Department of Physics

w.e. f. Session 2015-16

M.Sc. PHYSICS

INTEGRAL UNIVERSITY, LUCKNOW (2015-16)

Evaluation Scheme

Semester-III

SL. No	COURSE CODE	COURSE TITLE	Type of Paper	L	T	P	Evaluation Scheme				Subject Total	Credit	Total Credit
							CT	TA	Total	ESE			
THEORY													
1	PY 501	Atomic and Molecular Physics	Core	3	1	0	15	10	25	75	100	3:1:0	4
2	PY 502	Electronics Instrumentation	Core	3	1	0	15	10	25	75	100	3:1:0	4
3	PY 503	Advanced Condensed Matter Physics	Core	3	1	0	15	10	25	75	100	3:1:0	4
4	PY 504	Communication Electronics	Core	3	1	0	15	10	25	75	100	3:1:0	4
5	PY 505	Numerical techniques & Statistical Mechanics-II	Core	3	1	0	15	10	25	75	100	3:1:0	4
PRACTICALS													
6	PY 506	Electronics Lab	Core	0	0	9	15	10	25	75	100	0:0:4	4
		Total		15	5	9	90	60	15	450	600	24	24

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Paper-1 Atomic and Molecular Physics

PY 501 **L T P**
3 1 0

Unit 1 Atomic Physics-I 08

Quantum Mechanical Treatment of one-electron Atom, Spin-Orbit interaction and fine structure of hydrogen atom, Spectra of alkali elements. Singlet and triplet States of Helium,

Unit 2 Atomic Physics-II 08

Many electron atoms: Central field approximation, Thomas-Fermi field, Atomic wave function, Hartree and Hartree –Fock approximations, Spectroscopic Terms: L S and J J coupling schemes for many electron atoms, wave functions and energies of multiplets, Electric dipole and Electric Quadrupole.

Unit3 Molecular Physics 08

Born - Oppenheimer approximation, Heitler-London theory of H_2, LACO treatment of H_2^+ and H_2. Classification of Molecules, Types of Molecular Spectra and Molecular Energy States: Pure Rotational Spectra, Vibrational-Rotational Spectra, Raman Scattering, Selection rules, Nuclear spin and intensity alternation, Isotope effect, Classification of electronic states, Coupling of rotational and electronic motions, Electronic spectra: Franck-Condon principle.

Unit 4 08

Infrared Spectroscopy, Raman spectroscopy, Photoelectron Spectroscopy, Nuclear Magnetic Resonance, Chemical Shift, and Electron Spin Resonance (Introduction and their principles only).

Unit5 Spectroscopic Techniques 08

General description and working of infra-red Spectrophotometer, Photoelectron Spectrometer, Simple Raman Spectrometer, NMR Spectrometer and ESR Spectrometer.

Text and Reference Books:

1. Introduction to atomic spectra by H.E. White
2. Spectra of diatomic molecules by Herzberg
3. Atoms and molecules by M. Weissbluth
4. Quantum theory of Atomic Structure Vol I by Slater
5. Quantum theory of molecules and Solids by Slater
6. Fundamentals of molecular spectroscopy by C. B. Banwell
7. Introduction to molecular spectroscopy by G. M. Barrow
8. Molecular spectroscopy by Jeanne L. McHale
9. Molecular spectroscopy by J. M. Brown
10. Spectra of atoms and molecules by P.F. Bemath
11. Modern spectroscopy by J.M. Holias

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Paper-2 Electronic Instrumentation

PY 502 **L T P**
3 1 0

Unit1 Signal representation & generation 08

Periodic signals, modulated signals (A.M.F.M.P.M.), sampled data pulse Modulation (PWM, PAM, PPM) definition and their graphical representation. Generation of sine, Square, triangular, linear ramp & saw tooth waveform.

Unit2 Measurement of electrical signals 08

Meters: comparison of analog & digital meters, moving coil, moving iron, electrodynamics, Induction meter, clamp on meter. CRO: Block diagram of general purpose CRO, Detail study of CRT, Dual beam oscilloscope, How CRO displays waveform, various methods of measurement of voltage, current, resistance, frequency, phase, capacitance & inductance.

Unit3 Signal Processing Circuit 08

Electronic amplifiers: Difference or balance amplifier, Operational amplifier, Instrumentation amplifier, Charge amplifier, Power amplifier. passive & active filters. Butter worth filter (low pass, High pass, band pass), Notch filter.

Unit4 Data Acquisition conversion, processing & transmission system 08

General DAS, signal conditioning of inputs, single channel DAS multichannel DAS,R-2R ladder Network, successive approximation type ADC, Analog & digital multiplexer, Sample and hold Circuit. Data transmission system. Telemetry system Block diagram, Characteristics, Land line Telemetry, Radio telemetry, Processing system.

Unit5 Applications of electronic system 08

Frequency selective wave analyzer, Spectrum analyzer, Lock-in amplifier, Fiber optic sensors. Measurement of Humidity, Hygrometers, Measurement of pH, Measurement of thermal Conductivity (gas analyzer), Nuclear instrumentation-types of radiation, Geiger-muller tube, ionization chamber. Flow meters: Classification, working principle, electromagnetic flow meter, Ultrasonic flow meter. Q Meter- principle, working & applications. DFM-Block diagram, principle & working. DMM Block diagram, principle & working.

Reference Books:

1. Transducers& Instrumentation: D.V.S.Murthy.
2. Instrumentation-Devices &system: C.S.Rangan,G.R.Sharma,V.S.V.Mani.
3. Principles of measurement and Instrumentation : Alan S.Morris.
4. Electronic Instrumentation: Kalsi
5. Electrical & electronic measurement Instrumentation: A.K.Sawhney.
6. Modern electronic instrumentation & measurement Technique: Helfrick Cooper.

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Paper-3 Advanced Condensed Matter Physics

PY 503 **L T P**
3 1 0

UNIT 1 Dielectrics and Ferroelectrics:

Macroscopic electric fields, local field at an atom, dielectric constant and polarizability, ferroelectricity, antiferroelectricity, phase transition, piezoelectricity, ferroelasticity, electrostriction.

UNIT 2 Optical properties of materials:

Optical constants, Kramers-kroning relations, polarons, excitons. Electronic interband and intraband transitions, relation between optical properties and band structure, reflectance, diffraction, dispersion, photoluminescence, electroluminescence, screening, plasmons.

UNIT 3 Magnetism:

Diamagnetism (including Landau diamagnetism) and Paramagnetism including van Vleck and Langevin paramagnetism), Exchange interaction of free electrons, Ferromagnetism, super exchange, double exchange, Antiferromagnetism, Neel temperature, spin-waves, Bloch wall, Bloch-$T^{3/2}$ Law, anisotropy energy, Landau levels, Degeneracy.

UNIT 4 Superconductivity:

Fundamental phenomena of superconductivity, Meissner effect, London equation, Type I and type II superconductors. Ginsburg-Landau Theory, Coopers pairing and BCS theory. BCS wavefunctions, Josephson Effect, SQUIDS. Weakly interacting Bose gas, Superfluidity.

UNIT 5 Atomic Imperfections in Solids:

Point imperfection in ionic crystals, Line imperfection, Edge and Screw dislocation, Burgers vector and Burger's circuit, Dislocation motion, Energy of dislocation, Slip planes and slip directions, Perfect and imperfect dislocations, Dislocation reaction, Surface imperfections, Grain boundary, Tilt and Twist boundary.

References:

1. N.W. Ashcroft and N.D. Mermin, *Solid State Physics.*
2. D. Pines, *Elementary Excitations in Solids.*
3. S. Raimes, *The Wave Mechanics of Electrons in Metals.*
4. P. Fazekas, *Lecture Notes on Electron Correlation and Magnetism.*
5. M. Tinkham, *Introduction to Superconductivity.*
6. M. Marder, *Condensed Matter Physics.*

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Paper-4 Communication Electronics

PY 504 **L T P**
3 1 0

Unit 1 Microwave Devices 08

Klystrons amplifiers, velocity modulation, Basic principles of two cavity klystrons, Multicavity klystron amplifier and Reflex klystron oscillator, Magnetrons, principles of operation of magnetrons and Travelling wave tube (TWT). Transferred electron devices, Gun effect, Principles of operations, modes of operation, Readdiode, IMPATT diode, and TRAPATT diode.

Unit 2 Amplitude Modulated Systems 08

Frequency translation, method of frequency translation, recovery of the base band signal, Amplitude modulation, Maximum allowed modulation, The square law demodulation, Spectrum of an amplitude modulated signal, Modulators and Balanced modulators, Single side band modulation, Methods of generating as SSB signal, Vestigial side band modulation, Multiplexing.

Unit 3 Frequency Modulated Systems 08

Angle modulation, Phase and frequency modulation, Relationship between phase and frequency modulation, Phase and frequency deviation, Spectrum of an FM signal, Sinusoidal modulation, Bandwidth of a sinusoidally modulated FM signal, FM generation, Parameter variation method, Armstrog system.

Unit 4 Transmission and Radiation of signals 08

Primary line constants, phase velocity and line wavelength, Characteristic impedance, Propagation Coefficient, Phase and group velocities, Standing waves, Lossless line at radio frequencies, Voltage standing wave ratio, Slotted line measurements at radio frequencies, Transmission lines as circuit elements, Smith chart, Single and double Stub matching, Time domain reflectometry, Telephone lines and cables, Radio frequency lines.

Unit 5 Fiber optic communications 08

Light sources for optical communication, Optical Receivers, Modes in Optical fiber, Optical communication system, Losses in fibers, Dispersion in fiber, Power Budgeting, S/N ratio, Effect of index profile on propagation, TDM, WDM.

Text and Reference Books

1. Electronic Devices and circuit Theory by R. Boylested and L. Nashdsky
2. Principles of Communication Systems by H. Taub and Donald L. Schilling
3. Optoelectronics: Theory and Practice, Edited by Alien Chappal
4. Microwaves by K.L. Gupta
5. Electronic communications by Dennis Roddy and John Coolen

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Paper-5 Numerical Techniques & Statistical Mechanics-II

PY 505 **L T P**
3 1 0

Unit1 Numerical Analysis 08

Data interpretation and analysis, Precision and accuracy, Error analysis, propagation of errors, least square fitting, linear and non linear curve fitting, goodness of fit, chi-square test.

Unit2 Statistical Techniques 08

Elements of computation techniques; root of functions, interpolation, extrapolation, Newton's forward and backward interpolation, Lagrange's interpolation formula, integration by trapezoidal and Simpson's rules, Solution of first order differential equation using Runge-Kutta method, Finite difference method, Lagrange's method of undetermined multipliers.

Unit3 Phase Transitions and Critical Phenomena 08

Coexistence of phases, Gibb's phase rule, classification of phase transitions, critical phenomena and critical exponents, Landau theory, scaling hypothesis, universality classes phase transition of Vander Waal's gas, phase transition in liquid He, second, third and fourth sounds, Tisza two fluid model, Landau's spectrum of phonons and rotons.

Unit4 Dynamical Models of phase transitions 08

Heisenberg model, mean-field theory, Ising model in 1D, exact solution in one dimension, renormalization in one dimension, order disorder transformation in alloys, structural phase change, lattice gas.

Unit5 Non-equilibrium Systems & Time correlation functions 08

Systems out of equilibrium, approach to equilibrium and the H-theorem, thermodynamics of fluctuations, fluctuation-dissipation theorem, Fokker-Planck equation, Onsager relations, statistical correlation, correlation length, spatial and spin-spin correlation.

References:

1. K. Huang, *Statistical Mechanics.*
2. R.K. Pathria, *Statistical Mechanics.*
3. E.M. Lifshitz and L.P. Pitaevskii, *Physical Kinetics.*
4. D.A. McQuarrie, *Statistical Mechanics.*
5. L.P. Kadanoff, *Statistical Physics: Statistics, Dynamics and Renormalization.*
6. P.M. Chaikin and T.C. Lubensky, *Principles of Condensed Matter Physics.*

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PY 506: Electronics Lab

Students assigned the general laboratory work will perform at least eight (08) experiments of the following: (04 from each unit)

Unit A

1. Temperature to frequency conversion using a thermister and astable multivibrator circuit.
2. Operational Amplifier characteristics using IC 741.
3. Capacitance measurement using IC 555.
4. Experiments on MUX, DEMUX, Decoder and shift register.
5. JK Flip-Flop and up-down counter.
6. Fiber optic communication.

Unit B

1. A/D converter interfacing and AC/DC voltage / current measurement using microprocessor 8085/8086.
2. PPI 8251 interfacing with microprocessor for serial communication.
3. D/A converter interfacing and frequency / temperature measurement with microprocessor 8085 / 8086.
4. Program of 8085/ 8086 to solve a Boolean Equation which rep. Combinational logic.
5. Arithmetic operations using microprocessors 8085 / 8086.