CALICUT UNIVERSITY – FOUR-YEAR UNDER GRADUATE PROGRAMME (CU-FYUGP)

BSc PHYSICS

Programme	**B.Sc. Physics Honours**				
Course Title	**ELECTROMAGNETISM AND NETWORK THEOREMS**				
Type of Course	**Minor (SET I: MATHEMATICS FOR PHYSICAL SYSTEMS)**				
Semester	**II**				
Academic Level	**100 – 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	Fundamentals of vector algebra, calculus and basic electronics				
Course Summary	This course explores different characteristics of electric and magnetic fields, application of network theorems for solving various electrical networks and behaviour of circuit components in ac circuits.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Revise the concept of charge, coulomb force, electric field, electric dipole and apply Gauss theorem for calculating electric field.	U & Ap	C & P	Instructor-created exams / Home Assignments
CO2	Identify the sources of magnetism, explain properties of magnetic forces, behaviour of charged particles in magnetic field and apply Amperes law for calculating magnetic field.	U & Ap	C & P	Instructor-created exams / Home Assignments
CO3	Analyse various network theorems and apply these	An & Ap	P	Instructor-created exams / Home

	theorems for solving complex electrical circuits.			Assignments
CO4	Analyse the behaviour of various electrical components like resistors, capacitors and inductors in pure ac circuit.	An	P	Instructor-created exams / Home Assignments
CO5	Design and analyse the behaviour of ac circuits with more than one electrical component.	An & Ap	P	Seminar Presentation / Group Tutorial Work
CO6	Develop skills to set up and perform experiments to analyse different properties of electric and magnetic field. Design and construct ac circuits consisting various circuit elements and analyse its properties.	Ap	M	Practical Assignment / Observation of Practical Skills / Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F), Conceptual Knowledge (C), Procedural Knowledge (P), Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I		**ELECTROSTATICS**	**12**	**19**
	1	Coulomb's law, superposition of forces, Electric field and electric forces	3	
	2	Electric field calculations, Electric field lines	2	
	3	Electric dipoles	2	
	4	Charge and electric flux,	1	
	5	Gauss's law	2	
	6	Applications of Gauss's law	2	
	Relevant topics of chapter 21, 22 of Book 1; sections 21.3 – 21.7 of chapter 21 and 22.1–- 22.4 of chapter 22 of Book 1			

II	**MAGNETISM**		**11**	**17**
	7	Magnetic field, magnetic flux, motion of charged particles in magnetic field.	3	
	8	Magnetic force on current carrying conductor, torque on a current loop.	2	
	9	Magnetic field of a moving charge, current element and a straight current carrying conductor.	2	
	10	Force between parallel conductors, Magnetic field of a circular current loop	2	
	11	Ampere's law, Applications ampere's law.	2	
	Sections 27.1- 27.4, 27.6, 27.7 (section 27.7 - till magnetic torque: loops and coils) of chapter 27 and sections 28.1 -28.7 of chapter 28 of Book 1			
III	**NETWORK THEOREMS**		**11**	**17**
	12	Electrical circuits, Kirchhoff's laws.	2	
	13	Solving simultaneous equations, solving equations with two and three unknowns.	2	
	14	Source conversion, Ideal constant voltage source, Ideal constant current source, Superposition theorem.	2	
	15	Thevenin theorem.	2	
	16	Norton's theorem.	2	
	17	Maximum power transfer theorem.	1	
	Sections 2.1 - 2.8, 2.14 – 2.20, 2.25 – 2.27 and 2.30 – 2.31 of chapter 2 of Book 2			
IV	**AC CIRCUITS**		**11**	**17**
	18	Generation of alternating voltage and current, equation of the alternating voltage and current, AC through pure resistance, pure inductance and pure capacitance alone.	3	

	19	mathematical representation of vectors	1	
	20	AC through resistance and inductance.	2	
	21	A.C. through resistance and capacitance.	2	
	22	Resistance, inductance and capacitance in series.	3	
	Sections 11.1 – 11.2, 11.28 – 11.30, 11.32, 12.1 – 12.7, 13.1 – 13.19 of chapter 11, Chapter 12 and 13 of book 2			
V	**PRACTICALS**		**30**	
	Conduct any 6 experiments from the given list and 1 additional experiment, decided by the teacher-in-charge, related to the content of the course. The 7th experiment may also be selected from the given list. Other experiments listed here may be used as demonstrations of the concepts taught in the course.			
	1	**Mapping of the magnetic field lines of a bar magnet.** • Fix a paper on a drawing board kept on a table and place the bar magnet at the center along the magnetic meridian. • Using a small compass needle, map the magnetic field lines of the magnet placed with north pole pointing south • Mark the null points (where the horizontal component of Earth's magnetic field, Bh cancels the field due to magnet) along the axial/equatorial line and measure the distance, 2d, between them. • Calculate the moment of the magnet. $m = \frac{4\pi}{\mu_0}\frac{(d^2-l^2)^2}{2d}B_h$		
	2	**Study the variation of the magnetic field strength of a bar magnet using a smartphone magnetometer.** • Using a smartphone magnetometer, measure the strength of the magnetic field of a bar magnet, along the axial and equatorial lines and plot the data. • Magnetometer in the Phyphox app may be used to get the data after locating the approximate position of the magnetometer sensor.		

		https://phyphox.org/wiki/index.php?title=Sensor:_Magnetic_field • Fit the theoretical formulae to the data and obtain magnetic dipole moment. Along the axial line $B = \frac{\mu_0}{4\pi}\frac{2md}{(d^2-l^2)^2}$ and along the equatorial line $B = \frac{\mu_0}{4\pi}\frac{m}{(d^2+l^2)^{3/2}}$		
	3	**Determine the moment of a bar magnet and Bh using a deflection magnetometer and a box type vibration magnetometer.** • Determine m/Bh using deflection magnetometer in Tan A position and mBh using box type vibration magnetometer. Hence calculate the moment of the magnet and Bh. • If the same magnet was used, compare the dipole moment with that of experiment 2 and 3.		
	4	**Circular coil- Verification of Biot Savart's law and determination of Bh** • Move a compass through a platform along the axis of the coil carrying a study current. Note the deflection of the needle and plot magnetic flux density ($B = B_h tan\theta$) as a function of distance. • Optional: Smartphone magnetometer may be used to measure the strength of the magnetic field along the axial line and plot the data. https://phyphox.org/experiment/magnetic-field/ • Experiment 62 of Book 6 • By varying current and (or) distance of the compass box along the axial line of the coil, note the deflection and hence determine the value of Bh.		
	5	**Reduction factor of TG using potentiometer.** • Standardize the given potentiometer using a Danial cell or any other constant voltage source and use the standardized potentiometer to find the current through the TG. • By observing the deflection in the TG for different currents, calculate the reduction factor. • From the magnetic field at the center of a circular coil, deduce the value Bh.		

	6	**Verification of Kirchoff's laws/ Superposition theorem.** ● Verify Kirchoff's current law at a junction where a minimum of three branches meet. ● Verify Kirchoff's current law for a network with two loops. **OR** ● Verify the superposition theorem for a network with two sources, S1 and S2. ● First set particular voltage values in S1 and S2 and note down the ammeter reading. ● Set the same voltage in S1 and short circuit S2 and vise versa, note down the ammeter readings and verify the superposition theorem.		
	7	**Verification of Thevenin's theorem and maximum power transfer theorem** **Thevenin's theorem** ● Measure the current through the load resistance of the network. ● Estimate the values of R_{TH} and V_{TH}, construct the Thevenin's equivalent circuit and measure the current through load resistance and compare the two results with the theoretical values. **Maximum power transfer theorem** ● Measure the current through load resistance and estimate the power. Plot $R_L - P$ graph and find the R_L corresponding to the maximum power. ● Calculate the % of error with the theoretical value.		
	8	**AC three phase generator** ● Rotate a neodymium magnet about an axis perpendicular to its dipole axis and fix three coils displaced equally from each other, i.e., 120^o separated. ● Analyze the induced emf developed in the coils using CRO/ExpEYES and the phase relationship between the three induced voltages. ● https://expeyes.in/experiments/school-level/ac-generator.html		
	9	**RL and RC series AC circuits- Phase relationships of voltage across the elements.**		

		• Using a CRO/ ExpEYES, verify the phase relationship between voltage across the inductor/capacitor and the current. • Note the phase difference between the applied voltage and current and determine the value of inductance/capacitance. **OR** • Note the peak voltage and current and determine the value of inductance/capacitance. • https://expeyes.in/experiments/electrical/rcsteady.html • https://expeyes.in/experiments/electrical/rlsteady.html • https://expeyes.in/experiments/school-level/ac-rc.html • https://expeyes.in/experiments/school-level/ac-rl.html		
	10	**Series LCR circuits-Determination of resonance frequency, quality factor and bandwidth.** • The frequency of the signal generator is changed in steps and the corresponding voltage across the resistance is noted. • From the graph drawn for current against frequency, find the frequency corresponding to maximum voltage- resonant frequency. Also find the bandwidth and quality factor • CRO/Multimeter/ExpEYES can be used. https://expeyes.in/experiments/electrical/rlcsteady.html		
	11	**Thomson's e/m experiment - Determination of the specific charge of the electron.** • Measure the ratio of the electron charge-to-mass ratio (e/m) by studying the electron trajectories in a uniform magnetic field.		
	12	**Parallel plate capacitor. (a) verify the relationship between capacitance and the area of the plates (b) determination of dielectric constant of thin dielectric sheet** • Form a parallel plate capacitor with dielectric material filled between the plates. • Multimeter/ ExpEYES can be used to measure the capacitance. (For a significantly measurable value of the capacitance, use plates of dimension 10cmx10cm, or greater) • Change the area of the capacitor plates and verify the relationship of the capacitance on the area (Using the same set of plates, the area can be changed by varying the overlapping region of the plates)		

		• By measuring the capacitance for different areas of the capacitor plates and (or) thickness of the dielectric material,determine the dielectric constant of the given material/liquid. • https://www.youtube.com/watch?v=lKfIkUuFT-U		
	13	**Verification of Faraday's law and Lenz's law of electromagnetic induction** • Verify Faraday's law and Lenz's law by measuring the induced voltage across a coil subjected to the varying magnetic field. (section 7.2.1 of Book 1) • Galvanometer/ExpEYES can be used to measure the induced emf. • In the third experiment, for better coupling between the coils, use a high permeability material like iron or ferrite core, and observe the change in the induced emf. • https://expeyes.in/experiments/school-level/mutual-induction.html • Simulation: https://phet.colorado.edu/sims/html/faradays-law/latest/faradays-law_all.html		
	14	**Analysis of induced emf developed in a coil as a magnet dropping through it.** • Drop a neodymium magnet through a coil, guided through a vertical tube. • Repeat the experiment by dropping the magnet, through different heights from the coil and by changing the approaching pole. • Capture the induced emf as a function of time using ExpEYES, note the maximum value of the emf and verify Faraday's law and Lenz's law of induced emf and flux change. • Example 7.6 of Book 1 • https://expeyes.in/experiments/school-level/em-induction.html		
	15	**Demonstration of Eddy currents** • Mount aluminum/copper disk as a pendulum on a horizontal axis and observe the 'viscous drag' as it swings down and passes between the poles of a magnet (Can be realized using		

		two pieces of neodymium magnet. The demonstration illustrated in Fig. 7.16 of Book 3). • https://www.youtube.com/watch?v=qTkOpprVITM OR • Form a simple pendulum with a neodymium magnet and observe the 'viscous drag' as it swings down when an aluminium/copper sheet/block is placed under the pendulum. • https://www.youtube.com/watch?v=VK40utGgioI • https://www.youtube.com/watch?v=SF4xjO2RN1w OR • Drop a neodymium magnet through an aluminium/copper tube and observe the delay in the fall of the magnet. Tubes of different gauge may be used for the demonstration. • Keep the two probes at diametrically opposite points of the pipe and note the emf and current when a magnet is allowed to fall through the pipe. • https://www.youtube.com/watch?v=H31K9qcmeMU		

Books and References:

1. University Physics with Modern Physics (Edn.15) by Young & Freedman (Book 1)
2. A Textbook of Electrical Technology, Volume – I (Revised 23rd Edition) by B. L. Thereja and A. K. Thereja (Book 2)
3. Introduction to Electrodynamics-David J Griffith, 4th Edition, Pearson (Book 3)
4. Electricity and Magnetism by R. Murugesan- S Chand and Company Limited (Book 4)
5. Basic electrical engineering by V. K. Mehta and Rohit Mehta - S Chand and Company Limited (Book 5)
6. Smartphones as Mobile Minilabs in Physics(Edn. 1) by Jochen Kuhn & Patrik Vogt, Springer, (Book 6)

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	2	1	3	0	2	2	2	2	2	1	3	2	0
CO 2	2	1	2	0	2	2	2	2	2	1	3	2	0
CO 3	2	2	3	1	1	1	2	2	2	1	3	2	0
CO 4	0	0	2	3	1	1	2	2	2	1	3	2	0
CO 5	0	0	2	1	2	2	2	2	2	1	3	2	0
CO 6	2	3	2	2	1	1	2	2	2	1	3	2	0

Correlation Levels:

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Discussion / Seminar
- InternalTheory/Practical Exam
- Assignments /Viva
- End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory/ Practical Exam	Assignment /Viva	Practical Skill Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6		✓	✓	

CALICUT UNIVERSITY – FOUR-YEAR UNDER GRADUATE PROGRAMME (CU-FYUGP)

BSc PHYSICS HONOURS

Programme	**B.Sc. Physics Honours**				
Course Title	**MODERN PHYSICS AND NUCLEAR PHYSICS**				
Type of Course	**Minor (SET II: MATERIALS PHYSICS)**				
Semester	**II**				
Academic Level	**100 - 199**				
Course Details	Credit	Lecture per week	Tutorial per week	Practical per week	Total Hours
	4	3	-	2	75
Pre-requisites	1.Foundational understanding of classical physics, particularly in mechanics and electromagnetism. 2. Proficiency in algebra, calculus and trigonometry.				
Course Summary	This course explores the dual nature of particles and waves, as well as the structure and behavior of atomic and nuclear systems. Through theoretical discussions and practical applications, students will investigate electromagnetic waves, particle-wave duality phenomena, atomic structure, nuclear composition, and nuclear transformations.				

Course Outcomes (CO):

CO	CO Statement	Cognitive Level*	Knowledge Category#	Evaluation Tools used
CO1	Understand the duality of particles and waves, Describe experimental evidence supporting the wave-particle duality, including the photoelectric effect and Compton effect.	U	C	Instructor-created exams / Quiz
CO2	Define pair production and its significance in quantum	U, Ap	P	Seminar Presentation /

	mechanics, Understand the concept of matter waves proposed by Louis de Broglie.			Group Tutorial Work
CO3	Explain the structure of the atom according to the nuclear model, Understand Energy Levels and Spectra	Ap	P	Practical Assignment / Observation of Practical Skills
CO4	Investigate Nuclear Structure Understand stable nuclei, binding energy, and models such as the liquid drop model and shell model	U	C	Instructor-created exams / Home Assignments
CO5	Understand radioactive decay processes and their implications for nuclear stability,	Ap	P	One Minute Reflection Writing assignments
CO6	Analyse nuclear reactions, including fission and fusion, and their relevance in energy production and stellar evolution.	Ap	P	Writing assignments /Viva Voce
* - Remember (R), Understand (U), Apply (Ap), Analyse (An), Evaluate (E), Create (C) # - Factual Knowledge(F) Conceptual Knowledge (C) Procedural Knowledge (P) Metacognitive Knowledge (M)				

Detailed Syllabus:

Module	Unit	Content	Hrs (45 +30)	Marks (70)
I	**Particle properties of waves & Wave properties of particles**		**12**	**15**
	1	Electromagnetic Waves, Black body Radiation	3	
	2	Photoelectric Effect	2	
	3	Compton Effect	2	
	4	Pair Production	3	
	5.	De Broglie Waves	2	
	Sections from References: 2.1, 2.2, 2.3, 2.7,2.8, 3.1, Book 1			
II	**Atomic Structure**		**10**	**22**
	6	The Nuclear Atom	2	
	7	Electron Orbits	2	

	8	Atomic Spectra	2	
	9	The Bohr Atom	2	
	10	Energy Levels and Spectra	2	
	Sections from References:4.1, 4.2, 4.3, 4.4, 4.5, Book 1			
III	**Nuclear Structure**		**13**	**20**
	11	Nuclear composition	2	
	12	Nuclear properties	2	
	13	Stable nuclei	2	
	14	Binding energy	2	
	15	Liquid drop model, Shell model	2	
	16	Magic numbers	1	
	17	Meson theory of nuclear forces.	2	
	Sections from References:11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, Book 1			
IV	**Nuclear Transformations**		**10**	**13**
	18	Radioactive decay, radioactivity and the Earth	1	
	19	Half-life, Radiometric dating	2	
	20	Alpha decay, Beta decay, Gamma decay	3	
	21	Nuclear reactions, Nuclear fission	3	
	22	Nuclear fusion in stars	1	
	Sections from References: 12.1, 12.2, 12.4 (Tunnel theory concept only), 12.5, 12.6, 12.8, 12.9, 12.10, 12.11, Book 1			
V	**PRACTICALS**		**30**	
	Conduct any 6 experiments from the given list and 1 additional experiment, decided by the teacher-in-charge, related to the content of the course. The 7th experiment may also be selected from the given list. Other experiments listed here may be used as demonstrations of the concepts taught in the course. Necessary theory of experiments can be given as Assignment/ Seminar.			
	1	**Determination of Plank's constant using LEDs**		

		• Observe the turn-on voltage, V_0 of LEDs and calculate the value of h. Use at least 4 different colors of LED (with transparent casing) • Plot $\frac{1}{\lambda} - V_0$ graph using Python, fit a straight line to get the slope and estimate the value of h. • Calculate the %error. • Programmable voltage source of ExpEYES may be used to find the turn-on voltage.		
	2	**Continuous and line spectra- Determination of the wavelengths and photon energy.** • Familiarize the initial adjustments and measurements in the spectrometer. • Mount the grating at normal incidence on the spectrometer. • Determine the wavelengths of the sodium vapor lamp and calculate the associated photon energy. • Determine the approximate range of the wavelengths of the continuous spectrum of incandescent/white LED lamp or any one coloured LED and calculate the associated photon energy. • The readings of the first order spectrum will be enough. Number of lines/m of the grating can be given.		
	3	**Mercury spectrum- Determination of wavelength and photon energy.** • Determine wavelength of any four prominent lines and associated photon energy of the mercury spectrum using a spectrometer with grating at normal incidence. • The readings of the first order spectrum will be enough. Number of lines/m of the grating may be given.		
	4	**Hydrogen spectrum - Determination of wavelengths and calculation of the Rydberg's constant.** • Determine the wavelengths and photon energy in eV of the prominent lines of the Balmer series of the Hydrogen spectrum using a spectrometer with grating at normal incidence. • Calculate the Rydberg's constant and estimate the % error. • The readings of the first order spectrum will be enough. Number of lines/m of the grating may be given.		
	5	**Wave Packets - Analysis of beats in sound.** • The experiment is intended to understand the concept of wave packet, phase and group velocities. • Generate sounds waves of two near frequencies using smartphone/ExpEYES/Function generator and the superimposed wave can be recorded and analysed using smartphone/ExpEYES/CRO • Change the separation between the frequencies and compare the results with the theoretical values. • https://expeyes.in/experiments/sound/beats.html		

		• Multi Tone generator and Audio scope tools of Phyphox may be used https://phyphox.org/experiment/tone-generator/		
	6	**7. Analysis of Hydrogen spectra using the Tracker Video Analysis tool**. • Calibrate the video of the Hydrogen spectra in the Tracker tool using two laser wavelengths/lines of mercury spectra. • Plot the intensity profile, find the prominent wavelengths of the Balmer series and calculate the Rydberg's constant. • Estimate the %error. • Pre recorded video of the Hydrogen spectra can be used. • https://physlets.org/tracker/. • https://www.youtube.com/watch?v=UCCPkJpUQEw		
	7	**Black body spectrum of Sun -Estimation of surface temperature using the Tracker Video Analysis tool.** • Calibrate the video of the solar spectra in the Tracker tool using two laser wavelengths/lines of mercury spectra. • Plot wavelength vs intensity, get λ_{max} and using Wein's law calculate the surface temperature. • Pre recorded video of the solar spectra can be used.		
	8	**Verification of Wein's displacement law and Stefan's law using incandescent bulb.** • Calibrate the video of the spectra of the incandescent bulb in the Tracker tool using two laser wavelengths/lines of mercury spectra. • Plot wavelength vs intensity and note λ_{max} . • Repeat the experiment by increasing the operating voltage of the incandescent bulb(hence increasing the temperature of the source) • From the plots, verify the Wein's displacement law and Stefan's law.		
	9	**Study the specific rotation of the sugar solution using a polarimeter.** • Determine the specific rotation corresponding to different concentrations of the sugar dissolved in water. • Draw a graph between rotation and concentrations and verify the linear relationship.		
	10	**Verification of Malus's law using polarizer, analyzer and photo detector** • Unpolarized light is allowed to pass through a polarizer and is observed through an analyzer. • Vary the angle between the axes of polarizer and analyzer and measure the intensity of the light (current output of the photodetector). • Plot $\theta - I$ and $cos^2\theta - I$ graphs and verify the Malus's law.		

		• A flat computer monitor (or LCD TV screen) in plain white color can be used as the source of linear polarized light. • The ambient light sensor of the smartphone and the orientation sensor of the smartphone can be used to measure the illuminance and the angles respectively. • A small piece of polarizer (a square of about 1 cm side) from an old calculator's display was placed over the ambient light sensor as analyser. • https://arxiv.org/pdf/1607.02659		
	11	**Brewster's law experiment, determination of angle of polarisation and refractive index.** • Experimental arrangement- Sodium vapour lamp, Spectrometer, Polarizer (Graduated on 360° rotating) coupled in front of the spectrometer telescope, prism or glass plate. • Get the angle of incidence corresponding to the minimum intensity of light and hence calculate the refractive index of the material. • https://www.youtube.com/watch?v=f2A8sM1xhbQ		
	12	**Mapping of the magnetic field lines of a bar magnet.** • Fix a paper on a drawing board kept on a table and place the bar magnet at the center along the magnetic meridian. • Using a small compass needle, map the magnetic field lines of the magnet placed with north pole pointing south • Mark the null points (where the horizontal component of Earth's magnetic field, Bh cancels the field due to magnet) along the axial/equatorial line and measure the distance, 2d, between them. • Calculate the moment of the magnet. $m = \frac{4\pi}{\mu_0}\frac{(d^2-l^2)^2}{2d}B_h$		
	13	**Circular coil- Verification of Biot Savart's law and determination of Bh.** • Move a compass through a platform along the axis of the coil carrying a study current. Note the deflection of the needle and plot magnetic flux density ($B = B_h tan\theta$) as a function of distance. • Optional: Smartphone magnetometer may be used to measure the strength of the magnetic field along the axial line and plot the data. https://phyphox.org/experiment/magnetic-field/ • Experiment 62 of Book 2 • By varying current and (or) distance of the compass box along the axial line of the coil, note the deflection and hence determine the value of Bh.		
	14	**Calibrate the ammeter using potentiometer** • Standardize the potentiometer using a Danial cell or any other standard voltage source.		

		• Determine the current for at least 8 trials and draw the calibration graph.		
	15	**Parallel plate capacitor. (a) verify the relationship between capacitance and the area of the plates (b) determination of dielectric constant of thin dielectric sheet.** • Form a parallel plate capacitor with dielectric material filled between the plates. • Multimeter/ ExpEYES can be used to measure the capacitance. (For a significantly measurable value of the capacitance, use plates of dimension 10cmx10cm, or greater) • Change the area of the capacitor plates and verify the relationship of the capacitance on the area (Using the same set of plates, the area can be changed by varying the overlapping region of the plates) • By measuring the capacitance for different areas of the capacitor plates and (or) thickness of the dielectric material,determine the dielectric constant of the given material/liquid. http://www.indosawedu.com/dielectric-constant.php https://www.youtube.com/watch?app=desktop&v=sx0tzAj-Dm4 https://www.youtube.com/watch?v=lKfIkUuFT-U		

Books and References:

1. Concepts of Modern Physics, Arthur Beiser 6th Edition (Book 1)
2. Smartphones as Mobile Minilabs in Physics(Edn. 1) by Jochen Kuhn & Patrik Vogt, Springer, (Book 2)
3. Modern Physics for Scientists and Engineers" by John Morrison
4. Modern Physics by Raymond A. Serway
5. Introduction to Nuclear and Particle Physics - V K Mittal, R C Verma and S C Gupta
6. Introductory Nuclear Physics by Kenneth S. Krane
7. Principles of Nuclear Physics by A. B. Migdal
8. https://phyphox.org/
9. https://physlets.org/tracker/
10. https://expeyes.in/

Mapping of COs with PSOs and POs :

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO 1	3	2	2	1	1	0	3	2	1	1	2	0	0
CO 2	2	3	2	1	1	1	3	3	1	0	2	0	0
CO 3	1	2	3	3	1	1	2	2	2	2	2	0	0

CO 4	1	1	1	3	2	2	2	1	2	2	3	0	0
CO 5	1	2	1	1	3	1	2	2	2	2	3	0	0
CO 6	1	2	1	1	3	2	2	1	2	2	3	0	0

Correlation Levels:

Level	Correlation
0	Nil
1	Slightly / Low
2	Moderate / Medium
3	Substantial / High

Assessment Rubrics:

- Quiz / Discussion / Seminar
- InternalTheory/Practical Exam
- Assignments /Viva
- End Semester Exam (70%)

Mapping of COs to Assessment Rubrics

	Internal Theory/ Practical Exam	Assignment /Viva	Practical Skill Evaluation	End Semester Examinations
CO 1	✓	✓		✓
CO 2	✓	✓		✓
CO 3	✓	✓		✓
CO 4	✓	✓		✓
CO 5	✓	✓		✓
CO 6		✓	✓	