moduli measures the stiffness of the building materials.	CO2	L3
4	The knowledge of torque is important in the operation of electric motors, gyroscopes, etc.	CO2	L3
5	Lasers find vast applications in Industry, medical, scientific fields.	CO3	L3
6	Fermi energy is applied in determining the electrical and thermal characteristics of solids.	CO3	L3
7	Used in Remote Control, CD players, Television, switching circuits etc.	CO4	L3

8	Optical fibers are used in telecommunication companies to transmit telephone signals.	CO4	L3

Note: Write 1 or 2 applications per CO.

3. Mapping And Justification

CO – PO Mapping with mapping Level along with justification for each CO-PO pair.

To attain competency required (as defined in POs) in a specified area and the knowledge & ability required to accomplish it.

Expt.	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	CO	PO	-	'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'	-
1	CO1	PO1	L3 Apply	Engineering Knowledge: Acquisition of Engineering knowledge is required to understand the concept of oscillations and resonance to apply it in use of clocks, scientific instruments.	L3
1	CO1	PO2	L3	Problem Analysis: To solve the problems in mechanical and electrical engineering field requires the knowledge of frequency and resonance to use it in different types of oscillatory system.	L3
1	CO1	PO3	L3	Design and Development of solution: The knowledge of resonance and elasticity is required in designing and developing the LCR circuit and spring constant respectively.	L3
1	CO1	PO4	L3	Modern tool Usage: Various modern tool usage is required for analysis and interpretation of resonance, SHM and spring constant.	L3
1	CO1	PO5	L3	No Mapping – No tool content.	
1	CO1	PO6	L3	The engineer and society: The knowledge of applications of oscillations and resonance is required to the engineer and society in day to day life.	L3
1	CO1	PO7	L3	No Mapping – This does not have any impact on society.	
1	CO1	PO8	L3	No Mapping – the content is not related to professional ethics.	
1	CO1	PO9	L3	Individual and Team work: To understand the functions and properties of passive electrical devices requires the Individual and team work to perform the experiments.	L3
1	CO1	PO10	L3	No Mapping – There is no design and document, hence no mapping.	
1	CO1	PO11	L3	No Mapping – There is no project management. Hence no mapping.	
1	CO1	PO12	L3	Life long learning: The understanding of the applications of LCR and spring constant is essential in day to day learning.	L3
2	CO2	PO1	L3	Engineering Knowledge: The acquisition of engineering knowledge of Elasticity required in the study civil and mechanical engineering field.	L3
2	CO2	PO2	L3	Problem Analysis: Problem analyzing of different material requires the knowledge of elasticity.	L3
2	CO2	PO3	L3	Design and Development of solution: Designing and developing the solution for the study of Rigidity modulus and Young's modulus requires the knowledge of elasticity.	L3
2	CO2	PO4	L3	Modern tool usage: Modern tools require the knowledge of elasticity to analyze and interpret the Rigidity modulus and Young's modulus study.	L3
2	CO2	PO5	L3	No Mapping – No tool content.	
2	CO2	PO6	L3	The engineer and society: The engineer and society require the knowledge of elasticity to know the applications of rigidity modulus and Young's modulus in day to day life.	L3
2	CO2	PO7	L3	No Mapping – This does not have any impact on society.	
2	CO2	PO8	L3	No Mapping – The content is not related to professional ethics.	
2	CO2	PO9	L3	Individual and team work: Individual and team work is required to study the functions of Rigidity and Young's modulus used in projects.	L3

2	CO2	PO10	L3	No Mapping – There is no design and document, hence no mapping.	
2	CO2	PO11	L3	No Mapping – There is no project management involved here. Hence no mapping.	
2	CO2	PO12	L3	Life long learning: The life long learning of elasticity is required to recognize and identify the application of rigidity modulus and Young's modulus in day to day learning.	L3
3	CO3	PO1	L3	Engineering knowledge: The acquisition of engineering knowledge is required to understand interaction of radiation with matter in medical and communication field and analysis of Maxwell's equation in electrical and communication engineering filed.	L3
3	CO3	PO2	L3	Problem Analysis: Problem analysis of the material structure using free electron theory and problems in communication system requires the knowledge of electric and magnetic field.	L3
3	CO3	PO3	L3	Design and Development of solution: The design and development of experiment setup is required to study the process of diffraction, magnetic field and newtons ring.	L3
3	CO3	PO4	L3	Modern tool usage: Modern tool uses the concept of physical optics and electromagnetic theory to analyze and interpret the study of diffraction, interference and electromagnetic field.	L3
3	CO3	PO5	L3	No Mapping – No tool content.	
3	CO3	PO6	L3	The engineer and society: The society requires to study the applications of diffraction grating, magnetic field and newtons ring in day to day life.	L3
3	CO3	PO7	L3	No Mapping – This does not have any impact on society.	
3	CO3	PO8	L3	No Mapping – The content is not related to professional ethics.	
3	CO3	PO9	L3	Individual and team work is required to study the experiments of diffraction grating, magnetic field and newtons ring in day to day life.	L3
3	CO3	PO10	L3	No Mapping – There is no design and document, hence no mapping.	
3	CO3	PO11	L3	No Mapping – There is no project management. Hence no mapping.	L3
3	CO3	PO12	L3	Life long Learning: The life long learning of laser is required to identify the application in day to day life.	L3
4	CO4	PO1	L3	Engineering knowledge: The acquisition of engineering knowledge is required to understand band theory of solids which is required in understanding of different electronic components.	L3
4	CO4	PO2	L3	Problem analysis: The problem analysis is required to identify the different materials using band theory of solids.	L3
4	CO4	PO3	L3	Design and Development of solution: The design and development of solution is required to study the process of optical fiber, photo diode and transistor experiments.	L3
4	CO4	PO4	L3	Modern tool usage: Modern tools require the analysis and interpretation of working of optical fiber, photo diode and transistor.	L3
4	CO4	PO5	L3	No Mapping – No tool content.	
4	CO4	PO6	L3	The engineer and society: The engineer and society need to know the applications of optical fiber, photo diode and transistor in day to day life.	L3
4	CO4	PO7	L3	No Mapping – This does not have any impact on society.	
4	CO4	PO8	L3	No Mapping – the content is not related to professional ethics.	
4	CO4	PO9	L3	Individual and team work: Individual and team work is required to recognize and identify the application of the experiments in day to day learning which are used in projects.	L3
4	CO4	PO10	L3	No Mapping – There is no design and document, hence no mapping.	
4	CO4	PO11	L3	No Mapping – There is no project management. Hence no mapping.	
4	CO4	PO12	L3	Life long learning: The life long learning of semiconductors and optical fibers is required to recognize and identify the application of the experiments in day to day work.	L3

4. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Experiment Outcomes	Program Outcomes															-
Expt.	CO.#	**At the end of the experiment student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	18PHYL26	Students should be able to- Apply the knowledge of oscillations, frequency and resonance concept and their practical applications	√	√	√	√	-	√	-	-	√	-	-	√	-	-	-	L3
1	18PHYL26	Use and identify the Elastic moduli and Moment of inertia of given materials	√	√	√	√	-	√	-	-	√	-	-	√	-	-	-	L3
2	18PHYL26	Understand and apply the concept of Interference of light, Diffraction of light, Fermi energy and magnetic effect of current.	√	√	√	√	-	√	-	-	√	-	-	√	-	-	-	L3
2	18PHYL26	Understand and use the principles of operations of optical fibers and semiconductor devices using a simple circuits.	√	√	√	√	-	√	-	-	√	-	-	√	-	-	-	L3
-	**18PHYL26**	**Average attainment (1,**	**2**	**3**	**2**	**2**		**3**			**2**			**2**				**-**

		2, or 3)
-	PO, PSO	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*

5. Curricular Gap and Experiments

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Expt	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					

Note: Write Gap topics from A.4 and add others also.

6. Experiments Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Expt	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1					

D. COURSE ASSESSMENT

1. Laboratory Coverage

Assessment of learning outcomes for Internal and end semester evaluation.

Distinct assignment for each student. 1 Assignment per chapter per student. 1 seminar per test per student.

Unit	Title	Teaching Hours	No. of question in Exam							CO	Levels
			CIA-1	CIA-2	CIA-3	Asg-1	Asg-2	Asg-3	SEE		
1	Radius of curvature of plano convex lens using Newton's rings.	02	1	-	1	-	-	-	1	CO3	L3
2	Calculation of Dielectric constant by RC charging and Discharging	02	1	-	1	-	-	-	1	CO4	L3

3	Determine Wavelength of semiconductor laser using Laser diffraction by calculating grating constant.	02	1	-	1	-	-	-	1	CO3	L3
4	Study Series and parallel LCR resonance and hence Calculate inductance, band width and quality factor using series LCR Resonance	02	1	-	1	-	-	-	1	CO1	L3
5	Estimation of Fermi Energy of Copper	02	1	-	1	-	-	-	1	CO3	L3
6	n & I by Torsional pendulum.	02	1	-	1	-	-	-	1	CO2	L3
7	Study of input and output Transistor characteristics and hence calculate input resistance, ^ alpha and ° beta	02	-	1	1	-	-	-	1	CO4	L3
8	Draw photo diode characteristics and calculate power responsivity	02	-	1	1	-	-	-	1	CO4	L3
9	Young's modulus of a beam by Single Cantilever experiment.	02	-	1	1	-	-	-	1	CO2	L3
10	Determination of spring constants in Series and Parallel combination	02	-	1	1	-	-	-	1	CO1	L3
11	Determination of Magnetic field intensity at the center of a circular coil carrying current (by deflection method).	02	-	1	1	-	-	-	1	CO3	L3
12	Determine Acceptance angle and Numerical	02	-	1	1	-	-	-	1	CO4	L3

	aperture of an optical fiber										
-	**Total**	**24**	**4**	**4**	**4**	**0**	**0**	**0**	**12**	**-**	**-**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

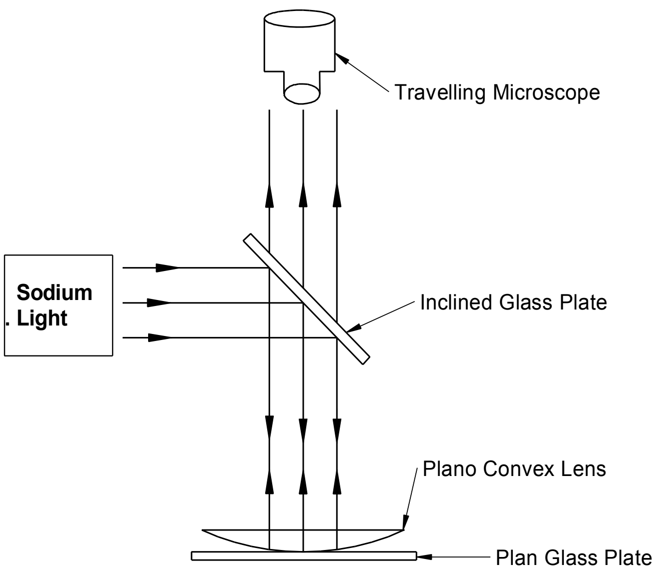
Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	40	CO1, CO2, CO3, CO4.	L3
CIA Exam – 2	40	CO1, CO2, CO3, CO4.	L3
CIA Exam – 3	40	CO1, CO2, CO3, CO4.	L3
Assignment - 1	00	-	-
Assignment - 2	00	-	-
Assignment - 3	00	-	-
Seminar - 1	00	-	-
Seminar - 2	00	-	-
Seminar - 3	00	-	-
Other Activities – define – Slip test		-	-
Final CIA Marks	**40**	**-**	**-**

SN o	**Description**	**Marks**
1	Writeup	16 Marks
2	Experimental setup	10 Marks
3	Experiment conduction	40 Marks
4	Calculation, graph and results	20 Marks
5	Vivoce	14 Marks
-	**Total**	**100 Marks**

E. EXPERIMENTS

Experiment 01: Newtons Ring

-	**Experiment**	1	**Marks**	16	**Date**		**Date**	

	No.:				Planned		Conducted	
1	Title	Newtons Ring						
2	Course Outcomes	Understand and apply the concept of Interference of light, Diffraction of light, Fermi energy and magnetic effect of current.						
3	Aim	To determine the radius of curvature of a given Plano-convex lens using the method of Newton's rings.						
4	Material / Equipment Required	Traveling microscope, Plano-convex lens. Glass slide, Sodium light, Beam splitter						
5	Theory, Formula, Principle, Concept	The radius of curvature of a given Plano-convex lens is given by, $$R=\frac{(D_m^2-D_n^2)_{avg}}{4(m-n)\lambda}m$$ Where, D_m - diameter of the m^{th} bright ring, m D_n - diameter of the n^{th} bright ring, m (m – n) - difference between the m^{th} and n^{th} bright rings λ - wavelength of sodium light = 5893 Å						
6	Procedure	The apparatus is set up as shown in the figure. The travelling microscope is placed such that its objective is directly above the plano-convex lens. The inclined glass plate is tilted (at 45° to the incident light beam) so that the light rays from the sodium vapour lamp are reflected on the plane glass plate, and the field of view is brightly illuminated. The focus of the microscope is adjusted such that Newton's Rings are clearly seen. Travelling microscope screw (in vertical mode) is moved such that the cross wire is tangent to the 8^{th} bright ring on the left side and the corresponding travelling microscope reading [TR=MSR+(CVDXLC)] is recorded. Similarly the readings corresponding to 7^{th}, 6^{th} are recorded. Same procedure is followed for the right side rings also from 1^{st} to 8^{th} ring. Diameter of the each ring is found. Then, D_m^2- D_n^2 is calculated by successive difference method for (m-n) = 3. Then radius of curvature of the plano-convex lens is found using the formula $$R=\frac{(D_m^2-D_n^2)_{avg}}{4(m-n)\lambda}m$$						
7	Block Diagram							

8	Observation Table	(see table below)

Ring no. (m)	TM Reading		Diameter $D_m = L_m - R_m$ (mm)	D_m^2 (m²)	Ring no. (n)	TM Reading		Diameter $D_n = L_n - R_n$ (mm)	D_n^2 (m²)	$D_m^2 - D_n^2$ (m²)
	Left L_m	Right R_m				Left L_n	Right R_n			
6					3					
5					2					
4					1					

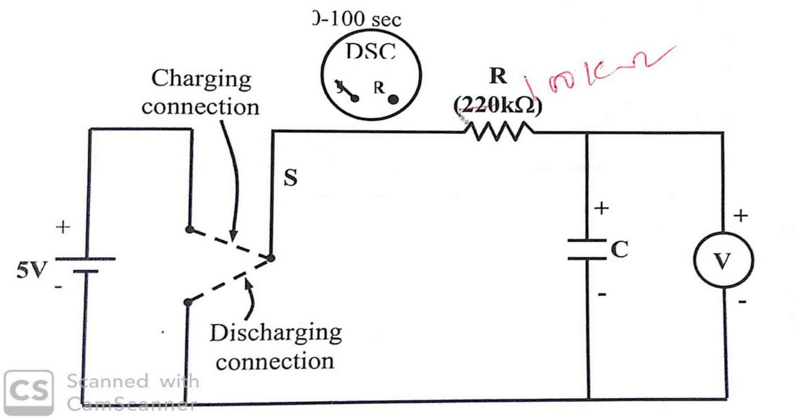
$(D_m^2 - D_n^2)_{avg} =$

9	Sample Calculations	$R = \frac{(D_m^2 - D_n^2)_{avg}}{4(m-n)\lambda} m$
10	Graphs	NO graphs
11	Results & Analysis	The radius of curvature of the given plano-convex lens using the method of Newton's rings is found to be R= ……………………………m.
12	Application Areas	To Measure the Wavelength of light.
13	Remarks	
14	Faculty Signature with Date	

Experiment 02: Dielectric constant

-	Experiment No.:	1	Marks	16	Date Planned		Date Conducted	
1	Title	Dielectric constant						
2	Course Outcomes	Understand and use the principles of operations of optical fibers and semiconductor devices using a simple circuits						
3	Aim	Calculation of Dielectric constant by RC charging and Discharging						
4	Material / Equipment Required	5V DC regulated power supply, digital stop clock, digital voltmeter, resistor of known value, capacitor of known dimensions, patch cords.						
5	Theory, Formula,	Dielectric constant,						

	Principle, Concept	$K = \frac{d t_{1/2} X 10^{-6}}{0.693 \varepsilon o A R}$ Where, A is area in m^2, A= l x b (l = 2.5 cm and b = 1.5 cm) d is the thickness of the material in mm, R is the resistance in ohms, $T_{1/2}$ is in seconds, εo = 8.854×10^{-12} F/m, is the permitivity of free space
6	Procedure,	CHARGING MODE The toggle switch **S** is set to charge mode and simultaneously the digital stop clock is set to start position. At this instant the capacitor get charged to higher voltage, immediately start noting down the voltage readings at every 5 seconds interval from zeroth second until V becomes constant (say two consecutive readings remain constant or upto 100sec). The voltage readings are entered in the tabular column, under charge mode. NOTE: The readings must be V = 0 for t = 0 [This can be achieved by shorting two ends of the capacitor]. DISCHARGING MODE When V is maximum in charge mode reset the timer to zero using reset button of digital stop clock, immediately change the toggle switch S to discharge mode and record the voltage in similar way as in charge mode. The voltage readings are entered in the tabular column, under discharge mode. For t = 0, the same maximum value of V during charge mode to be retained. A graph is plotted with time t in seconds along X – axis and voltage V in volts along Y – axis. The point where both the charge mode curve and discharge mode curve intersect; from there drop a perpendicular line to

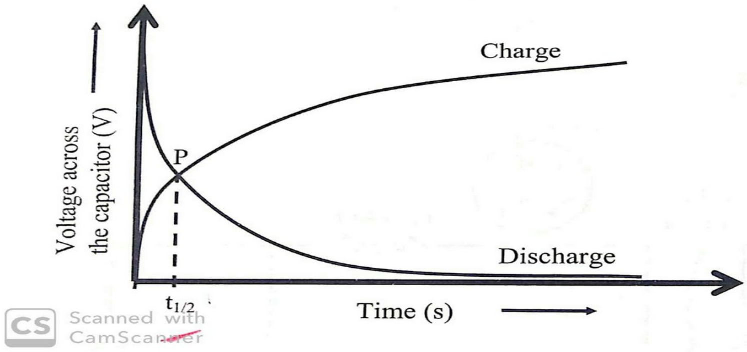
		time axis which gives $t_{1/2}$ in seconds. From the known the values of R, A and d the value of dielectric constant and value of the capacitor can be calculated using the relations
7	Circuit Diagram	
8	Observation Table,	OBSERVATIONS: Dependence of capacitor's voltage on time: R = 100 kΩ C = C_1

Time	Voltage across

(seconds)	C (V)	
	Charge mode	Discharge mode
0		
5		
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		
65		
70		
75		
80		
85		
90		
95		
100		

9 Sample Calculations

$$K = \frac{dt_{1/2}\, X\, 10^{-6}}{0.693\, \varepsilon o A R}$$

10	Graphs, Outputs	
11	Results & Analysis	The value of the dielectric constant of the material in the capacitor is _______.
12	Application Areas	Can be used in switching circuits.
13	Remarks	
14	Faculty Signature with Date	

Experiment 03: Laser Diffraction

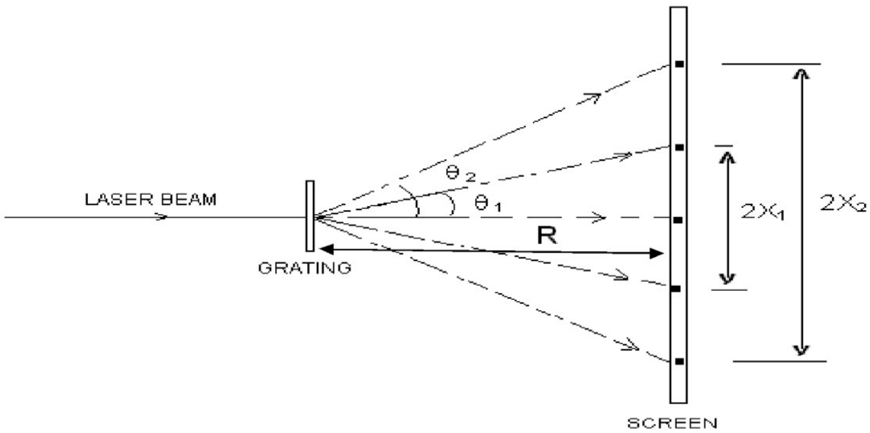
-	Experiment No.:	3	Marks		Date Planned		Date Conducted	
1	Title	Diffraction						

2	Course Outcomes	Understand and apply the concept of Interference of light, Diffraction of light, Fermi energy and magnetic effect of current
3	Aim	To study the diffraction of laser light and hence to determine its wavelength.
4	Material / Equipment Required	Diode laser source, grating with holder, scale, screen and thread.
5	Theory, Formula, Principle, Concept	$\lambda = d\, sin\theta_m (m)$ Where, λ = wavelength of laser light measured in m d = grating constant measured in m Example: For 500 number of lines per mm of a grating 'd' can be calculated as below $d = \frac{1\,x\,10^{-3}\,m}{500}$ $sin\theta_m = \frac{X}{\sqrt{R^2 + X^2}}$ where m = difference between the order of spots θ_m = angle of diffraction for m^{th} order spot x_m = distance between $Zero^{th}$ order spot and m^{th} order spot measured in m R = distance between screen and grating measured in m
6	Procedure	1. Place the laser source on the holder and mount on the heavy base. 2. Place the grating in its holder and the screen is placed at a distance of 3 to 4 meter. 3. The grating is kept between the laser

source and the screen.

4. The laser beam after passing through the grating undergoes diffraction. The diffraction spots are observed on the screen.
5. The distances $2x_m$ between the symmetrical spots on either side of 0^{th} order are measured and recorded.
6. The angle of diffraction θ_m and the LASER wavelength λ are calculated.

7 Block Diagram



8 Observation Table

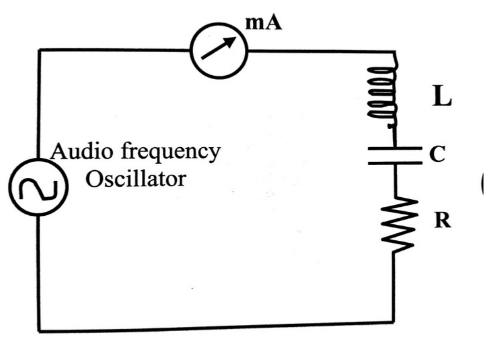
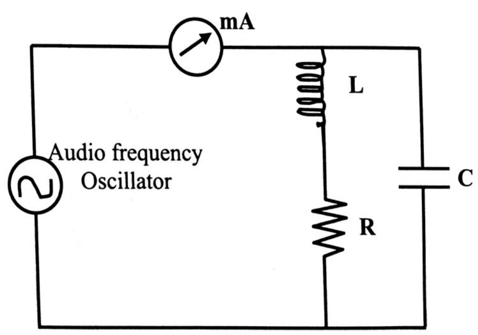
Sl No	Distance b/w grating & scale (R) in cm	Distance b/w central to spot to first order spot	x (in cm)	Sin θ
		x_1 (in cm)	x_2(in cm)	
1	10			
2	15			
3	20			

9	Sample Calculations	$\lambda = d \sin\theta_m (m)$ $\sin\theta_m = \frac{X}{\sqrt{R^2 + X^2}}$
10	Graphs	No graphs
11	Results & Analysis	The wavelength of the given Laser light source is…………………………..m.
12	Application Areas	To measure the Wavelength of light.
13	Remarks	
14	Faculty Signature with Date	

Experiment 04: Series and Parallel LCR resonance

-	Experiment No.:	4	Marks		Date Planned		Date Conducted	
1	Title	Series and parallel LCR resonance						
2	Course Outcomes	Apply the knowledge of oscillations, frequency and resonance concept and their practical applications						
3	Aim	Study the series and parallel LCR resonance and hence Calculate inductance, band width and quality factor using series LCR Resonance						
4	Material / Equipment Required	Audio frequency oscillator, inductance coil, capacitors, resistors, milliammeter						
5	Theory, Formula, Principle, Concept	1) The resonance frequency of the circuit is given by $f_r = \frac{1}{2\pi\sqrt{LC}}$ Hz. Where, L= Value of Inductance = 0.2 Henry.						

		C=Value of the capacitance = 0.01μF. 2) Bandwidth, $\Delta f = (f_2 - f_1)$ Hz. Where f_2=Upper cut off frequency, Hz. f_1=Lower cut off frequency, Hz. 3) The quality factor of the circuit is given by $Q = \frac{f_r}{f_2 - f_1}$
6	Procedure	SERIES RESONANCE CIRCUIT The electrical connections are made as shown in the circuit diagram, Fig (a). Set the amplitude knob to maximum position. The frequency of the oscillator is varied from 1 KHz to 7 KHz in steps of 500 Hz and each time the corresponding milliammeter readings are tabulated. Plot a graph by taking frequency (f in Hz) along the X-axis and current (I in mA) along the Y-axis as shown below. The frequency corresponding to the maximum value of current (I_{max}), which is called the resonance frequency f_r is noted from the graph. The maximum value of current (I_{max}) of a resonance curve for a particular value of C and R is noted. A straight line parallel to X-axis corresponding to the value of $I_{max}/\sqrt{2}$ is drawn such that the line cuts the curve at two points on either side of the resonance frequency. The frequencies f_1 and f_2 corresponding to these points are noted down. PARALLEL RESONANCE CIRCUIT

		The electrical connections are made as shown in the circuit diagram, Fig (b). Readings are tabulated and graph is plotted as described in the case of series resonance circuit. In this case the resonance occurs when current is minimum. Hence the frequency corresponding to I_{min} gives the resonance frequency f_r of the circuit. A straight line parallel to X-axis corresponding to the value of $I_{min}\sqrt{2}$ is drawn such that the line cuts the curve at two points on either side of the resonance frequency which gives the upper cut-off frequency (f_2) and lower cut-off frequency (f_1).
7	Circuit Diagram	 Series Resonance 

Parallel Resonance

8 Observation Table

Series Resonance

R =1 KΩ , C = 0.01 μF , L = L_2

Frequency (kHz)	Current (mA)
1	
1.5	
2	
2.5	
3	
3.5	
4	
4.5	
5	
5.5	
6	
6.5	
7	

Parallel Resonance

R =1 KΩ , C = 0.01 μF , L = L_2

Frequency (kHz)	Current (mA)
1	
1.5	
2	

2.5	
3	
3.5	
4	
4.5	
5	
5.5	
6	
6.5	
7	

9 Sample Calculations

1. From the known value of capacitance (C) and Inductance (L), the value of the Resonant frequency can be calculated using the relation

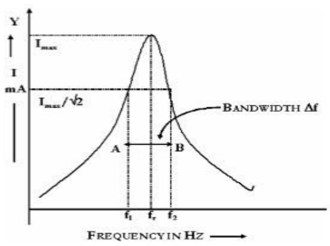
$$f_r = \frac{1}{2\pi\sqrt{LC}} \text{ KHz}$$

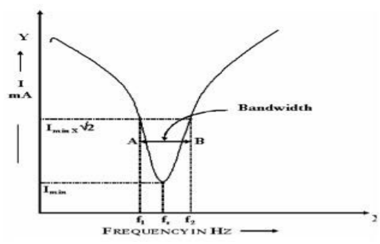
2. The bandwidth and quality factor of the given circuit is calculated as shown below

Bandwidth, $\Delta f = (f_2 - f_1)$ KHz.

Quality factor, $Q = \frac{f_r}{\Delta f}$.

10 Graphs





		Series Resonance Parallel Resonance
11	Results & Analysis	SERIES RESONANCE 1. The value of the Resonant Frequency from the formula =_______ KHz 2. The value of the Resonant Frequency from the Graph =_________ KHz 3. Bandwidth = __________KHz 4. Quality factor = ________ PARALLEL RESONANCE 1. The value of the Resonant Frequency from the formula =_______ KHz 2. The value of the Resonant Frequency from the Graph =_________ KHz 3. Bandwidth = __________KHz 4. Quality factor = ________
12	Application Areas	Used in Radio Stations
13	Remarks	
14	Faculty Signature with Date	

Experiment 05: Fermi Energy

-	**Experiment No.:**	5	**Marks**		**Date Planned**		**Date Conducted**	
1	Title	Fermi Energy						
2	Course Outcomes	Understand and apply the concept of Interference of light, Diffraction of light, Fermi energy and magnetic effect of current.						
3	Aim	Estimation of Fermi Energy of Copper						
4	Material / Equipment	Copper coil, thermometer, test tube, beaker,						

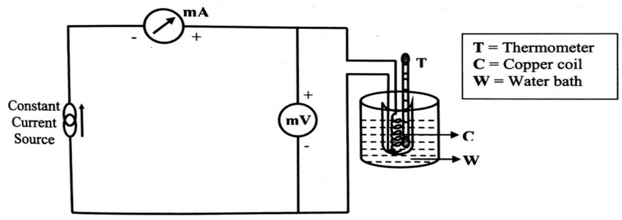
	Required	digital voltmeter, digital ammeter, constant current source.
5	Formula	1. The Fermi energy of a given conductor is related as $E_F = \left(\frac{ne^2\pi Ar^2}{L\sqrt{2m}}\right)^2 \times \left(\frac{\Delta R}{\Delta T}\right)^2$ J. Where n = Electron density of copper, 8.464×10^{28}/kg mol. e = Charge on electron, 1.602×10^{-19} C. A = Constant for copper, 7.4×10^{-6}. r = Radius of the given copper wire, 0.26×10^{-3} m. L = Length of the copper wire, 3.6 m. m = Mass of electron, 9.1×10^{-31} kg. $\frac{\Delta R}{\Delta T}$ = Slope of the graph obtained on plotting Resistance vs Temperature. 2. The Fermi temperature is calculated as $T_f = \frac{E_f}{K_B}(K)$

Where E_F = Fermi energy of the copper coil, (J).

K_B = Boltzmann constant, 1.38×10^{-23} (J/K).

6 Procedure

1) The experimental wire whose resistance and Fermi energy has to be determined is wound over an insulating tube; it is taken in a test tube along with a thermometer and immersed in a water bath.
2) The two ends of the coil is connected to a constant current source through a Milli ammeter and Milli voltmeter as shown in the circuit diagram.
3) The coil immersed in water bath is heated to a steady temperature say about 80º C.
4) Note down the voltage and current values for different cooling temperatures starting from 77ºC to 52ºC in steps of 5ºC.
5) Replace the hot water by cold water and note down voltage and current reading for room temperature.
6) (... each
ten...



7) ... perature and
her...
8) ... rature of the
given conductor is calculated using the above relation

7 Circuit Diagram

8 Observation Table

To determine the variation of Resistance with Temperature:

Sl. No.	Temperature (T)		Current (mA)	Voltage (mV)	Resistance (Ω)
	ºC	ºK			
1	77				
2	72				

3	67				
4	62				
5	57				
6	52				
7	RT				

9 Sample Calculations

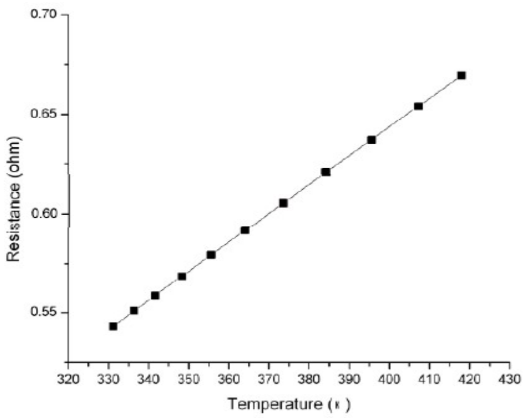
1) The Fermi energy of a given conductor is related as

$$E_F = \left(\frac{ne^2\pi Ar^2}{L\sqrt{2m}}\right)^2 \times \left(\frac{\Delta R}{\Delta T}\right)^2 \text{ J.}$$

2) The Fermi temperature is calculated as

$$T_f = \frac{E_f}{K_B}(K)$$

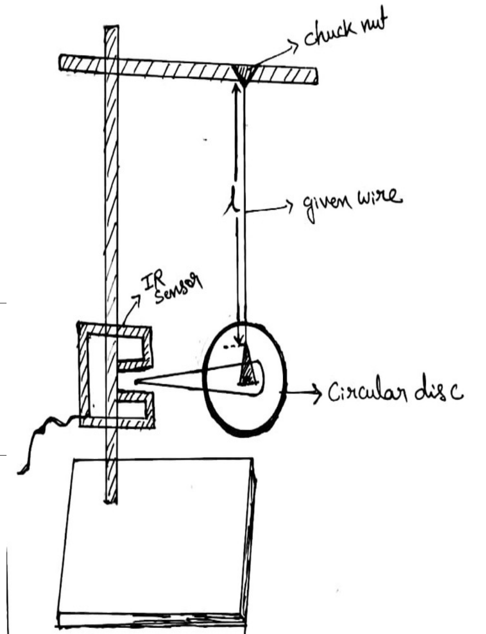
10 Graph



11	Results & Analysis	1) The Fermi energy of the given conductor is found to be ____________ eV. 2) Fermi temperature of the given conductor is found to be ______________ K.
12	Application Areas	Helps in Studying thermal properties of material
13	Remarks	
14	Faculty Signature with Date	

Experiment 06: Rigidity Modulus by Torsional Pendulum

-	Experiment No.:	6	Marks		Date Planned		Date Conducted
1	Title	Torsional pendulum.					
2	Course Outcomes	Use and identify the Elastic moduli and Moment of inertia of given materials					
3	Aim	Determine the Rigidity Modulus(n) of the material of the given wire by Torsional Oscillations.					
4	Material / Equipment Required	Circular plate, IR gated torsional pendulum, steel or brass wire with chuck nuts, pointer, stop – clock, screw gauge etc.					
5	Theory, Formula, Principle, Concept	1. $I=\frac{MR^2}{2}$ Kg.m² Where, M = Mass of Circular disc in Kg. R = Radius of the circular disc in m. 2. $n=\frac{8\pi I}{r^4}\left(\frac{l}{T^2}\right)$ N/m²					

		Where, $[l/T^2]_{mean}$ = The mean value of moment of inertia over period square for regular bodies, kg-m^2 /sec^2. l = Length of the wire between the two chuck nuts (m). r = Mean radius of the given wire (m). n = Rigidity Modulus in N/m^2.
6	Procedure,	1. One end of the wire is rigidly clamped to the stand and the other end is fixed to the circular disc with the help of chuck nuts as shown in the figure. 2. The chuck nut screwed to the circular plate is rotated through a small angle so that it performs torsional oscillations. 3. Time taken for 10 oscillations is noted down twice in each case and their corresponding periods are calculated. 4. The Experiment is repeated for different length (l) of the wire between the chuck nuts. 5. The length of the shearing wire between two chuck nuts areb measured by using thread and meter scale. 6. The rigidity modulus 'n' of the material is calculated using the formula, $n=\frac{8\pi I}{r^4}\left(\frac{l}{T^2}\right)$ N/m^2
7	Block, Circuit, Model Diagram,	

	Reaction Equation, Expected Graph	
8	Observation Table	Mass of the circular plate, M =___________ kg. Radius of the circular plate,=____________ m $R = \frac{circumference}{2\pi}$ Length of the wire between the two chuck nuts, l =___________ m.
9	Sample	1. $I = \frac{MR^2}{2}$ Kg.m^2

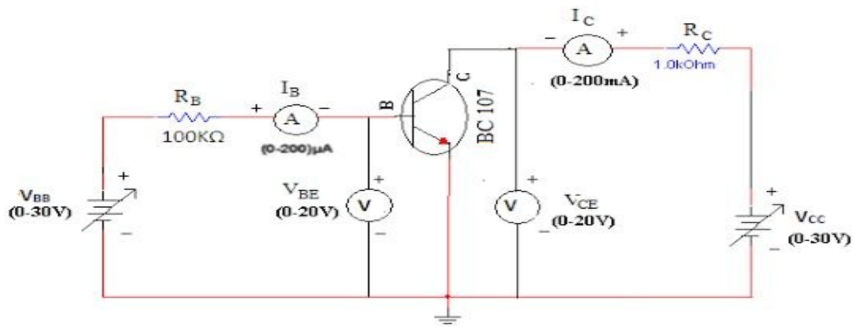
	Calculations	2. $n=\frac{8\pi l}{r^4}\left(\frac{I}{T^2}\right)$ Nm^{-2}
10	Graph	No graph
11	Results & Analysis	The moment of inertia of the given irregular body, I_o=_____kg-m^2. The rigidity modulus of the material of the given wire,n=____N/m^2.
12	Application Areas	1. One's body movement to the side when a car makes a sharp turn. 2. Tightening of seat belts in a car when it stops quickly. 3. A ball rolling down a hill will continue to roll unless friction or another force stops it.
13	Remarks	
14	Faculty Signature with Date	

Experiment 07: Transistor characteristics

-	Experiment No.:	7	Marks		Date Planned		Date Conducted	
1	Title	Transistor characteristics						
2	Course Outcomes	Understand and use the principles of operations of optical fibers and semiconductor devices using a simple circuits.						
3	Aim	Study of input and output Transistor characteristics and hence calculate input and output resistance, alpha and beta						
4	Material / Equipment Required	NPN transistor, variable DC power supplies, DC micro ammeter, DC milli ammeter, DC voltmeter and connecting wires.						

5	Theory, Formula, Principle, Concept	Input resistance, (R_i) $R_i=\frac{\Delta V_{BE}}{\Delta I_B}$ =---KΩ Output resistance (Ro) $R_o=\frac{\Delta V_{CE}}{\Delta I_C}$ =----Ω The current gain 'β' (common emitter configuration) is given by $\beta=\frac{Ic_2-Ic_1}{Ib_2-Ib_1}$ The current gain 'α' is given by $\alpha=\frac{\beta}{1+\beta}$
6	Procedure	The circuit connections are made as shown in the figure. INPUT CHARACTERISTICS 1. To start with, the collector emitter voltage (V_{CE}) is made constant; to be saying 2V. 2. Vary V_{BE} from 0.1V to 0.7V in steps of 0.1V and note down the corresponding base current (I_B) readings. 3. A graph V_{BE} verses I_B at constant V_{CE} is plotted by taking V_{BE} along X-axis and I_B along Y-axis. The graph is drawn for various values of V_{CE}. OUTPUT CHARACTERISTICS 1. The base current I_B is kept constant say 25μA. 2. Vary V_{CE} from 0.1V to 0.8V in steps of 0.1V and note down the corresponding I_C readings. 3. The experiment is repeated for I_B = 50μA. 4. A graph is drawn for various values of I_B, taking V_{CE} along X-axis and I_C along the Y-axis.

7 Circuit Diagram



Observation Table

INPUT CHARACTERISTICS

V_{CE} = 2V	
V_{BE} in (V)	I_B in (μA)
0.1	
0.2	
0.3	
0.4	
0.5	
0.6	

0.7	

OUTPUT CHARACTERISTICS

I_B = 25μA		I_B = 50μA	
V_{CE} (V)	I_C (mA)	V_{CE} (V)	I_C (mA)
0.1		0.1	
0.2		0.2	
0.3		0.3	
0.4		0.4	
0.5		0.5	
0.6		0.6	
0.7		0.7	

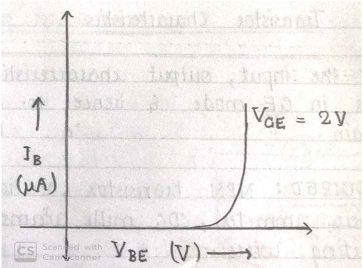
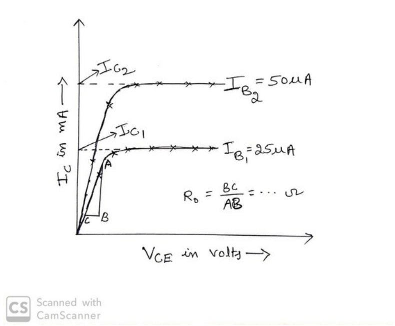
9 Sample Calculations

The current gain 'β' (common emitter configuration) is given by

$$\beta = \frac{\Delta I_C}{\Delta I_B}$$ at constant V_{CE}.

The current gain 'α' is given by

$$\alpha = \frac{\beta}{1+\beta}$$

10	Graphs	  Input Characteristics Output Characteristics
11	Results & Analysis	The input and output characteristics of the given NPN transistor are drawn and hence 1. Input resistance, (R_i) =----KΩ 2. Output resistance (Ro) =----Ω 3. The current gain, β = ___________. 4. The current gain α = ___________.
12	Application Areas	Used in switching circuits and amplification circuits
13	Remarks	
14	Faculty Signature with Date	

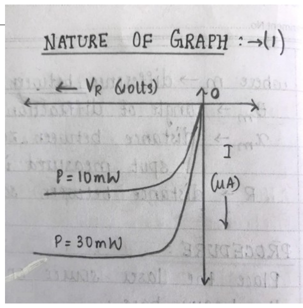
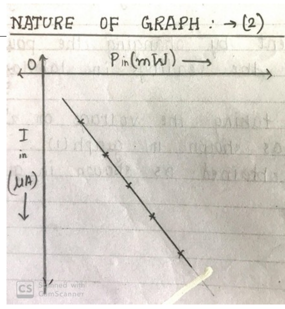
Experiment 08 : Photo diode characteristics

-	Experiment No.:	8	Marks		Date Planned		Date Conducted	
1	Title	Photo diode characteristics						
2	Course Outcomes	Understand and analyze the principles of photo electric current, & intensity by using semiconductor in a simple circuits.						

3	Aim	Study of V-I characteristics in reverse bias and variation of photocurrent as function of reverse voltage and intensity
4	Material / Equipment Required	A battery Eliminator, Voltmeter, Micro ammeter, photo diode, LED, experimental board and power supply
5	Theory, Formula, Principle, Concept	Photo diode is a two terminal junction diode in which the reverse saturation current changes when it's reverse biased junction is illuminated by suitable wavelength of light. When a p - n junction is reverse biased, a small amount of reverse saturation current is due to thermally generated electron - hole pairs. The number of these minority charge carriers depends on the intensity of light incident on the junction. When the diode is in a glass package, light can reach the junction and thus changes the reverse current
6	Procedure	Part - A 1. The electrical connections are made as shown in the circuit diagram, taking care that photo diode is reverse biased. 2. Vary the voltage from 0 to 2 volts and correspondingly measures the current by keeping power 10 mw constantly. 3.Repeat the experiment by changing the power to 30 mw. Note down the readings in tabular column. 4.Draw the graph by taking the voltage on x'-axis and current on Y'-axis as shown in model graph. 5.The curve will be obtained as shown in graph. Part- B 1. The circuit connection are connected as shown in the circuit diagram 2. Keep the voltage (V) =1volts constant, the vary the power as shown in the tabular column and correspondingly measure the current in µA. 3.Draw the graph by taking power on x-axis and current on y'- axis as show in the graph. 4.Join all possible points, we get straight line as shown in model graph.
7	Circuit Diagram	Analyze and identify the Elastic moduli and Moment of inertia of given materials
8	Observation Tabl	(table below)

Sl No	Reverse voltage V_R	Reverse Current (µA)	
		P = 10 mW	P= 30 mW
1	0		
2	0.1		
3	0.2		
4	0.3		

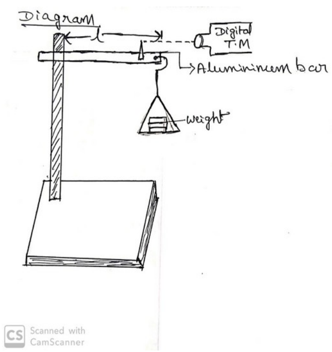
5	0.4		
6	0.5		
7	1.0		
8	1.5		
9	2.0		
10	2.5		

9	Sample Calculations	No Calculation
10	Graphs	 
11	Results & Analysis	The I - V characteristics of the given photodiode for different intensity of light as represented in the graph.
12	Application Areas	Used in Remote Control, CD players, Television
13	Remarks	
14	Faculty Signature with Date	

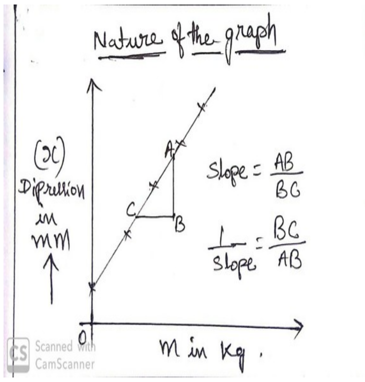
Experiment 09: Young's modulus by Single Cantilever method

-	Experiment No.:	8	Marks		Date Planned		Date Conducted	
1	Title	Young's modulus by Single Cantilever method						
2	Course Outcomes	Use and identify the Elastic moduli and Moment of inertia of given materials						
3	Aim	To determine the Young's Modulus of given Aluminum beam by using Single Cantilever Method.						
4	Material / Equipment Required	Aluminum beam, slotted weight (7x50gms), digital travelling microscope, digital vernier calipers and half meter scale						
5	Theory, Formula, Principle, Concept	Young’s modulus is one of the fundamental physics experiments which determine properties of material in the form of a rectangular beam. In this experiment we have used an aluminum beam about 30cms long, 3cm width and 2mm thick. One end of this beam is fixed to a stand with a screw, at the free end force is applied by hanging slotted weights. The non-uniform bending of the beam is monitored using a digital travelling microscope. The depression of the beam for different force is measured and young’s modulus is calculated using equation $Y=\frac{4gl^3}{bd^3}X\frac{m}{x}$ = -----N/m^2 Where Y - Young’s modulus , m - mass hanging at the open end g =9.8 m/s^2 l - length of the cantilever b - breadth of the beam						

		d - thickness of the beam and x - depression at the open end of the cantilever
6	Procedure	1. The experimental setup is arranged as shown in the figure. The digital travelling microscope reading is set to around zero mm. 2. Now the microscope is placed in front of the cantilever with the horizontal telescope is about 5-6 cm from the pointer on the cantilever 3. The telescope is adjusted to see clearly the pointer and it is coincided with the horizontal cross wire. 4. 50gm weight hanger is now loaded to the cantilever due which the cantilever bend the pointer in the microscope moves up. 5. The microscope fine screw is adjusted such that the pointer again coincide with the horizontal cross wire and travelling microscope reading is noted in Table. 6. Trial is repeated by increasing weight in steps of 50gm and in each case the pointer is again coincided with the horizontal cross wire and corresponding depression is noted in the travelling microscope and recoded in Table-1 7. Trial is continued till 350gms and each case coinciding the pointer to the horizontal cross wire the depression is noted. 8. The length of the cantilever is measured from the fixed end till the end of open end using meter scale 9. Using digital vernier the thickness (t) and breadth (b) of the cantilever beam is noted 10. A graph is drawn taking mass m along the x axis and depression x along Y-axis as shown in Figure using Excel. From the straight line graph the slope is determined 12. Young's modulus is calculated using equation-1

7	Experimental Setup.	
8	Observation Table	Depression of the beam for different mass
9	Sample Calculations	

Mass (gm)	Digital traveling microscope reading (mm)
0	
50	
100	
150	
200	
250	
300	
350	

		$Y=\frac{4gl^3}{bd^3} X \frac{m}{x}$ =-----N/m^2
10	Graphs	
11	Results & Analysis	The Young's modulus of given Aluminum beam = ______ N/m^2
12	Application Areas	The elastic moduli measures the stiffness of the building materials.
13	Remarks	
14	Faculty Signature with Date	

Experiment 10 : Series and Parallel Combinations of Spring

-	Experiment No.:	8	Marks		Date Planned		Date Conducted	
1	Title	Series and parallel combinations of spring						
2	Course Outcomes	Apply the knowledge of oscillations, frequency and resonance concept and their practical						

		applications
3	Aim	To Determination of given spring constants in Series and Parallel combination.
4	Material / Equipment Required	Springs, Scale, Rigid stand, Slotted weights, Digital Balance etc.
5	Formula	1) Spring constant(K), $$k = \frac{F}{x} \quad in \ \ Nm^{-1}$$ Where, F – Force applied (= mg) in N. x – Displacement produced in the spring in m 2) Spring constant for Series combination of springs, $$k_{Series} = \frac{k_1 k_2}{k_1 + k_2} \quad in \ \ Nm^{-1}$$ 3) Spring constant for Parallel combination of springs, $$k_{Parallel} = k_1 + k_2 \quad in \ \ Nm^{-1}$$
6	Procedure	Part-1 1. spring-1 is hooked to the rigid stand with initial dead load(w=100gm).note down the position 'a' of the pointer on the scale in cm. 2. Add some more load into the weight hanger (say 50gm) and note down the weight edge reading as 'b' in cm and write in table. 3. Repeat the trial until the total mass 250gm in steps

of 50gm each time. The
corresponding displacement 'b' is noted in table -1
4. Find out average spring constant k_1 from the formula-1

Part-2

1.Now the spring -1 is removed and spring-2 is hooked to the stand.
2. Experiment is repeated by using part-A procedure. And corresponding displacements are tabulate in table-2
3. The spring constant k_2 is determined by using the formula-2

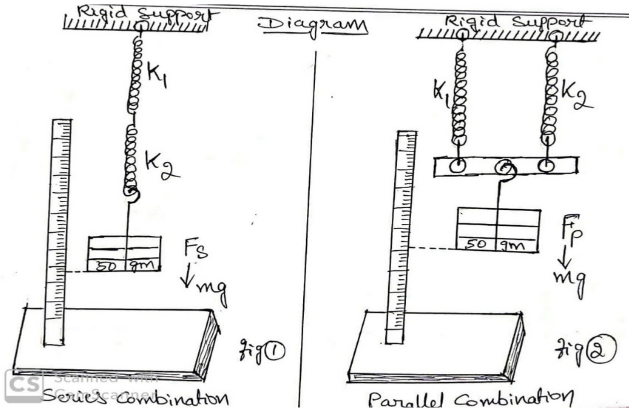
Part-3

1. Spring-1 & Spring-2 are connected in series and hooked the rigid support as shown in figure.
2. Add 100gm(w) dead load to the series combination and the corresponding
displacement 'a' is note down in cm.
3. Add 50gm more load into the weight hanger and note down the weight edge reading 'b' in cm and write in table-3
4.Trial is continued by increasing the mass in steps of 50gm upto 250gm. And
the corresponding displacement(b) are noted in table-3
5. The series spring constant(K_S) can be calculated by using formula-3

Part-4

1. The mass es are removed from the spring and the two springs are now connected in parallel as shown in the figure 2.
2. The experiment is repeated by using part 3 procedure. And the corresponding readings are tabulated in table 4.
3. The parallel spring constant (K_p) can be calculated using the formula 4.

7 Experimental Setup.



8 Observation Table, Look-up Table, Output

Table-for k_1

Pointer reading with initial load(w), a = ………… cm

Sl. No	Load (gm)	Pointer reading b(cm)	Spring stretch x= b-a (cm)	Force F= mg (N)	Spring constant (N/m)

Average k_2 = …………….. N/m

Table-for k_2

Pointer reading with initial load(w), a = ………… cm

Sl. No	Load (gm)	Pointer reading b(cm)	Spring stretch x= b-a (cm)	Force F= mg (N)	Spring constant (N/m)

Average k_2 = …………….. N/m

Table-for k_s

Pointer reading with initial load(w), a = ………… cm

Sl. No	Load (gm)	Pointer reading b(cm)	Spring stretch x= b-a	Force F= mg (N)	Spring constant (N/m)

			(cm)		

Average k_2 = …………….. N/m

Table-for k_p

Pointer reading with initial load(w), a = ………… cm

Sl. No	Load (gm)	Pointer reading b(cm)	Spring stretch x= b-a (cm)	Force F= mg (N)	Spring constant (N/m)

Average k_2 = …………….. N/m

9 Sample Calculations

$$k = \frac{F}{x} \quad in \ Nm^{-1}$$

$$k_{Series} = \frac{k_1 k_2}{k_1 + k_2} \quad in \ Nm^{-1}$$

$$k_{Parallel} = k_1 + k_2 \quad in \ Nm^{-1}$$

10	Graphs, Outputs	No Graph
11	Results & Analysis	The spring constants for the springs are found to be, k_1 = …………… N/m k_2 = …………… N/m The spring constants for the combination of springs are found to be, <table><tr><th>Combination</th><th>Theoretical</th><th>Experimental</th></tr><tr><td>Series</td><td>K_{series} =</td><td>K_{series} =</td></tr><tr><td>Parallel</td><td>$K_{parallel}$ =</td><td>$K_{parallel}$ =</td></tr></table>
12	Application Areas	Used in Clocks, Scientific Instruments, Fax Machine and Radio Stations
13	Remarks	
14	Faculty Signature with Date	

Experiment 11 : Magnetic Field

-	Experiment No.:	11	Marks		Date Planned		Date Conducted	
1	Title	MAGNETIC FIELD INTENSITY						
2	Course Outcomes	Analyze and identify the oscillations, frequency and resonance concept and their practical applications.						
3	Aim	To determine the magnetic field intensity (B) along the axis of a circular coil carrying current and earth's horizontal magnetic field (B H) by deflection method.						
4	Material /	Deflection magnetometer, sprit level,						

	Equipment Required	commutator, ammeter, variable power supply and connecting wires.
5	Theory, Formula, Principle, Concept	The magnetic field intensity, Horizontal component of earth's magnetic field, in T Where, = Permeability of free space = 4π x 10 -7 H m -1 . n = number of turns in the coil. (n = 140 turns) I = Current through the coil in amp. a = Radius of the coil in m. (a = 12 cm) x = distance between the centre of the coil and pointer in the compass box in m. = mean deflection in magnetometer in deg. = horizontal component of earth's magnetic field in T.
6	Procedure	1 The connections are made as shown in the circuit diagram. 2 Arrange the deflection of the magnetometer in the magnetic meridian of the earth 3 Now align the plane of the coil with respect to 90°-90° line of the magnetometer. 4 Keep the magnetometer exactly at the centre of the coil (for this case x = 0). 5 Pass a current I (say 0.5A) to flow through the coil and the corresponding magnetometer deflections θ_1 and θ_2 are noted. 6 The direction of the current is reversed by using the commutator C and the corresponding magnetometer deflections

θ_3 and θ_4 are noted.

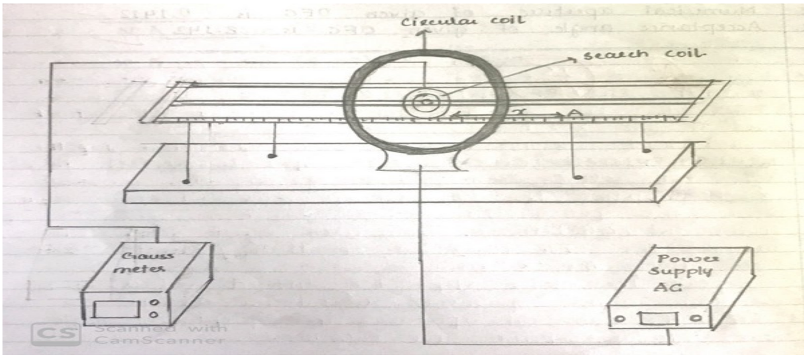
7 Average deflection θ is calculated.

8 Calculate the magnetic field at the centre of the coil by using the given formula $B = \frac{\mu_0 nI}{2} \frac{a^2}{(a^2 + x^2)^{3/2}}$ and also B_H .

9 Repeat the experiment for different values of x (say 5cm, 10cm, …) by sliding the magnetometer along the axis.

10 Find the average of both B and B_H.

7 Experimental Setup. Expected Graph



8 Observation Table, Look-up Table, Output

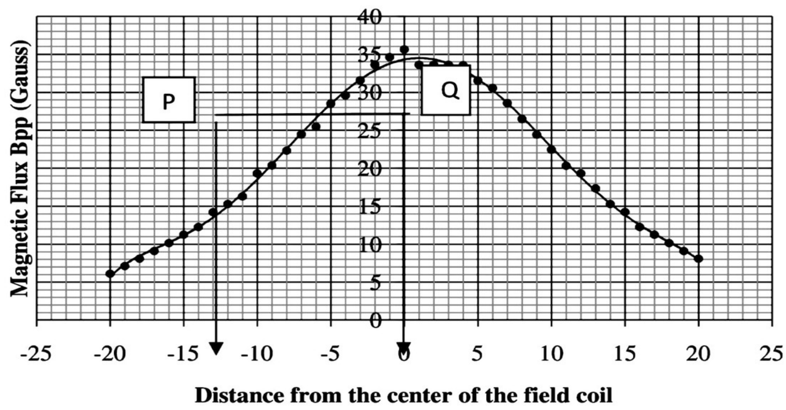
Sl. No.	Distance from the center of the coil, x in cm.	Magnetic field left hand side of the coil	Magnetic field Right hand side of the coil

		B in gauss	B in gauss
1	0		
2	2		
3	4		
4	6		
5	8		
6	10		
7	12		
8	14		
9	16		
10	18		
11	20		

9 Sample Calculations

$$B = \frac{\mu_0 n l}{2} \frac{a^2}{(a^2 + x^2)^{3/2}}$$

10 Graphs, Outputs



11	Results & Analysis	The magnetic field intensity along the axis of the given circular coil is calculated and is as shown in the tabular column. At the center (x = 0) it is found to be B = ………….T and the Earth's horizontal magnetic field intensity is found to be B_H =…………….T
12	Application Areas	Industry and medical applications.
13	Remarks	
14	Faculty Signature with Date	

Experiment 12 : Numerical Aperture

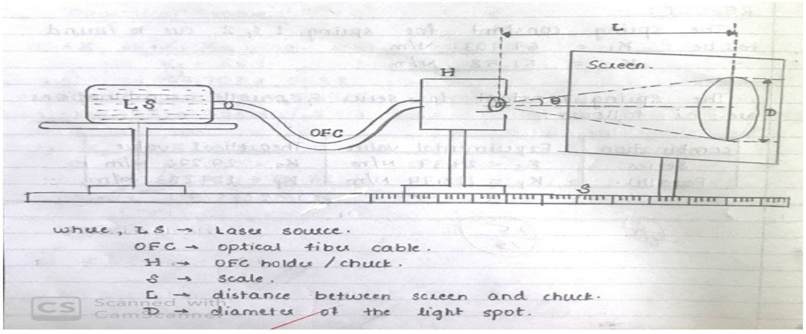
-	Experiment No.:	12	Marks		Date Planned		Date Conducted	
1	Title	Acceptance angle and Numerical Aperture						
2	Course Outcomes	Understand and analyze the principles of operations of optical fibers and semiconductor devices using a simple circuits.						
3	Aim	To determine the Acceptance angle and Numerical aperture of the given optical fiber.						
4	Material / Equipment Required	Laser source, Optical fiber, Screen, Scale.						
5	Theory,	The Sine of the acceptance angle of an						

	Formula, Principle, Concept	optical fiber is known as the numerical aperture of the fiber. The acceptance angle can also be measured as the angle spread by the light signal at the emerging end of the optical fiber. Therefore, by measuring the diameter of the light spot on a screen and by knowing the distance from the fiber end to the screen, we can measure the acceptance angle and there by the numerical aperture of the fiber. The Acceptance angle, $\theta_0 = \tan^{-1}\left(\frac{D}{2L}\right)$ Where D – the diameter of the bright circle formed on screen, L – the distance between the optical fiber end and screen. And the Numerical Aperture, $NA = \sin\theta_0$
6	Procedure	Switch on the laser source and adjust the distance between output end of the optical fiber and the screen ‘L’ (say 5 cm). • Place a graph sheet on the screen and observe the circle formed on the graph sheet. • Mark the points ‘a’,’b’,’c’ & ‘d’ on the inner bright circle as shown in the diagram. Note down the horizontal diameter D_1 and vertical diameter D_2 of the inner bright circle in the tabular column.

<table>
<tr><td></td><td></td><td>

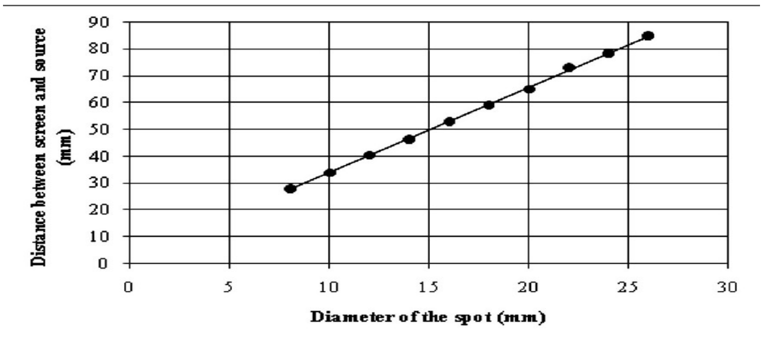
- Repeat the above steps for different values of L (for 4cm, 3cm, …).
- Find the Acceptance angle from the tabular column and hence the Numerical aperture.

</td></tr>
<tr><td>7</td><td>Experimental Setup. Expected Graph</td><td>



</td></tr>
<tr><td>8</td><td>Observation Table, Look-up Table, Output</td><td>
<table>
<tr><th>Trail No.</th><th>L (in cm)</th><th>Horizontal dia</th><th>Vertical dia met</th><th>Mean Dia met</th><th>Acceptance angl</th><th>Numerical aper</th></tr>
</table>
</td></tr>
</table>

		meter D₁ (in cm)	**er D₂** (in cm)	**er D** (in cm)	**e**	**ture NA**
1						
2						
3						
4						

9	Sample Calculations	$\theta_0 = \tan^{-1}\left(\frac{D}{2L}\right)$ $NA = \sin\theta_0$
10	Graphs	
11	Results & Analysis	The Angle of acceptance and Numerical aperture of the given optical fiber are found to be θ_0 = ………….. NA = ………….

12	Application Areas	Used in Remote Control, CD players, Television, switching circuits etc.
13	Remarks	
14	Faculty Signature with Date	

F. Content to Experiment Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Expt-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	B	C	D	E	F	G	H
1	Radius of curvature of plano convex lens using Newton's rings.	3	- L2 - L3	L3	Apply	Experiment	Slip Test
2	Calculation of Dielectric constant by RC charging and Discharging	3	- L2 - L3	L3	Apply	Experiment	Slip Test
3	Determine Wavelength of semiconductor laser using Laser diffraction by calculating grating constant.	3	- L2 - L3	L3	Use	Experiment	-Slip Test
4	Study Series and parallel LCR resonance and hence Calculate inductance, band width and	3	- L2 - L3	L3	Apply	Experiment	-Slip Test

	quality factor using series LCR Resonance						
5	Estimation of Fermi Energy of Copper	3	- L2 - L3	L3	Apply	Experiment	Slip Test
6	Rigidity Modulus by Torsional pendulum.	3	- L2 - L3	L3	Use	Experiment	Slip Test
7	Study of input and output Transistor characteristics and hence calculate input resistance, alpha and beta	3	- L2 - L3	L3	Apply	Experiment	Slip Test
8	Draw photo diode characteristics and calculate power response	3	- L2 - L3	L3	Use	Experiment	Slip Test
9	Young's modulus of a beam by Single Cantilever experiment.	3	- L2 - L3	L3	Use	Experiment	Slip Test
10	Determination of spring constants in Series and Parallel combination	3	- L2 - L3	L3	Apply	Experiment	Slip Test
11	Determination of Magnetic field intensity at the center of a circular coil carrying current (by deflection method).	3	- L2 - L3	L3	Apply	Experiment	Slip Test
12	Determine Acceptance angle and Numerical aperture of an optical fiber	3	- L2 - L3	L3	Apply	Experiment	Slip Test