Department of Physics

Jagannath Barooah University

Teaching Plan for **Akash Dipta Thakur**, 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	**Mechanics (PHYMJ-1)** (4 Credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 2 and Unit 5	Work and Energy Fluid Motion	6+4=10 hours	Unit 2 :Work and Kinetic Energy Theorem. Conservative and non conservative forces. Potential energy. Elastic Potential energy. Force as gradient of potential energy. Work and Potential Energy. Work done by non-conservative forces. Law of conservation of Energy. Unit 5 : Kinematics o moving fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.	*1. An Introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973 McGraw-Hill.* *2. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000.*
B.Sc. 1st Semester	**Mechanics (PHYMI-1)** (4 Credits)	Lecture, Discussion, Visual Aids	Whiteboard, LCD Projector	Unit 2 and 5	Interior of the Earth	6+4=10 hours	Unit 2 : Work and Kinetic Energy Theorem. Conservative and non	*1. An Introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973*

							conservative forces. Potential energy. Elastic Potential energy. Force as gradient of potential energy. Work and Potential Energy. Work done by non-conservative forces. Law of conservation of Energy. Unit 5 : Kinematics o moving fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.	*McGraw-Hill.* *2. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000.*
B.Sc. 3rd Semester	**Physics in Everyday Life (PHYMU-1)** (3 Credits)	Lecture, Problem-solving	Whiteboard, LCD Projector	Unit 2 and 3	Physics in Human Body Household Electricity	26 hours	**Unit 2 :** The Eye as an optical instrument. Vision defects. Resolving power. Sound waves and hearing. Sound intensity. Decibel scale and temperature control.	*Conceptual Physics by Paul G Hewitt*

B.Sc. 5th Semester	**Solid State Physics-1 And Atomic and Molecular Physics (PHYMJ-051 and PHYMJ-052)** (4+4 Credits)	Lecture, PPT Presentation	Whiteboard, LCD Projector	Unit 3 Unit 7 (PHYMJ-051)and Unit 7(PHYMJ-052)	Magneti Properties of matter And Superconductor (PHYMJ-051) Lasers (PHYMJ-052)	22 hours	**PHYMJ-051** **Unit 3:** Dia, Para, Ferri and Ferromagnetic materials. Langevin theory of dia and parmagnetic domains. Quantum Mechanical treatment of Paramagnetism. Curies law, Weiss Theory of Ferromagnetism and Ferromagnetic domains. Discussion of B-H curve. Hysteresis and energy lss. **Unit 7:** Experimental results. Critical Temperature. Critical magnetic field. Meissnereffect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect.Idea of BCS theory (No derivation)	1) Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley IndiaPvt. Ltd. 2) Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India 3) Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-GrawHill 1) 10 K.Thyagarajan and A.K.

							PHYMJ-052 **Unit 7: Lasers:** Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulatedemissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic lasing.	Ghatak, Laser: Theory and Applicaton,. 2) 11 B.B. Laud, Lasers and Non-linear Optics

B.Sc. 5th Semester	**Thermal Physics (PHYMI-054) (Credits : 4)**	Lecture, PPT Presentation	Whiteboard, LCD Projector	Unit 1 Unit 2 Unit 3	Unit 1 **Introduction to Thermodynamics Zeroth and First Law of Thermodynamics Unit 2 Second Law of Thermodynamics Unit 3 Entropy**:	21 hours	Unit 1 : Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. Unit 2 : Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into	1) A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press 2) Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill 3) Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.

							Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. Unit 3 : Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in	

							Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero.	
M.Sc. 2st Semester	Electromagnetic Theory and Electrodynamics **Course Code: PHYC-201 Credits: 4 (4 – Theory)** Nuclear and particle	Lecture, PPT	White board, LCD projector	Unit I PHYC-021 Unit I, II, V PHYC-022	Review of Maxwell's equations Introduction to Nucleus Nuclear Models Particle accelerat	34 hours	Review of Maxwell's Equations: Fundamental problem of electromagnetic theory. Scalar and vector potentials. Gauge transformations. Coulomb and Lorentz gauges. Poynting's theorem, Energy and momentum conservation; Electromagnetic waves: wave equation, propagation of	Classical Electrodynamics by John David Jackson (3rct Ed.,Wiley,l998) 2. Introduction to Electrodynamics by David Griffiths (3rd Ed., Benjamin Cummings, 1999) 3. Principles of Electrodynamics by Melvin Schv-iartz (Dover Pub]ications,

	physics **Course Code: PHYC-202 Credits: 4 (4 - Theory**				ors		electromagnetic waves in non-conducting medium, reflection and refraction at dielectric interface, total internal reflection, Brewster's angle, complex refractive index. Recapitulation of nuclear properties and nuclear forces, Yukawa hypothesis, Nuclear models: Thomas Fermi model, nuclear shell model, magnetic moments and spin parity of nuclei, the magic numbers; The collective model and application to even-even nuclei, their spectrum and selection rules for radiation. Particle accelerators and detectors: electrostatic accelerators, cyclotron, synchrotron, linear accelerators, colliding beam accelerators, ionization chamber, scintillation detectors, semiconductor detectors, their simple applications to material	1987) 4. Classical Electrodynamics by J. Schwinge

							science and medicine.	
M.Sc. 3rd Semester	**COURSE TITLE: Lasers and Nonlinear Optics Course Code: PHYD-302 Credits: 4**	Lecture, PPT	White board, LCD projector	Unit I, II and III	Lasers, Types and formation of Pulses	26 hours	**Fundamentals of Lasers**: Absorption, Spontaneous emission and Stimulated emission, Einstein coefficients and their significance, Lasing mechanisms, Laser oscillator, Laser characteristics, Principles for operation of Lasers, modes and mode selection, Temporal & Spatial Coherence, comparison of laser with conventional sources of light, Laser Line width and Line broadening mechanisms, Gaussian Beams and optical resonators. **Types of Lasers**: Rate equations, CW lasers, and Pulsed Lasers, Gas lasers, solid state lasers, semiconductor lasers, Dye Lasers and Fiber lasers, Spectral coverage with current	Laser fundamentals- W. T .Silfvast, 2nd edition, Cambridge University Press (2008) (Text). 2. Lasers: Fundamentals and Applications, K. Thyagarajan and Ajoy Ghatak, Springer, 2nd edition (2011) 3. Principles of Lasers, Orazio Svelto and David C. Hanna, Springer, Fifth Edition (2010)

							Laser technologies. **Generation of short and Ultrashort pulses**: Q-Switching, Mode locking, Chirping and Pulse compression, YAG Lasers, State-of–art-lasers (Ti: Sapphire Lasers and Fiber Lasers).	

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	**Electricity and Magnetism (PHYMJ-2)** (4 Credits)	Lecture, PPT Presentation,	Whiteboard, LCD Projector	Unit 3 And Unit 4	**Unit 3 : Magnetic Field: Unit 4 : Magnetic Properties of Matter:**	18 hours	Unit 3 : Magnetic force between current elements and definition of MagneticField**B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current	1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw 2. Electricity and Magnetism, Edward M.

							elements. Torque on a current loop in a uniform Magnetic Field. Unit 4 : Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis.	Purcell, 1986 McGraw-Hill Education 3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
B.Sc. 4th Semester	**Thermal Physics (PHYMJ-042)** (4 Credits)	Lecture, PPT	Whiteboard, LCD Projector,	Unit 1 Unit 2 Unit 3 Unit 4	Unit 1 **Introduction to Thermodynamics** **Zeroth and First Law of Thermodynamics** **Unit 2** **Second Law of Thermo**	28hours (Theory)	**Introduction to Thermodynamics Zeroth and First Law of Thermodynamics:** Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State	1) Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill. 2) A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian

					dynamics **Unit 3** **Entropy** **Unit 4** Themodynamic potential.		Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. **Second Law of Thermodynamics**: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law	Press 3) Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill 4) Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.

							of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. **Entropy**: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible	

							and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of Absolute Zero. **Thermodynamic Potentials**: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation.	

B.Sc. 6th Semester	**ELECTROMAGNETICTHEORY& ELECTRODYNAMICS (PHYMJ-061)** **NUCLEAR AND PARTICLE PHYSICS (PHYMJ-063)** (4 Credits)	Lecture	Whiteboard, LCD Projector	Unit1 Unit2 Unit3	Unit1 **Maxwell Equations** **Unit2 EMWavePropagationinUnboundedMedia** **Unit3 EMWavePropagationinUnboundedMedia**	53 hours	**Unit I:** Definition of Charge density, Current density. Relation of current density with Electric field. Reviewof Ampere's circuital law, Gauss's law in electrostatics and Magnetostatics, Faraday's law in electromagnetic induction, Divergence and Curl of magnetic field, Magnetic vector potential. Electric polarization vector and polarization Charge density. Useful vector identities in electromagnetic theory. Equation of continuity, conservation of charge. Maxwell's equations, Derivation of Maxwell's equation. Maxwell's equation in Integral Physical	1) IntroductiontoGeometricalandPhysicalOptics-B.K.Mathur 2) IntroductiontoElectrodynamics,D.J.Griffiths,3rdEd.,1998,BenjaminCummings. 3) ElementsofElectromagnetics,M.N.O.Sadiku,2001,OxfordUniversityPress. 4) IntroductiontoElectromagneticTheory,T.L.Chow,2006,Jones&BartlettLearning 1) Introductorynuclear Physicsby KennethS.Krane(Wiley IndiaPvt.Ltd.,2008).

							interpretation of Maxwell'sequations.DisplacementCurrent.Vectorand scalar potential.GaugeTransformations:LorentzandCoulombGauge. Electrostatic and Magnetostatic energy densities.PoyntingTheoremandPoyntingVector.PhysicalConceptofElectromagneticFieldEnergyDensity, ElectromagneticMomentumDensities (linear and angular).. **Unit II:** The wave equation and its solution. PlaneEMwavesthrough free spaceandisotropicdielectricmedium. Plane electromagnetic wave in anisotropic dielectric medium.transversenatureofplaneEMwaves,refractiveindexanddielectricconstant, waveimpedance. Propagation of	2) Conceptsofnuclearphysicsby BernardL. Cohen.(TataMcgrawHill,1998). 3) Introductiontothephysicsofnuclei&particles,R. A.Dunlap.(ThomsonAsia,2004). 4) IntroductiontoHighEnergyPhysics,D. H.Perkins,CambridgeUniv.Press

							electromagnetic wave throughconductingmedia, relaxationtime,skindepth. Drude model of Dynamic conductivity, electricalconductivityofionized gases, Wavepropagationthroughdiluteplasma,plasma frequency,refractiveindex,skindepth,applicationtopropagationthroughionosphere.. **Unit III:** Boundaryconditionsataplaneinterfacebetweentwomedia.Reflection& Refractionofplanewavesatplaneinterfacebetweentwodielectricmedia-LawsofReflection&Refraction. Kinematic and Dynamic Properties of reflection and refraction.Fresnel'sFormulaeforperpendicular &parallelpolarizationcases,Brewster'slaw.Reflection&Transmissioncoefficients. Normal	

							and oblique incidence. Degree of polarization. Totalinternalreflection PHYMJ-063 Unit1 : All about a nucleus – its constituents and basic characteristics. General ideas about isotope, isobar, isotone, isomer and mirror nuclei, Structure of atomic nucleus and its relation with atomic weight,Intrinsicproperties of nuclei, Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle, Nuclear composition theories, Nature of nuclear force , NZ graph, Nuclear bindingenergy,aver	

							agebindingenergyanditsvariationwithmassnumber,mainfeaturesofbindingenergyversusmassnumbercurve Unit 4 : Nuclear Fission and Fusion-mass deficit; relativity and generation of energy; Fission- Chain reaction, nature of fragments and emission of neutrons. Nuclear reactor: Power and Breeder reactor. Fusion and thermonuclear reaction driving stellar energy.	

Besides the Theory Classes, we use to demonstrate in practical classes of both UG and PG; and also supervise the projects to be performed by both UG and PG students.