DEPARTMENT OF PHYSICS
LESSION Plan
Session 2023-24
SEMESTER – VI

Name of Teacher: Dr. Goutam Biswas
Paper Allotted: PHSACOR13T, PHSGDSE04T

Month	Paper	Topic	No of classes
March 2024 (02.03.2024)	**PHSACOR13T** *Electro-magnetic Theory*	**MAXWELL EQUATIONS:** [Part -A] Maxwell's equations. Displacement Current. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. Momentum Density and Angular Momentum Density (statement only).	06
	PHSGDSE04T *Nuclear Physics*	**General Properties of Nuclei:** [Part-A] Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number.	04
April 2024	**PHSACOR13T** *Electro-magnetic Theory*	**MAXWELL EQUATIONS & WAVE PROPAGATION:** [Part -B] Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. (for the slow learners/weaker students = 2 extra class)	06
	PHSGDSE04T *Nuclear Physics*	**General Properties of Nuclei:** [Part B] Main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states. **Nuclear Models:** [Part -A] Liquid drop model approach semi empirical mass formula and significance of its various terms, condition of nuclear stability (for the slow learners/weaker students = 1 extra class)	02 02
May 2024	**PHSACOR13T** *Electro-magnetic Theory*	**EM WAVE PROPAGATION:** [Part -A] Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. [Part -B] Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere	05

		(for the slow learners/weaker students = 1 extra class)	01
	PHSACOR13T *Electro-magnetic Theory*	**Internal Assessment Class test (I) will be taken for Hons. Students**	01
	PHSGDSE04T	**Interaction of Nuclear Radiation with matter :** **Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect** **(for the slow learners/weaker students = 1 extra class)**	04
June 2024	**PHSACOR13T**	**EM WAVE IN BOUNDED MEDIA:** **[Part -A] Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction.**	04
		[Part -B] Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).	03
		Internal Examination & **Class for Slow Learners**	01
	PHSGDSE04T	**Interaction of Nuclear Radiation with matter:** **Compton scattering, pair production, neutron interaction with matter.**	02
within 03.06.2024	**PHSGDSE04T**	**Internal Examination &** **Class for Slow Learners**	01
14.06.2024		**END SEMESTER EXAMINATION**	
Total Classes			**41**

Name of Teacher: Dr. Indranil Bhattacharyya

Paper Allotted: PHSACOR14T (Statistical Mechanics), PHSACOR13P

Month	Paper	Topic	No of classes
March 2024 (02.03.2024)	**PHSACOR14T**	**Macrostate & Microstate, concept of time averaging in a macroscopic measurement. Ergodic hypothesis (statement only). Elementary Concept of Ensemble, Liouville's theorem. Microcanonical ensemble, Phase Space, postulate of equal a priori probability, Entropy and Thermodynamic Probability, Canonical ensemble, Partition Function, Density of states: for ideal gas, for standing waves in a cavity.** **(for the slow learners/weaker students = 1 extra class)**	**10+1=11**
	PHSACOR13P	**1. To verify the law of Malus for plane polarized light.** **2. To determine the specific rotation of sugar solution using Polarimeter.** **3. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.** **[After being demonstrated the Experiments are done by the student groups]**	**8**
April 2024	**PHSACOR14T**	**Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two-Energy Levels System, Negative Temperature. Grand canonical ensemble and chemical potential. Equivalence of microcanonical, canonical and grand canonical ensemble for large systems (qualitative discussion only)** **(for the slow learners/weaker students = 2 extra class)**	**10+2=12**
	PHSACOR13P	**4. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.** **5. To determine the Boltzmann constant using V-I characteristics of PN junction diode** **[After being demonstrated the Experiments are done by the student groups]**	**6**
May 2024	**PHSACOR14T**	**Chemical potential and chemical reaction. Law of chemical equilibrium. Chemical potential for ideal gas, for photon gas. Ionisation potential. Saha's Ionization Formula.** **(for the slow learners/weaker students = 1 extra class)**	**5+1=6**
	PHSACOR13P	**6. To determine the refractive index of liquid by total internal reflection using Wollaston's air film.** **7. To study the reflection, refraction of microwaves** **[After being demonstrated the Experiments are done by the student groups]**	**6**
June 2024	**PHSACOR14T**	**Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Recapitulation of Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) RayleighJeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.**	**6+1=7**
	PHSACOR13P		

Month	Paper	Topic	No of classes
within 03.06.2024		(for the slow learners/weaker students = 1 extra class) For PHSACOR13P the lab classes are provided for the practice of the students.	
within 03.06.2024		Internal Examination & Class for Slow Learners	6
14.06.2024		END SEMESTER EXAMINATION	
Total Classes			62

Name of Teacher: Dr. Ananda Sarkar

Paper Allotted: PHSACOR13T

Month	Paper	Topic	No of classes
March 2024 (02.03.2024)	PHSACOR13T	**Polarization of Electromagnetic Waves:** Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction.	8
April 2024	PHSACOR13T	**Polarization of Electromagnetic Waves:** Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized LightRotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter	10
May 2024	PHSACOR13T	**Wave guides:** Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission. **Problem solving classes.**	10
within 03.06.2024 June 2024		**Internal Examination& Class for Slow Learners**	5
within 03.06.2024 June 2024	PHSACOR13T	**Optical Fibres:** Numerical Aperture. Step and Graded Indices (Definitions Only). Single and Multiple Mode Fibres (Concept and Definition Only). **Problem solving classes.**	4
14.06.2024		**END SEMESTER EXAMINATION**	
Total Classes			37

Name of Teacher: Dr. Saurish Chakrabarty

Paper Allotted: PHSACOR14T: Statistical Mechanics, PHSACOR14P: Statistical Mechanics Lab, PHSGDSE04T: Nuclear and Particle Physics

Month	Paper	Topic	No of classes
March 2024 **(02.03.2024)**	PHSACOR14T	• **System of identical identical particles** ○ **Classical approach and quantum approach: distinguishability and indistinguishability** ○ **Occupation number and Maxwell-Boltzmann distribution** ○ **Emergence of Boltzmann factor** ○ **Composite system postulate** ○ **Symmetry postulate of quantum mechanics** ○ **Bosons and Fermions** ○ **Spin statistics theorem** ○ **Pauli exclusion principle**	7
	PHSACOR14P	• **Two Level System – Maxwell-Boltzmann** • **N-Level System – Maxwell-Boltzmann** • **Quantum harmonic oscillator** • **Fermions in N-Level system**	8
	PHSGDSE04T	• **Detector for Nuclear Radiations** ○ **Basic principles of ionization chamber and GM Counter** ○ **Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT)** ○ **Semiconductor Detectors (Si and Ge) for charge particle and photon detection** ○ **Neutron detector** • **Particle Accelerators** ○ **Linear accelerator**	9
April 2024	PHSACOR14T	• **Bose-Einstein Statistics** ○ **Bose-Einstein distribution law** ○ **Strongly degenerate Bose Gas** ○ **Bose-Einstein condensation** ○ **Properties of liquid He** • **First Internal Assessment**	7
	PHSACOR14P	• **Fermions in a box** • **Bosons in N-Level System** • **Two bosons in three levels** • **First Internal Assessment Examination**	8
	PHSGDSE04T	• **Particle Accelerators (contd.)** ○ **Cyclotron** ○ **Synchrotrons** • **Particle physics** ○ **Particle interactions** ▪ **basic features** ▪ **types of particles and its families** ○ **Symmetries and Conservation Laws** ▪ **Energy and momentum**	9

Month	Paper	Topic	No of classes
		■ **Angular momentum** ■ **Parity**	
May 2024 within 03.06.2024	**PHSACOR14T**	● **Bose-Einstein Statistics (continued)** ○ **Radiation as a photon gas** ○ **Thermodynamic functions of photon gas** ○ **Bose derivation of Planck's law** ○ **Phonon gas** ○ **Debye theory of specific heat of solids – T^3 law** ● **Fermi-Dirac Statistics** ○ **Fermi-Dirac Distribution Law** ○ **Thermodynamic functions of a Completely and strongly Degenerate Fermi gas** ○ **Fermi Energy, Fermi temperature, Fermi momentum** ○ **Sommerfield theory** ● **Internal Assessment Examination**	**8**
	PHSACOR14P	● **Planck's law** ● **Specific heat of solids** ● **Plots of distribution functions – MB, FD, BE** ● **Second Internal Assessment Examination**	**8**
	PHSGDSE04T	● **Particle physics (contd.)** ○ **Symmetries and Conservation Laws (contd.)** ■ **Baryon number** ■ **Lepton number** ■ **Isospin** ■ **Strangeness and charm** ○ **concept of quark model** ○ **color quantum number and gluons.** ● **Internal Examination**	**8**
14.06.2024		**END SEMESTER EXAMINATION**	
Total Classes			**72**

Name of Teacher: Dr. Atanu Nandy

Paper Allotted: PHSADSE06T: Communication Electronics (Theory), PHSADSE06P: Communication Electronics (Lab)

Month	Paper	Topic	No of classes
March 2024 (02.03.2024)	**PHSADSE06T**	● **Electronic communication** ○ **Introduction to communication – means and modes.** ○ **Need for modulation.** ○ **Block diagram of an electronic communication system.** ○ **Brief idea of frequency allocation for radio communication system in India (TRAI).** ○ **Electromagnetic communication spectrum, band designations and usage.**	**8**

		o **Channels and base-band signals.** o **Concept of Noise, signal-to-noise (S/N) ratio.**	
	PHSADSE06P	✓ **To design an Amplitude Modulator using Transistor** ✓ **To study envelope detector for demodulation of AM signal** ✓ **To study FM - Generator and Detector circuit** ✓ **To study AM Transmitter and Receiver** • **[After being demonstrated the Experiments are done by the student groups]**	**10**
April 2024	**PHSADSE06T**	• **Introduction to Communication and Navigation systems** o **Satellite Communication– Introduction, need** o **Geosynchronous satellite orbits** o **Geostationary satellite** o **Advantages of geostationary satellites.** o **Satellite visibility** o **Transponders (C - Band), path loss, ground station** o **Simplified block diagram of earth station.** o **Uplink and downlink.**	**10**
	PHSADSE06P	✓ **To study FM Transmitter and Receiver** ✓ **To study Time Division Multiplexing (TDM)** ✓ **To study Pulse Amplitude Modulation (PAM)** ✓ **To study Pulse Width Modulation (PWM)** • **[After being demonstrated the Experiments are done by the student groups]**	**10**
May 2024	**PHSADSE06T**	• **Mobile Telephony System** o **Mobile Telephony System – Basic concept of mobile communication** o **Frequency bands used in mobile communication** o **Concept of cell sectoring and cell splitting** o **SIM number** o **IMEI number** o **Need for data encryption** o **Architecture (block diagram) of mobile communication network** o **Idea of GSM, CDMA, TDMA and FDMA technologies** o **Simplified block diagram of mobile phone handset** o **2G, 3G and 4G concepts (qualitative only).** o **GPS navigation system (qualitative idea only).**	**10**
	PHSADSE06P	✓ **To study Pulse Position Modulation (PPM)** ✓ **To study ASK, PSK and FSK modulators** • **[After being demonstrated the Experiments are done by the student groups]**	**8**
June 2024 within 03.06.2024	**PHSADSE06T**	**Internal Examination & Class for Slow Learners**	**2**
	PHSADSE06P	**Internal Examination & Class for Slow Learners**	**2**
14.06.2024		**END SEMESTER EXAMINATION**	
Total Classes			**60**

Name of Teacher: Ms. Anamika Das

Paper Allotted: PHSADSE06T - COMMUNICATION ELECTRONICS, PHSADSE06P - COMMUNICATION ELECTRONICS LAB PHSGDSE04T - NUCLEAR AND PARTICLE PHYSICS MECHANICS

Month	Paper	Topic	No. Of classes
March 2024 02.03.2024	**PHSADSE06T**	**Analog Modulation** Amplitude Modulation, modulation index and frequency spectrum. Generation of AM (Emitter Modulation), Amplitude Demodulation (diode detector), Concept of Single side band generation and detection. Frequency Modulation (FM) and Phase Modulation (PM), modulation index and frequency spectrum, equivalence between FM and PM, Generation of FM using VCO, FM detector (slope detector), Qualitative idea of Super heterodyne receiver	**14**
	PHSADSE06P	1. To design an Amplitude Modulator using Transistor 2. To study envelope detector for demodulation of AM signal 3. To study FM - Generator and Detector circuit 4. To study AM Transmitter and Receiver [After being demonstrated the Experiments are done by the student groups]	**10**
	PHSGDSE04T	**Radioactivity decay** (a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) Beta-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion.	**10**
April 2024	**PHSADSE06T**	**Analog Pulse Modulation** Channel capacity, Sampling theorem, Basic Principles- PAM, PWM, PPM, modulation and detection technique for PAM only, Multiplexing.	**10**
	PHSADSE06P	5. To study FM Transmitter and Receiver 6. To study Time Division Multiplexing (TDM) 7. To study Pulse Amplitude Modulation (PAM) 8. To study Pulse Width Modulation (PWM) [After being demonstrated the Experiments are done by the student groups]	**8**
	PHSGDSE04T	**Nuclear Reactions** Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering(Rutherford scattering).	**8**
May 2024	**PHSADSE06T**	**Digital Pulse Modulation** Need for digital transmission, Pulse Code Modulation, Digital Carrier Modulation Techniques, Sampling, Quantization and Encoding. Concept of Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), and Binary Phase Shift Keying (BPSK).	**10**

	PHSADSE06P	9. To study Pulse Position Modulation (PPM) 10. To study ASK, PSK and FSK modulators [After being demonstrated the Experiments are done by the student groups]	8
	PHSGDSE04T	**Interaction of Nuclear Radiation with matter** Energy loss due to ionization (Bethe- Block formula), energy loss of electrons, Cerenkov radiation. Gamma ray interaction through matter, photoelectric effect, Compton scattering, pair production, neutron interaction with matter.	8
within 03.06.2024 June (1st, 2nd week) 2024		**Internal Examination & Class for Slow Learners**	6
14.06.2024		**END SEMESTER EXAMINATION**	
Total Classes			**92**

Name of Teacher: Md Moinul Islam

Paper Allotted: PHSADSE05T

Month	Paper	Topic	No of classes
March 2024 02.03.2024	**PHSADSE05T**	**The sun and solar family:** The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics (Helioseismology). The solar family (Solar System: Facts and Figures, Origin of the Solar System: The Nebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets. Stellar spectra and classification Structure (Atomic Spectra Revisited, Stellar Spectra, Spectral Types and Their Temperature Dependence, Black Body Approximation, H R Diagram, Luminosity Classification). Main sequence, red giants and white dwarfs, Chandrashekhar mass limit.	12
April 2024	**PHSADSE05T**	**The milky way:** Basic Structure and Properties of the Milky Way, Nature of Rotation of the Milky Way (Differential Rotation of the Galaxy and Oort Constant. Rotation Curve of the Galaxy and the Dark Matter, Nature of the Spiral Arms), Stars and Star Clusters of the Milky Way,	12
May 2024	**PHSADSE05T**	**The milky way:** Properties of and around the Galactic Nucleus. **Galaxies:** Galaxy Morphology, Hubble's Classification of Galaxies. Elliptical Galaxies (The Intrinsic Shapes of Elliptical, de Vaucouleurs Law, Stars and Gas). Spiral and Lenticular Galaxies (Bulges, Disks, Galactic Halo). The Milky Way Galaxy, Gas and Dust in the Galaxy, Spiral Arms.	12

		Large scale structure & expanding universe: Cosmic Distance Ladder (An Example from Terrestrial Physics, Distance Measurement using Cepheid Variables)	
within 03.06.2024 June (1st, 2nd week) 2024		**Internal Examination & Class for Slow Learners**	**5**
	PHSADSE05T	**Physical principles: Gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.**	**4**
	PHSADSE05T	**Large scale structure & expanding universe: Hubble's Law (Distance- Velocity Relation), Clusters of Galaxies (Virial theorem and Dark Matter).**	**7**
14.06.2024		**END SEMESTER EXAMINATION**	
Total Classes			**74**