Bachelor of Science
B.Sc. Physics (Semester -VI)

Course Code	US06CPHY51	Title of the Course	Quantum Mechanics
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. To give basic and preliminary knowledge of quantum mechanics and its mathematical details of computing observable physical quantities through examples. 2. To train the students in the physical interpretations of the wave functions, their asymptotic behavior, the energy Eigen values and Eigen functions etc.

Course Content		
Unit	Description	Weightage* (%)
1.	**Stationary States and Energy Spectra** Stationary States: The time independentSchrödinger wave equation, A particle in a square well potential, Bound state in a square well potential (E< 0): Admissible solutions of wave equation, The energy eigen values – Discrete spectrum, The energy eigen functions, parity, Penetration into classically forbidden regions, Square well: Non-localized states (E>0), The square potential barrier: Quantum mechanical tunnelling, Reflection at potential barriers and wells [A Textbook of Quantum Mechanics by P M Mathews & K Venkatesan: 2.9, 2.10, 2.11, 2.12, 2.13]	25%
2.	**General Formalism of Wave Mechanics** The Schrödinger equation and probability for N-particle system, The fundamental postulates of wave mechanics, The adjoint of an operator and self adjointness, The eigen value problem: Degeneracy, Eigen values and eigen functions of self-adjoint operators, The Dirac delta function, Observables: Completeness and normalization of eigen functions, Closure, Physical interpretation of eigen values, eigen functions and expansion coefficients, Momentum eigen functions: wave functions in momentum space [A Textbook of Quantum Mechanics by P M Mathews & K Venkatesan: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10]	25%
3.	**Uncertainty Principle & SHO** The uncertainty principle, States with minimum value for uncertainty product, Commuting observables; removal of degeneracy, Evolution of system with time; constants of the motion, Non-interacting and interacting systems, Systems of identical particles **The Simple Harmonic Oscillator:** The Schrödinger equation and energy eigen values, The energy eigen functions: Series solution; Asymptotic	25%

	behaviour [A Textbook of Quantum Mechanics by P M Mathews & K Venkatesan: 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 4.1, 4.2]	
4.	**<u>Exactly Soluble Eigen value Problem</u>** **Angular Momentum and Parity:** The angular momentum operators, The eigen value equation for L^2; Separation of variables, Admissibility conditions on solutions; eigen values, The eigen functions: Spherical harmonics, Physical interpretation **Angular momentum in stationary states of system with spherical symmetry:** The rigid rotator, A particle in a central potential; The radial equation, The radial wave function, The Hydrogen Atom: Solution of the radial equation and energy levels, The Anisotropic oscillator, The Isotropic oscillator [A Textbook of Quantum Mechanics by P M Mathews & K Venkatesan: 4.6, 4.7, 4.8, 4.9, 4.10, 4.12, 4.15, 4.16, 4.20, 4.21]	25%

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basic concepts and describe the main features of the historical development of quantum physics.
2.	solve the Schrödinger equation for standard systems with both analytical and numerical methods, and then interpret the results.
3.	Understand the requirement of normalization of the wave function, interpretation of the normalized wave function etc.
4.	Get familiar with the methods of solving exactly solvable problems and explain the physical states of elementary particles and atoms in different systems based on quantum mechanics.

Suggested References:	
Sr. No.	References
1.	A Textbook of Quantum Mechanics P M Mathews and K Venkatesan (2nd Edition) Tata McGraw Hill, New Delhi
2.	Introduction to Quantum Mechanics David J Griffiths (2nd Edition) Pearson
3.	Quantum Mechanics Theory and applications Ajoy Ghatak and S Lokanathan, McMillan Publishers India Limited, Delhi
4.	Quantum Mechanics Leonard I Schiff McGraw Hill Book Co.

On-line resources to be used if available as reference material
On-line Resources
https://www.livescience.com/33816-quantum-mechanics-explanation.html https://www.britannica.com/science/quantum-mechanics-physics http://ursula.chem.yale.edu/~batista/classes/vvv/FiniteSquareWell.pdf http://www.iitg.ac.in/physics/fac/charu/courses/ph405/Formalism.pdf https://en.wikipedia.org/wiki/Uncertainty_principle https://en.wikipedia.org/wiki/Quantum_harmonic_oscillator http://www.nat.vu.nl/~wimu/EDUC/MNW-lect-2.pdf

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Bachelor of Science
B.Sc. Physics (Semester- VI)

Course Code	US06CPHY52	Title of the Course	Atomic and Molecular Spectroscopy
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To provide a quantum mechanical understanding of atomic and molecular processes through spectroscopy and the applications to understand the structure of different types of matter. 2. To enable the students to study the macroscopically observable physical phenomena through the microscopic constituents of atoms and molecules and their interactions. 3. To enable the students to understand various applications of spectroscopic techniques.

Course Content		
Unit	Description	Weightage* (%)
1.	**Spectra of Atom** Spectrum of Hydrogen atom and spectral series, Observation of Hydrogen spectrum, Failure of electromagnetic theory of radiation, Bohr's theory and spectrum of Hydrogen atom, Franck-Hertz Experiment, Short coming of Bohr's theory, Larmor's theorem, Stern-Gerlach Experiment, Fine structure of Hydrogen lines, Positronium, Different series in Alkali spectra: Main features, Ritz combination principle, explanation of salient features of Alkali spectra, Related Numerical. [Elements of Spectroscopy by Gupta, Kumar And Sharma: (Section: I) 1.4.1, 1.4.2, 1.5, 1.6, 1.11.2, 1.14, 3.6, 3.7, 3.8, 3.10, 6.1, 6.2, 6.5].	25
2.	**Spectra of Molecule** Separation of Electronic and Nuclear Motion: The Born-Oppenheimer approximation, Types of molecular energy states and associated spectra, Types of spectra, Salient features of rotational spectra, The molecule as a rigid rotator: Explanation of rotational spectra (Rotational energy only), Diatomic molecule as a Non-rigid rotator, Validity of the theory: Determination of the inter-nuclear distance (Bond length) and moment of inertia, Isotope effect in rotational spectra, Rotational spectra of polyatomic molecules, Related Numerical. [Elements of Spectroscopy by Gupta, Kumar And Sharma (Section: IV) 1.1, 1.2, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5]	25

3.	**Infrared Spectroscopy** Salient features of vibrational - Rotational spectra, Vibrating diatomic molecule as a harmonic oscillator, Vibrating diatomic molecule as anharmonic oscillator (without force constant for HCl molecule), Molecule as a vibrating rotator: fine structure of Infra-red bands: Ignoring interaction of vibrational and rotational energies, Molecule as a vibrating rotator: fine structure of Infra-red bands: considering interaction of vibrational and rotational energies, Applications of vibrational spectroscopy, General experimental arrangement for studying infra-red spectra, Related Numerical. [Elements of Spectroscopy by Gupta, Kumar And Sharma, (Section: IV) 3.0, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7].	25
4.	**Raman Spectra** Raman Effect and its salient features, experimental study, Apparatus, Result, Raman effect in liquids, Raman effect in gases, Raman effect in solids, Intensity of Raman lines, Polarization of Raman lines, Nature of Raman Effect, Relation between the Raman and infra-red absorption spectra, Importance of Raman effect, Applications of Raman Effect in Physics: Molecular structure, Nature of liquid state, Crystal Physics, Nuclear Physics, Classical theory of Raman Effect, Quantum theory of Raman Effect, Related Numerical. [Atomic Physics by J B Rajam, (Chapter XI) 4 (page no. 795 to 814)], [Elements of Spectroscopy by Gupta, Kumar And Sharma, (Section: IV) 4.0, 4.2, 4.3].	25

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage*
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: At the end of the course, the students will be able to:	
1.	Understand and be able to apply atomic and molecular spectroscopy.
2.	Understand the motions of atoms and molecules within a macroscopic substance.
3.	Understand infrared and Raman Spectra through Classical and quantum theory and their potential applications.

Suggested References:	
Sr. No.	References
1.	Elements of Spectroscopy S L Gupta, V Kumar, R C Sharma, (30th Edition) Pragati Prakashan, Meerut
2.	Atomic Physic J B Rajam (7th Edition) S. Chand publication, Delhi
3	Molecular structure and Spectroscopy G Aruldhas PHI Private Limited, Delhi

On-line resources to be used if available as reference material
On-line Resources Resource Type: Reference
1. **Atomic and Molecular Spectra** https://nptel.ac.in/courses/115/101/115101003/
2. Introduction to Infrared Spectroscopy https://www.researchgate.net/publication/224831013
3. Raman spectroscopy https://en.wikipedia.org/wiki/Raman_spectroscopy

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Bachelor of Science
B.Sc. Physics (Semester -VI)

Course Code	US06CPHY53	Title of the Course	Solid State Physics & Nuclear Physics
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To train the students in various methods like X-ray diffraction to understand the structure and symmetry of crystalline materials. 2. To create awareness about basic theoretical approaches and approximations to study the electrical and thermal conductivity of materials. 3. To provide an exposure to general properties of nucleus, nuclear reactions, estimation of energy release during nuclear reactions like fission, the Q-value equation. 4. To understand the nucleus and its properties by treating it as a charged liquid drop model. 5. To create awareness about functions of nuclear detectors and accelerators.

Course Content

Unit	Description	Weightage* (%)
1.	**X-ray diffraction**: Introduction, Reciprocal lattice, Bragg's law, Laue's interpretation of X-Ray diffraction by crystal, construction of reciprocal lattice, relation between a , b , c and a∗, b∗, c∗, Application to some crystal lattice (SC, BCC HCP) , Measurement of diffraction pattern of crystal, The Ewald construction, Experimental methods (The Laue method, The Oscillation method, The powder method), Analysis of X-ray diffraction pattern from crystal, Structure factor for bcc crystal, Structure factor of mono atomic FCC crystal, Measurement of diffraction pattern of crystals, The Ewald construction, Experimental methods (The Laue method, The Oscillation method, The Powder method), Selection of incident beam (X-rays, Neutrons, Electrons)	25%

	[Elements of Solid State Physics by J. P. Srivastava (4th Edition): 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.8.1, 3.8.2, 3.10]	
2.	**Free electron Fermi Gas:** Introduction of the free electron gas, Drude model, DC electrical conductivity of metals, Thermal conductivity of metals, Lorentz modification of the Drude model, Energy level in one dimension, Effect of temperature on the Fermi-Dirac distribution, Free electron gas in three dimensions, Heat capacity of the electron gas, Experimental heat capacity of metals, Electrical Conductivity and Ohm's Law, Experimental Electrical resistivity of metals, Motion in magnetic field, Hall effect [Elements of Solid State Physics by J. P. Srivastava (4th Edition): 6.1, 6.1.1, 6.1.2, 6.2, Introduction to Solid State Physics by Charles Kittle (8^{th} Edition): Page no: 134-156]	25%
3.	**General Properties of Nucleus, Q –Equation and Liquid Drop Model of Nucleus:** Constituents of Nuclei and their intrinsic properties, Nuclear size, Nuclear mass - Aston's mass spectrograph and Dempster's mass spectrometer, Nuclear angular momentum, Nuclear magnetic moment, Electric quadrupole moment, Wave mechanical properties -parity and statistics, Non-existence of electron in nucleus, Neutron-proton hypothesis, Binding energy, Types of nuclear reactions, Balance of mass and energy in nuclear reactions, The Q equation, Solution of Q equation, Weizsacher's semi empirical mass formula. [P.K. Puri and V.K. Babbar 1.1 to 1.10] [S.B. Patel 3.2, 3.3, 3.4, 3.5,5.3]	25%
4.	**Detectors and Accelerators:** **Accelerators:** Introduction, Cockcroft and Walton Generator, Van de Graff Accelerator, Tandem accelerator, Linear Accelerator or Drift Tube accelerator, Magnetic resonance accelerators or cyclotron Betatron, Synchrocyclotron or frequency modulated cyclotrons. **Detectors:** Introduction, Gas filled detectors, Ionization chamber, Geiger-Muller counter, Cloud chamber, Bubble chamber, Spark chamber [V.K. Mittal, R.C. Verma, S.C. Gupta 6.1 to 6.5, 6.7 to 6.9, 7.1 to 7.3, 7.5, 7.8 to 7.10]	25%

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer

	Class discussion led by teacher/students Case Studies Literature review Problem solving activities Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: On the successful completion of the course, the students will be able to understand:	
	The application of X-ray diffraction techniques to determine the structure and symmetry of various solid materials.
	The electrical and thermal conductivity of metals based on free electron gas model and the effect of free charge carriers under electric and magnetic fields.
	The basic properties of nucleus, different types of nuclear reaction processes and Q-value equation through which the energy release in nuclear reactions like fission can be estimated.
	Properties of nucleus by considering analogy of nucleus with a drop of liquid.
	The experimental techniques used to produce highly energetic nuclear and sub nuclear particles in accelerators.
	The functions of and applicability of different detectors used to detect nuclear and sub nuclear particles.

Suggested References:

Sr. No.	References
1.	Elements of Solid State Physics J. P. Srivastava (4th Edition) PHI Learning Pvt. Ltd.
2.	Introduction to Solid State Physics Charles Kittel (8th Edition) Wiley India Pvt. Ltd.
3.	Solid State Physics S.O. Pillai (7th Edition) New Age International Publisher
4.	Introductory Nuclear Physics P. K. Puri and V. K. Babbar Narosa Publishers (1996)
5.	Nuclear Physics – An Introduction S. B. Patel BPB Publications
6.	Nuclear and Particle Physics V. K. Mittal, R. C. Verma, S. C. Gupta (2nd edition) PHI Learning Pvt. Ltd. (2011)
7.	Fundamentals of Nuclear Physics D.R.S. Somayajulu, Roop Chand Bhandari and Jagdish Varma BS Publishers & Distributers Pvt. Ltd. (2005)

On-line resources to be used if available as reference material

On-line Resources:

X-Ray diffraction

http://web.pdx.edu/~pmoeck/phy381/Topic5a-XRD.pdf

https://en.wikipedia.org/wiki/X-ray_crystallography

Free Electron Fermi gas

https://en.wikipedia.org/wiki/Fermi_gas

http://www.phys.nthu.edu.tw/~spin/course/104F/Kittel-Chapter%206-Tina.pdf

General Properties of Nucleus

Resource Type: Reference:

https://www.hep.phy.cam.ac.uk/~chpotter/particleandnuclearphysics/Lecture_13_BasicNuclearProperties.pdf

https://inpp.ohio.edu/~meisel/PHYS7501/file/Lecture1_Properties_PHYS7501_F2019_ZM.pdf

http://inside.mines.edu/~kleach/PHGN422/lectures/Lecture4.pdf

Detectors and Accelerators

https://en.wikipedia.org/wiki/Van_de_Graaff_generator

https://www.britannica.com/technology/particle-accelerator/Cyclotrons

https://www.studyandscore.com/studymaterial-detail/geiger-muller-counter-construction-principle-working-plateau-graph-and-applications

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Bachelor of Science (Programme Name)
B.Sc. Physics Semester VI

Course Code	US06CPHY54	Title of the Course	Electrodynamics and Plasma Physics
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	1. To learn the effect of electric and magnetic fields in matter. 2. To learn various electromagnetic processes and meaning and the importance of Maxwell's equation. 3. To learn the basic properties of Plasma state of matter and the motion of charged particle under different electric and magnetic field conditions. 4. To learn the properties of plasma as a multi species fluid and to learn the origin and behaviour of different waves in plasma.

Course Content

Unit	Description	Weightage* (%)
1.	**<u>Conductors and Electric Fields in Matter</u>:** **Conductors:** Basic properties, Induced charges, Surface charge and the force on a conductor, Capacitors, **Laplace's equation:** Laplace's equation in one-Dimension, two-Dimension and three-Dimension, **Separation of variables:** Separation of variable by Cartesian and Spherical polar coordinates, **Electric Fields in Matter:** Di electrics, Induced Dipoles, Alignment of Polar molecules, Polarization, The Field of a polarized object: Bound Charges, Physical interpretation of Bound Charges, The field inside a Dielectric **The Electric displacement:** Gauss's law in the presence of Dielectrics, Deceptive parallel, Boundary Conditions, [D.J. Griffith: Chapter Two: Point-5.1, 5.2, 5.3,5.4; Chapter Three: Point-1.1,1.2, 1.3, 1.4; 3,3.1, 3.2; Chapter Four: Point-1.1,1.2, 1.3, 1.4, 2, 2.1, 2.2, 2.3, 3, 3.1,3.2, 3.3] Related Numerical	25%
2.	**<u>Magnetic Fields in Matter</u>:** **Magnetic Fields in Matter:** Diamagnets, Paramagnets, Ferromagnets, Torques and forces on magnetic dipoles, Effect of magnetic field on atomic orbits, Magnetization, **The field of a magnetized object:** Bound currents, Physical interpretation of bound currents, **The auxiliary Field of H:** Ampere's law in magnetized materials, **Electromotive Force:**	25%

	Ohm's Law, Electromotive Force, Motional emf, **Electromagnetic Induction:** Faraday's Law, The Induced Electric Field, Inductance, Energy in Magnetic Fields, **Maxwell's Equations:** Electrodynamics Before Maxwell, Ampere's Law fixed by Maxwell. [D.J. Griffith: Chapter Six Point-1.1, 1.2, 1.3.1.4, 2, 2.1, 2.2, 2.3, 3, 3.1, Chapter Seven: Point-1, 1.1, 1.2, 1.3, 2, 2.1, 2.2, 2.3, 2.4, 3, 3.1, 3.2] Related Numerical	
3.	**Plasma and Applications of Plasma Physics, Single Particle Motions:** **Introduction**: Occurrence of plasma in nature, Definition of plasma, Concept of temperature, Debye shielding, The plasma parameter, Criteria for plasma, Applications of plasma physics: Gas discharges (gaseous Electronics), Controlled thermo nuclear fusion, Space physics, Modern astrophysics, MHD energy conversion and ion propulsion, Solid state plasma, Gas laser, **Single particle motions:** Introduction, Uniform E&B Fields, E=0, Finite E, Gravitational field, Non uniform B field, $\nabla \boldsymbol{B} \perp \boldsymbol{B}$: Grad-B Drift, curved B: Curvature drift, $\nabla \boldsymbol{B} \parallel \boldsymbol{B}$: Magnetic Mirrors, Non uniform E field, Time varying E field, Time varying B field. [F.F. Chen 1.1 to 1.7, 2.1 to 2.5] Related Numerical	25%
4.	**Plasmas as Fluids:** Introduction, Relation of plasma physics to ordinary electromagnetic: Maxwell's Equations, Classical Treatment of Magnetic Materials, Classical treatment of dielectrics, The dielectric constant of a plasma, The fluid equation of motion, The convective derivative, Pressure (only definition), Collision, Comparison with ordinary hydrodynamics, Equation of continuity, Equation of state, The complete set of fluid equations, Fluid drift perpendicular to B, Fluid drift parallel to B, The plasma approximation, Waves in plasmas: Concept of phase velocity and group velocity, Plasma oscillations, Sound waves, Ion waves, Validity of the plasma approximation. [F.F. Chen 3.1 to 3.6, 4.2, 4.3, 4.5, 4.6, 4.7] Related Numerical	25%

Teaching-Learning Methodology	Direct Teaching through Chalk-Walk and Talk ICT enabled teaching Question-Answer Class discussion led by teacher/students Case Studies Literature review Problem solving activities

	Debate Collaborative and Co-operative Learning Think Pair Share Jigsaw Inquiry Based Learning Panel Discussion Project Based Learning Flipped Classroom Blended Learning designs Concept Mapping

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: On the successful completion of the course, the students will be able to

	Understand the behaviour of electric and magnetic fields in matter.
	Explain various laws of electro statics and magneto statics, electromotive force, electromagnetic induction and their applications.
	The contribution of Maxwell in the formation of Maxwell's equations and its physical implications.
	The basic plasma properties, motion of charged particles in various conditions of electric and magnetic fields and its plasma waves

Suggested References:

Sr. No.	References
1.	David J. Griffith, Introduction to Electrodynamics, Fourth Edition (2015), Pearson New International Edition.
2.	John David Jackson, Classical Electrodynamics, Third Edition (2009) Wiley-India Edition, John Wiley and Sons, New York.

3.	Francis F Chen, Introduction to Plasma Physics, 2nd Edition (1974) Plenum Press, New York and London.
4.	S N Goswami, Elements of Plasma Physics (Reprint 2011), New Central book Pvt. Ltd. Calcutta.

On-line resources to be used if available as reference material
On-line Resources:
https://nptel.ac.in/courses/115/101/115101004/#   Web course: Electromagnetic Waves. The course contains Three modules having forty lectures.
Glossary of Plasma Physics and Fusion Energy Research   Resource Type: Reference   https://fusedweb.llnl.gov/Glossary/glossary.html   This website contains a glossary of plasma physics and fusion energy research provided by Lawrence Livermore National Laboratory. It provides plain-language definitions of over 3600 frequently used terms in this field. The glossary can be browsed and searched, and contributions of new entries are welcome   **Plasma Physics : History**   Resource Type: Other educational resources   http://www.phy6.org/Education/whplasma.html   A brief history of plasma physics is provided. This page forms part of the larger 'Exploration of the Earth's Magnetosphere' educational resource, written by David P Stern and Mauricio Peredo and aimed at pre-University students.   **Introduction to Plasma Physics**   Resource Type: Lecture notes and courses   http://farside.ph.utexas.edu/teaching/plasma/lectures1/index.html   More course material can be access at: http://farside.ph.utexas.edu/teaching.html   An introductory graduate course in plasma physics, taught by Professor Richard Fitzpatrick at the University of Texas, Austin (USA). The course sections are: charged particle motion; plasma fluid theory; waves in cold plasmas; magnetohydrodynamic theory; and kinetic theory of waves. The lecture notes are available in HTML, PDF and Postscript formats.   **Development of plasma technology for waste Management in India**   International Journal of Engineering and Techniques – Volume 4 Issue 3, May – June 2018   **http://www.ijetjournal.org**   **Waste to Wealth: Sustainable Processing of Municipal Solid Waste**   https://www.eetindia.co.in/waste-to-wealth-sustainable-processing-of-municipal-solid-waste/   **Plasma gasification: Clean renewable fuel through vaporization of waste**   Plasma gasification technology in the US is developing fast, and could be the perfect way to divert MSW from landfill and produce valuable by-products.   https://waste-management-world.com/a/plasma-gasification-clean-renewable-fuel-through-vaporization-of-waste

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BACHELOR OF SCIENCE (PHYSICS PRACTICALS)
B.Sc. Semester-6

Course Code	US06CPHY55	Title of the Course	PHYSICS PRACTICAL
Total Credits of the Course	8	Hours per Week	16

Course Objectives:	1. To impart practical knowledge by performing experiments based on the principles of theory courses. 2. To provide hands on experience with equipments such as CRO, Interferometer electronic circuits etc. 3. To provide training how to analyze the experimental observations and draw conclusions with quantitative measurements.

Course Content

Description	**Weightage* (%)**
SECTION A: 1. L - by Owen's bridge 2. 'e/m' of an electron by magnetron/Thomson method 3. LVDT characteristics 4. Numerical study of harmonic motion (simple and damped) 5. High resistance by leakage 6. Mutual inductance by Ballistic Galvanometer 7. Susceptibility of paramagnetic /ferromagnetic solution by Quink's method	25%
SECTION B: 1. Determination of unknown frequency by Wein-bridge oscillator 2. Bistable Multivibrator 3. Power amplifiers 4. Operational amplifier applications (Integrator, Differentiator, Adder, Subtractor, log amplifiers and Comparator) 5. Measurements of Op-Amp parameters (Input offset voltage, input offset current, CMRR, Slew rate) 6. Four Bit Binary Up and Down Counters 7. To study the characteristics of UJT	25%
SECTION C: 1. Michelson Interferometer (measurement of dλ) 2. Planck's constant by LED 3. Square well potential 4. Characteristics of LDR 5. Fabry–Pérot Etalon 6. Milikan's oil drop method 7. Numerical integration (computer related)	25%

SECTION D: 1. Searl's Goniometer (Variable distance) 2. Hall effect (constant probe current) 3. Computer simulation of Digital electronic circuits 4. Numerical aperture and acceptance angle of optical fiber (computer simulation) 5. Characteristics of Geiger – Müller Tube 6. Curie-Weiss law for ferroelectric material 7. Determination of lattice parameters from a photograph (Electron diffraction ring pattern)	25%

NOTE	Minimum 80% practical should be performed. To provide flexibility up to the maximum of 20% of total experiments can be replaced/ added to the list by respective colleges.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	The basic principles of Physics related to their courses in a practical way.
2.	The operational details of CRO, Interferometer and electronic circuits etc.
3.	The experimental design aspects to determine various properties of materials like resistivity, Hall coefficient, energy band gap, thickness of film etc.
4.	The process to analyze the observations and infer the outcome of the experiment.

Suggested References:	
Sr. No.	References
1.	Advanced Practical Physics for students B L Worsnop and H T Flint, Methuen and Co. Ltd., London
2.	B.Sc. Practical Physics C L Arora, S. Chand & Co. Ltd., New Delhi
3.	Advanced Practical Physics M S Chauhan and S P Singh, Pragati Prakashan, Meerut
4.	Advanced Practical Physics S L Gupta and V Kumar, Pragati Prakashan, Meerut
5.	An advanced course in practical Physics D Chattopadhyay and P C Rakshit, New Central book agency Pvt. Ltd.

On-line resources to be used if available as reference material
On-line Resources
MUTUAL INDUCTANCE BY CAREY FOSTER METHOD https://www.tandfonline.com/doi/abs/10.1080/14786448708628061?journalCode=tphm16 HIGH RESISTANCE BY LEAKAGE http://vlabs.iitb.ac.in/vlabs-dev/labs/physics-basics/labs/condenser-leakage-method-iitk/simulation.html L BY OWEN'S BRIDGE https://circuitglobe.com/owens-bridge.html#:~:text=Definition%3A%20The%20bridge%20which%20measures,is%20shown%20in%20the%20figure. e/m OF AN ELECTRON BY MAGNETRON METHOD https://www.youtube.com/watch?v=SNBzY0XbNLM https://www.iitr.ac.in/departments/PH/uploads/Teaching%20Laboratory/5%20ebym.pdf SUSCEPTIBILITY OF PARAMAGNETIC/FERROMAGNETIC SOLUTION BY QUINK'S METHOD https://www.holmarc.com/magnetic_susceptibility_quinke.php#:~:text=The%20Quincke's%20Method%20is%20used,a%20non%2Duniform%20magnetic%20field.&text=Measuring%20this%20rise%20enables%20to%20determine%20the%20susceptibility%20of%20the%20solution. https://www.youtube.com/watch?v=yzgdq8uUfO4

LVDT CHARACTERISTICS
(i) https://www.tech-wonders.com/2010/08/characteristics-of-lvdt-linear-variable.html#:~:text=Characteristics%20of%20LVDT%20%E2%80%93%20Linear%20Variable%20Differential%20Transformer&text=The%20primary%20is%20excited%20by,the%20secondary%20cancel%20each%20other
(ii) https://www.watelectronics.com/lvdt-linear-variable-displacement-transformer/
(iii) https://www.youtube.com/watch?v=F7ltLRgkHqs

SIMULATION OF HARMONIC OSCILLATOR
https://www.youtube.com/watch?v=Ln_R4w9PrEM
https://ophysics.com/w1.html

FEBRY- PAROT ETALON
https://en.wikipedia.org/wiki/Fabry%E2%80%93P%C3%A9rot_interferometer
https://www.csustan.edu/sites/default/files/groups/Write%20to%20Live/physics/sample-average1.pdf
https://www.youtube.com/watch?v=9fbLu5MjAno
https://www.youtube.com/watch?v=HkjlfCiEqGE

(electron diffraction ring pattern) Determination of lattice parameter from a photograph
https://www.intechopen.com/books/modern-electron-microscopy-in-physical-and-life-sciences/electron-diffraction
http://instructor.physics.lsa.umich.edu/adv-labs/Electron_Diffraction/electron_diffraction2.pdf

PLANK'S CONSTANT BY SOLAR CELL
https://www.iitr.ac.in/departments/PH/uploads/Teaching%20Laboratory/Thermal/4%20Plancks%20%20Constant.pdf
https://www.youtube.com/watch?v=qtSd3wYg7oE

TO STUDY HYDROGEN SPECTRUM AND DETERMINATION OF RYDBERG'S CONSTANT
http://www.phys.utk.edu/labs/modphys/BalmerSeries.pdf
https://www.youtube.com/watch?v=T4MeU-LbKdM

SEARL'S GONIOMETER (VARIABLE DISTANCE)
https://www.youtube.com/watch?v=m2EiFqSzBnY
https://www.youtube.com/watch?v=DVU0VTMoJoY

SQUARE WELL POTENTIAL
https://en.wikipedia.org/wiki/Finite_potential_well#:~:text=The%20finite%20potential%20well%20(also,a%20concept%20from%20quantum%20mechanics.&text=In%20the%20quantum%20interpretation%2C%20there,walls%20(cf%20quantum%20tunnelling).
https://www.youtube.com/watch?v=FL4QCymhYDA
https://www.youtube.com/watch?v=WOPhz9dBOXc

CHARACTERESTICS OF LDR
http://eeeforum.weebly.com/uploads/1/0/2/5/10254481/e392_lab8b.pdf
https://www.youtube.com/watch?v=mn8YLWMv3HM

NUMERICAL INTEGRATION BY COMPUTER
https://www.slideshare.net/chauhansp198/numerical-integration-59190592?qid=c7fccdec-e38f-

4580-8a22-4690015bda90&v=&b=&from_search=4
https://learn.lboro.ac.uk/archive/olmp/olmp_resources/pages/workbooks_1_50_jan2008/Workbook31/31_2_num_int.pdf

HALL EFFECT
https://www.youtube.com/watch?v=pxdHnXV0kWc

Numerical Aperture of Optical Fiber Virtual Lab : Amrita Vishwa Vidyapeetham Virtual Lab

Verify the truth table of RS, JK, T and D flip-flops using NAND & NOR gates - Virtual Labs (vlabs.ac.in)

Design and verify the 4-bit synchronous/asynchronous counter using JK flip flop - Virtual Labs (vlabs.ac.in)

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