Department of Physics

Jagannath Barooah University

Teaching Plan for Mr Jayur Tisso, Session :2025-26

Odd Semester: 2025-26

Class/Semester	Title & Code of The Paper Allotted (credit)	Method of Teaching	Teaching Material	Unit	Topic	Period/Hours Required	Details of the Contents	Remarks/Books
B.Sc. 1st Semester (Major)	**Mechanics (PHYMI-011)** (4 Credits)	Lecture, discussion, and assignment.	Whiteboard	Unit 9	**Unit 9:** Special Theory of Relativity	8 hours	**Unit 9: Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with	1) Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons. 2) Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley. 3) Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000.

							velocity. Massless Particles. Mass-energy equivalence.	
B.Sc. 3rd Semester (Major)	**WAVES AND OPTICS(**PHYMJ-032) (4 Credits)	Lecture, Problem-solving, and assignment.	Whiteboard and LCD projector.	**Unit** 1, 2 and 3	**Unit1:** Superposition of Collinear Harmonic oscillation. Superposition of two perpendicular Harmonic Oscillations **Unit2:** Wave Motion. Velocity of Waves. **Unit3:** Superposition of Two Harmonic Waves.	17 hours	**Unit1:** **Superposition of Collinear Harmonic oscillations**: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **Superposition of two perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **Unit2:** **Wave Motion:** Plane and Spherical Waves. Longitudinal and	1) Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill. 2) The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill

							Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. **Velocity of Waves:** Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. **Unit3:** **Superposition of Two Harmonic Waves**: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating	

							String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.	
B.Sc. 3rd Semester (SEC)	**Design & Maintenance of Electronic Devices (Skill Enhancement Course)**	Lecture and demonstration	Electronics devices and kits	**Unit 1 and 2**	**Unit 1:** Fundamentals of Electronic Devices and Components **Unit 2:** Circuit Design Principles and Prototyping	15 hours	**Unit 1: Fundamentals of Electronic Devices and Components** Introduction to electronic devices and their role in modern life Classification: analog vs. digital, active vs. passive devices Basic electronic components: resistors, capacitors, inductors, diodes, transistors Introduction to circuit analysis methods (Ohm's Law, Kirchhoff's laws,	1) Fundamentals of Electronics Devices & Circuits,S.K. Kataria & Sons; 2013th edition (1 January 2013) 2) Electronic Circuit Design and Application, Springer Nature Switzerland AG; 2nd ed. 2022 edition

							Thevenin/Norton equivalents) **Unit 2: Circuit Design Principles and Prototyping** Circuit design principles: voltage, current, power, efficiency Common circuit topologies (series, parallel, amplifier, rectifier, oscillator circuits) Introduction to simulation tools (e.g., Multisim, LTSpice) Laboratory session: breadboarding and testing simple circuits	

B.Sc. 5th Semester (Major)	**SOLID STATE PHYSICS -I** (PHYMJ-051) (4 Credits)	Lecture, PPT Presentation, and assignment.	Whiteboard and LCD Projector	Unit 1,2,4, 5, and 6.	**Unit1:** Crystal Structure. **Unit2:** Elementary Lattice Dynamics. **Unit4:** Dielectric Properties of Materials. **Unit5:** Ferroelectric Properties of Materials. **Unit6:** Elementary band theory.	46 hours	**Unit1: Crystal Structure** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Lattice planes, Miller Indices and Bravais lattice. Reciprocal Lattice. Types of Lattices. Packing fraction, Brillouin Zones. Diffraction of X-rays by crystals. Bragg's Law. atomic and geometrical structure factor. **Unit2: Elementary Lattice Dynamics** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative description of the Phonon Spectrum in Solids. Dulong and Petit's Law, Einstein and Debye	1) Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd. 2) Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India. 3) Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning

							theories of specific heat of solids. T^3 law. **Unit4:** **Dielectric Properties of Materials** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. **Unit5:** **Ferroelectric Properties of Materials** Structural phase transition, Classification of crystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect, Electrostrictive effect, Curie-Weiss Law,	

							Ferroelectric domains, PE hysteresis loop. **Unit6:** **Elementary band theory** Bloch theorem. Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect & Hall coefficient.	
B.Sc. 5th Semester (Major)	**LABORATORY – III** (Credit 4)	Practical demonstrations, hands-on lab work.	Lab apparatus and manuals.	Part A and B	**PART A:** SOLID STATE PHYSICS **PART B:** ANALOG SYSTEMS AND APPLICATIONS	16 hours	**PART A: SOLID STATE PHYSICS** 1) Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method) 2) To determine the Coupling Coefficient of a Piezoelectric crystal. 3) To measure the Dielectric Constant of a dielectric Materials with frequency 4) To draw the BH curve of Fe using Solenoid	1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House. 2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal 3. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, McGraw Hill.

							& determine energy loss from Hysteresis. 5) To determine the Hall coefficient of a semiconductor sample. **PART B: ANALOG SYSTEMS AND APPLICATIONS** 1) To study V-I characteristics of PN junction diode, and Light emitting diode. 2) To study the V-I characteristics of a Zener diode and its use as voltage regulator. 3) Study of V-I & power curves of solar cells, and find maximum power point & efficiency. 4) To study the characteristics of a Bipolar Junction Transistor in CE configuration. 5) To study the frequency response of	4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall. 5. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.

							voltage gain of a RC-coupled transistor amplifier. 6) To design a Wien bridge oscillator for given frequency using an op-amp. 7) To design a phase shift oscillator of given specifications using BJT. 8) To study the Colpitt`s oscillator. 9) To design a digital to analog converter (DAC) of given specifications. 10) To study the analog to digital convertor (ADC) IC. 11) To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain 12) To design inverting amplifier using Op-amp (741,351) and study its frequency response 13) To design non-inverting amplifier using Op-amp (741,351) & study its frequency response	

B.Sc. 5th Semester (Minor)	**THERMAL PHYSICS** (PHYMI-051) (Credit 4)	Lecture, Problem-solving, and assignment.	Whiteboard	Unit 6 and 7	**Unit6: Kinetic Theory of Gases** Unit7: **Molecular Collisions**	15 hours	**Unit6:** **Kinetic Theory of Gases** Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas. (derivation not required) Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. Unit7: **Molecular Collisions**: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance, Einstein's theory of Brownian Motion.	

M.Sc. 1st Semester	**Atomic and Molecular physics** (PPHYC - 104) (Credit 4)	Lecture, PPT Presentation, and assignment	Whiteboard and LCD Projector	Unit 1 and 5	**Unit1: Review of one-electron and two-electron atoms. Unit2: Electronic properties of molecules.**	20 hours	**Unit1: Review of one-electron and two-electron atoms:** spectrum of hydrogen, helium and alkali atoms; Many electron atoms: central field approximation, Thomas-Fermi model, Slater determinant, Hartee-Fock and self-consistent field methods, Hund's rule, L-S and j-j coupling, Equivalent and nonequivalent electrons, Spectroscopic terms, Lande interval rule **Unit2: Electronic properties of molecules:** Electronic spectra of diatomic molecules: Born-Oppenheimer approximation, Franck-Condon principle, Dissociation energy and dissociation products, rotational fine structures, pre-dissociation of	1) H. E. White, Introduction to Atomic Spectra, Tata McGraw Hill (1934). C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed.,Tata McGraw (2004).

							molecules.	
M.Sc. 3rd Semester	**Quantum Optics** (PPHYD 302B) (Credit 4)	Lecture, PPT Presentation, and assignment	Whiteboard and LCD Projector	Unit 6	**Unit 6 Atom Optics**	8 hours	**Unit 6:** **Atom Optics:** Mechanical effects of light, Laser cooling, atom interferometry, atoms in cavity, Experimental realization of Jaynes-Cummings model	1) Elements of Quantum Optics, Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 3rd edition. 2) Quantum Optics for Beginners, Jenny Stanford Publishing; 1st edition.

Teaching Plan for Mr Jayur Tisso, Session :2025-26

Even Semester: 2025-26

Class/Semester	Title & Code of The Paper Allotted (credit)	Method of Teaching	Teaching Material	Unit	Topic	Period/Hours Required	Details of the Contents	Remarks/Books
B.Sc. 2nd Semester (Major)	**Electricity and magnetism** (PHYMJ-021) (Credit 4)	Lecture and assignment	Whiteboard	Unit 5 and 6	**Unit 5:** Electromagnetic Induction. **Unit 6:** Electrical Circuits.	16 hours	**Unit 5:** **Electromagnetic Induction:** Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. **Unit 6:** **Electrical Circuits:** AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.	1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw. 2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education.

B.Sc. 2nd Semester (Minor)	**Electricity and magnetism** (PHYMI-021) (Credit 4)	Lecture and assignment	Whiteboard	Unit 5 and 6	**Unit 5:** Electromagnetic Induction. Unit 6: Electrical Circuits.	16 hours	**Unit 5: Electromagnetic Induction:** Faraday's Law. Lenz's Law. Self-Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. **Unit 6: Electrical Circuits:** AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit.	1) Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw. 2) Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education.

B.Sc. 4th Semester (Major)	**THERMAL PHYSICS (**PHYMJ-042)	Lecture and assignment	Whiteboard	Unit 6 and 7	**Unit 6:** Kinetic Theory of Gases Distributio n of Velocities. **Unit 7:** Molecular Collisions.	15 hours	**Unit 6:** **Kinetic Theory of Gases Distribution of Velocities**: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas. (derivation not required) Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. **Unit 7:** **Molecular Collisions**: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance, Einstein's theory of Brownian Motion.	1) Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press 2) Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

B.Sc. 4th Semester (Major)	**LABORATORY – II** (Credit 4)	Practical demonstrations, hands-on lab work.	Lab apparatus and manuals.	Part A and B	**PART A:** Waves & Optics **PART B:** Thermal Physics	16 hours	**PART A : Waves & Optics** 1) To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 – T law. 2) Familiarization with: Schuster`s focusing; determination of angle of prism. 3) To determine refractive index of the Material of a prism using sodium source. 4) To determine the dispersive power and Cauchy constants of the material of a prism using mercury source. 5) To determine the wavelength of sodium source using Michelson's interferometer. 6) To determine wavelength of sodium light using Fresnel Biprism.	1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, AsiaPublishing House 2. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

							7) To determine wavelength of sodium light using Newton’s Rings. 8) To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film. 9) To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. 10) To determine dispersive power and resolving power of a plane diffraction grating. 11) To verify the law of Malus for plane polarized light. 12) To determine the specific rotation of sugar solution using Polarimeter. 13) To analyze elliptically polarized Light by using a Babinet’s compensator.	

							PART B : Thermal Physics 1. To determine Mechanical Equivalent of Heat, J, by Joule's Calorimeter method. 2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus. 3. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method. 4. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT). 5. To study the variation of Thermo-Emf of a Chromium – Aluminium Thermocouple with Difference of Temperature of its Two Junctions. 6. To calibrate a thermocouple to measure	

							temperature in a specified Range using 1. Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature. 7. Find the specific heat by Clement and Desorme's Method	
B.Sc. 4th Semester (Minor)	**WAVES AND OPTICS** (PHYMI-041) (Credit 4)	Lecture and assignment	Whiteboard	Unit 1,2 and 3	**Unit1:** Superposition of Collinear Harmonic oscillations and Superposition of two perpendicular Harmonic Oscillations. **Unit 2:** Wave	17 hours	**Unit1: Superposition of Collinear Harmonic oscillations**: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences.	1) Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill. 2) The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.

					Motion and Velocity of Waves and Velocity of Waves. **Unit 3:** Superposition of Two Harmonic Waves.		**Superposition of two perpendicular Harmonic Oscillations**: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **Unit 2:** **Wave Motion:** Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. **Velocity of Waves:** Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's	

							Correction. **Unit 3: Superposition of Two Harmonic Waves**: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.	
B.Sc. 6^{th} Semester (Major)	**DIGITAL SYSTEMS AND APPLICATIONS**	Lecture and assignment	Whiteboard	Unit 1,2 and 3.	**Unit1:** Integrated Circuits and Digital Circuits.	30 hours	**Unit1: Integrated Circuits:** (Qualitative treatment only): Active & Passive components. Discrete	1) Digital Principles and Applications, A.P. Malvino, D.P.Leach

	(PHYMJ-062) (Credit:4)				**Unit 2:** Boolean algebra. **Unit 3:** Data processing circuits and Arithmetic Circuits.		components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs. **Digital Circuits:** Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. **Unit 2:** **Boolean algebra:** INHIBIT (ENABLE) operation, De Morgan's Theorems.	and Saha, 7th Ed., 2011, Tata McGraw 2) Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill

							Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. **Unit 3:** **Data processing circuits**: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders. **Arithmetic Circuits:** Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.	

M.Sc. 2nd Semester	**Solid State Physics** (PPHYC 203) (Credit 4)	Lecture, PPT Presentation , and assignment	Whiteboard and LCD Projector	Unit 1,2 and 3.	**Unit1:** Basics of crystal structure and Crystal binding. **Unit 2:** Free electron theory and Electrons in a Periodic Potential. **Unit 3:** Wannier functions and Tight binding model.	26 hours	**Unit1:** **Basics of crystal structure:** symmetry operations, Bravais lattices**,** Reciprocal lattice, Bragg and von Laue diffraction**,** Ewald Construction. **Crystal binding:** molecular crystals, repulsive interaction, cohesive energy, ionic metallic and covalent crystals. **Unit 2:** **Free electron theory:** Drude and Sommerfield's model of conductivity. **Electrons in a Periodic Potential,** Bloch Theorem in lattice and reciprocal space, origin of band gap in a weak periodic potential, Kronig-Penney Model, Band structures, Metal, Insulator Semiconductor, Concepts of Effective mass, light and heavy holes in semiconductor, optical	1) Kittel, C., *Introduction to Solid State physics* 7th Edition (Wiley, Eastern Ltd., 1996) 2) Dekker, A. J., *Solid State Physics* (Macmillan India Ltd., 2003)

							properties of semiconductors. **Unit 3:** **Wannier functions, Tight binding model** and Calculation of Band structure, Fermi Surfaces.	
M.Sc. 4th Semester	**Statistical Physics** (PPHYC 401) (Credit 4)	Lecture and assignment	Whiteboard	Unit 1	**Unit1:** Review of Statistical Physics	15 hours	**Unit1:** **Review of Statistical Physics**, Phase space, ergodicity and Liouville theorem, Macrostates, microstates and fundamental postulate of equilibrium statistical mechanics, Micro canonical, Canonical and Grand canonical ensembles. Concept of ensemble average, Equation of state, specific heat and entropy of a classical ideal gas using microcanonical ensemble. Entropy of mixing, Gibb's paradox, Sakura Tetrode	

							Equation. Energy and Density fluctuations; Equivalence of various ensembles, Virial and equipartition theorems	