Department of Physics

Jagannath Barooah University

Teaching Plan for **Dr. Ankur Gogoi**, 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-011) (4 Credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit I	Fundamentals of Dynamics	8	Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.	As suggested in the syllabus
B.Sc. 1st Semester	Mechanics (PHYMI-011) (4 Credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit I	Fundamentals of Dynamics	8	Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.	As suggested in the syllabus

B.Sc. 3rd Semester	Waves and Optics (PHYMJ-032) (4 Credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 5	Diffraction of light	12	Diffraction of light, types of diffraction Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.	As suggested in the syllabus
B.Sc. 3rd Semester	Design & Maintenance of Electronic Devices (PHYSK-031) (3 Credits)	Lecture, PPT Presentation, Discussion, practical demonstrations	Whiteboard, LCD Projector	Unit 5	Maintenance and Repair of Electronic Devices	6	Common causes of electronic device failures, Fault diagnosis and preventive maintenance strategies, Safe handling and replacement of components, Soldering and desoldering techniques (through-hole and SMD), Laboratory: Repair of simple faulty circuits and devices	As suggested in the syllabus
				Unit 6	Project-Based Application and Skill Integration	9	Planning and executing a mini-project involving electronic device design, combining design, PCB development, assembly, and testing into a working prototype, Documentation and report writing for electronic projects, Demonstration and peer evaluation of student projects, Emphasis on safety, sustainability, and best practices in device maintenance	As suggested in the syllabus

B.Sc 5th Semester	ANALOG SYSTEMS AND APPLICATIONS (PHYMJ-053) (4 Credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 1	Network Theorems	9	Kirchhoff's Laws, Nodal Analysis, Mesh Analysis, Source transformations, Linearity and Superposition, Thevenin's and Norton's Theorems, Maximum power transfer theorem, Star-Delta and Delta-Star Conversion.	As suggested in the syllabus
				Unit 2	Semiconductor Diodes, Two-terminal Devices and their Applications	17	Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode. Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.	As suggested in the syllabus

				Unit 3	Bipolar Junction transistors, Amplifiers	26	Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions. Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers. Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response Feedback in Amplifiers: Effects of Positive and Negative feedback on input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.	As suggested in the syllabus

				Unit 4	Operational Amplifiers, Applications of Op-Amps	18	Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. CMRR Frequency response of an op-amp and active filter: Gain and phase shift vs. frequency, Bode plots, compensated frequency response, slew rate. Concept of Virtual ground and virtual short. Applications of Op-Amps: Inverting and non-inverting amplifiers, Adder, Subtractor, Differentiator, Integrator, Log amplifier, Zero crossing detector, Wein bridge oscillator, active filter, first and second order low pass and high pass, Butterworth filter, band reject filter.	As suggested in the syllabus
B.Sc 5th Semester	LABORATORY – III	Practical demonstration	Practical demonstration	-	Laboratory practical	40	Laboratory practical experiments listed in the syllabus	As suggested in the syllabus

PG 1st semester	Atomic and Molecular physics (PPHYC104) (4 credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 4	Molecular Physics	20	Molecular symmetry, irreducible representation Rotational Spectra of diatomic molecule, intensity of spectral lines, Effect of isotope substitutions, non-rigid rotator, Vibrational spectra of diatomic molecules, harmonic and anharmonic Vibrator-rotational spectra Pure rotational Raman spectra, linear and symmetric top molecules, vibrational Raman spectra, rotational fine structure, selection rule, overtone spectra	As suggested in the syllabus
PG 3rd Semester	Lasers and Nonlinear Optics (PPHYD 301B) (4 credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 4	Nonlinear Optics	10	Optics & Wave propagation in anisotropic medium, Electromagnetic Waves in Nonlinear Media, Phenomenological theory of nonlinearities, Nonlinear polarization, Nonlinear susceptibility, Wave equation.	As suggested in the syllabus
				Unit 5	Nonlinear processes	15	Second Order Nonlinear Optics: Electro-Optic and Acousto-optic effects, Acousto-optic Modulators, Harmonic generation, Phase Matching, Parametric Effects, Photorefractive Effect. Third-order Nonlinear Optics: Wave Mixing; Nonlinear Refraction and Absorption, Multiphoton Processes, Self-focusing, Self-phase-modulation, Photon Echo, Optical Switching and Solitons. Stimulated Scattering: Rayleigh, Brillouin, and Raman Processes.	As suggested in the syllabus

PG 3rd Semester	PROJECT (PPHYC 302) (4 credits)	Supervision, discussion	Hands-on experiments	Project	Project	120	This course is based on preliminary research topics both in theory and experiment. The teachers who act as supervisors for the projects will float projects and any one of them will be allocated to the student. At the semester end, the student will submit Project Report in the form of Dissertation which will be examined by the examiners. The examination shall consist of (a) presentation and (comprehensive viva-voce).	Depending on the topic of the project, reference books will be suggested to each of the students
Ph.D. Coursework	Research Methodology (PHYP101) (4 Credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 2	Literature Review	20	Uses of literature review, sources of information using internet, organization information, importance of literature survey. Literature survey of the previous works and search for articles in the library, review of articles in the relevant field, and preparation of a short report. Use of internet in searching research materials (research papers, books, etc.), paper downloading, and submission of papers in arXiv, use of SPRIES database, various websites for journals, knowledge of impact factor, citation of research paper. (25 hours)	As suggested in the syllabus

	Academic and Research Report Writing (PHYP103) (4 Credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 1	Introduction	10	Importance of report writing in academics and research. Various kinds of academic and research activities. Necessity of report writing for achievement of academic and research goals. Various kinds of reports / presentations. Characteristics of academic and research reports / presentations.	As suggested in the syllabus
				Unit 2	Research paper writing	15	Types of research papers, typical structure of a research paper, different formatting styles of research papers: abstract, introduction to the work to be reported, methodology, results and discussions, conclusion, referencing. Communicating a research paper to a suitable journal.	As suggested in the syllabus
				Unit 3	Thesis writing	15	Typical structure of a thesis, Scope of the work, Literature review, Experimental/ computational details, Preliminary studies, Results and Discussions, Figures and Tables preparation, Conclusions and future works, Bibliography, Appendices.	As suggested in the syllabus
				Unit 4	Tools and Techniques	7	Various word processors, e.g., MS Word, Libra-office, Latex etc. Making effective presentations using Power Point and Beamer, Uses of plagiarism detection tools.	As suggested in the syllabus

				Unit 5	Miscellaneous Reports	8	Writing research proposals, Writings project proposals, Lecture notes, Progress reports, Utilization reports, Scientific reports etc.	As suggested in the syllabus
				Unit 6	Hands-on and Mini Project	5	Assignment of mini project, Discussions	As suggested in the syllabus
Ph.D. Research Programme	PhD Research Supervision	Method of Supervision: individual guidance, research discussion, lab work, literature review, periodic presentations, manuscript writing guidance, etc.	Research Resources: reference books, journal articles, software tools (COMSOL, GAMESS, etc.), experimental facilities, datasets, HPC access, etc.	Research	Literature Review, Research Methodology, Simulation/Experimentation, Data Analysis, Thesis Writing, Publications.	-	The supervision process involves individualized guidance through regular discussions, progress reviews, and mentoring in all stages of research. Scholars are supported in conducting literature surveys, formulating research methodology, performing experimental or simulation-based studies, analyzing data, and preparing scientific manuscripts. Periodic seminars and presentations are encouraged to enhance research communication skills. The contents also include training in the use of standard reference materials, peer-reviewed journals, software tools (COMSOL, Gaussian, MATLAB), experimental setups, and high-performance computing resources to ensure comprehensive development of research capabilities.	Recent journal articles from Nature, ACS, AIP, Elsevier, etc.

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-021) (4 credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 1	Electric Field and Electric Potential	14	Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.	As suggested in the syllabus

B.Sc. 2nd Semester	Electricity and magnetism (PHYMI-021) (4 credits)	Lecture, PPT Presentation, Discussion	Whiteboard, LCD Projector	Unit 1	Electric Field and Electric Potential	14	Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.	As suggested in the syllabus
B.Sc. 2nd Semester	Renewable Energy and Energy Harvesting (PHYSK-021) (3 credits)	Lecture, PPT Presentation, Discussion, Demonstration	Whiteboard, LCD Projector	Unit 1	Fossil fuels and Alternate Sources of energy	9	Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.	As suggested in the syllabus

B.Sc. 4th Semester	THERMAL PHYSICS (PHYMJ-042) (4 credits)	Lecture, PPT Presentation, Discussion, Demonstration	Whiteboard, LCD Projector	Unit 5	Maxwell's Thermodynamic Relations	7	Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of C_P-C_v, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.	As suggested in the syllabus
				Unit 5	Kinetic Theory of Gases Distribution of Velocities	8	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.	
B.Sc. 4th Semester	LABORATORY – II	Practical Demonstration	Practical Demonstration	-	Laboratory practical	40	Laboratory practical experiments listed in the syllabus	As suggested in the syllabus

B.Sc. 4th Semester	WAVES AND OPTICS (PHYMI-041) (4 credits)	Lecture, PPT Presentation, Discussion, Demonstration	Whiteboard, LCD Projector	Unit 6	Diffraction of light	12	Diffraction of light, types of diffraction Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.	As suggested in the syllabus
B.Sc. 6th Semester	DIGITAL SYSTEMS AND APPLICATIONS (PHYMJ-062) (4 credits)	Lecture, PPT Presentation, Discussion, Demonstration	Whiteboard, LCD Projector	Unit 4	Sequential Circuits, timers, counters	18	Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JKFlip-Flop. Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter.	As suggested in the syllabus

				Unit 5	Computer organization, Intel 8085 Microprocessor Architecture, Introduction to Assembly Language	12	Computer Organization: Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map. Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI. Introduction to Assembly Language: 1 byte, 2 byte & 3 byte instructions.	As suggested in the syllabus
B.Sc. 6th Semester	LABORATORY – IV	Practical Demonstration	Practical Demonstration	-	Laboratory practical	40	Laboratory practical experiments listed in the syllabus	As suggested in the syllabus
B.Sc. 6th Semester	PROJECT	Supervision, discussion	Hands-on experiments	Project	Project	60	This course is based on preliminary research topics both in theory and experiment. The teachers who act as supervisors for the projects will float projects and any one of them will be allocated to the student. At the semester end, the student will submit Project Report in the form of Dissertation which will be examined by the examiners. The examination shall consist of (a) presentation and (comprehensive viva-voce).	Depending on the topic of the project, reference books will be suggested to each of the students

PG 2nd Semester	Analog and Digital Electronics (PPHYC 204) (4 credits)	Lecture, PPT Presentation, Discussion, Demonstration	Whiteboard, LCD Projector	Unit 1	Op Amp non-linear applications	12	Voltage limiters, comparators, zero detector, Schmitt trigger, voltage to frequency and frequency to voltage converter, small-signal diodes, sample-and-hold circuits and signal generators: oscillators-square-wave, Wien bridge, phase shift.	As suggested in the syllabus
				Unit 2	Frequency response of an op-amp and active filter	10	Gain and phase shift vs. frequency, Bode plots, compensated frequency response, slew rate, active filter, first and second order low pass and high pass, Butterworth filter, band reject filter.	As suggested in the syllabus
PG 2nd Semester	Physics Laboratory-II	Practical Demonstration	Practical Demonstration	-	Laboratory practical	40	Laboratory practical experiments listed in the syllabus	As suggested in the syllabus
PG 2nd Semester	FUNDAMENTALS OF MATERIAL SCIENCE (PPHYG 201) 4 credits	Lecture, PPT Presentation, Discussion, Demonstration	Whiteboard, LCD Projector	Unit 5	Nanostructured materials	10	Introduction to nanomaterials, history and scope, interdisciplinary nature, surface to volume ratio, electronic structure, types of nanomaterials, applications of nanomaterials.	As suggested in the syllabus
PG 4th Semester	Advanced Laser Spectroscopy (PPHYD	Lecture, PPT Presentation, Discussion, Demonstration	Whiteboard, LCD Projector	Unit 4	Infrared Spectroscopy	10	Steady-state and time-resolved Infrared spectroscopy: from overview to potential applications	As suggested in the syllabus

	401B) (4 credits)			Unit 5	Raman Spectroscopy	12	Spontaneous Raman Spectroscopy, Resonance-enhanced Raman Spectroscopy, Stimulated Raman spectroscopy, hyper Raman and coherent anti Stokes Raman spectroscopy, applications	As suggested in the syllabus
				Unit 6	Spectroscopy	10	Principles and applications of photon correlation spectroscopy, Frequency Comb Spectroscopy, Photoacoustic Spectroscopy, Laser-induced Breakdown Spectroscopy, and their applications	As suggested in the syllabus
PG 4th Semester	Advanced Optics & Photonics Laboratory II (PPHYD 402B) (4 credits)	Practical Demonstration	Practical Demonstration	-	Laboratory practical	40	Laboratory practical experiments listed in the syllabus	As suggested in the syllabus
PG 4th Semester	PROJECT (PPHYC 402) (4 credits)	Supervision, discussion	Hands-on experiments	Project	Project	120	This course is based on preliminary research topics both in theory and experiment. The teachers who act as supervisors for the projects will float projects and any one of them will be allocated to the student. At the semester end, the student will submit Project Report in the form of Dissertation which will be examined by the examiners. The examination shall consist of (a) presentation and (comprehensive viva-voce).	Depending on the topic of the project, reference books will be suggested to each of the students

Ph.D. Research Programme	PhD Research Supervision	Method of Supervision: individual guidance, research discussion, lab work, literature review, periodic presentations, manuscript writing guidance, etc.	Research Resources: reference books, journal articles, software tools (COMSOL, GAMESS, etc.), experimental facilities, datasets, HPC access, etc.	Research	Literature Review, Research Methodology, Simulation/Experimentation, Data Analysis, Thesis Writing, Publications.	-	The supervision process involves individualized guidance through regular discussions, progress reviews, and mentoring in all stages of research. Scholars are supported in conducting literature surveys, formulating research methodology, performing experimental or simulation-based studies, analyzing data, and preparing scientific manuscripts. Periodic seminars and presentations are encouraged to enhance research communication skills. The contents also include training in the use of standard reference materials, peer-reviewed journals, software tools (COMSOL, Gaussian, MATLAB), experimental setups, and high-performance computing resources to ensure comprehensive development of research capabilities.	Recent journal articles from Nature, ACS, AIP, Elsevier, etc.

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