Department of Physics

w.e. f. Session 2015-16

M.Sc. PHYSICS

INTEGRAL UNIVERSITY, LUCKNOW (2015-16)

Evaluation Scheme

Semester-IV

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		Elective-I	Elective-I	3	1	0	15	10	25	75	100	3:1:0	4
2		Elective-II	Elective-II	3	1	0	15	10	25	75	100	3:1:0	4
3	PY 507	Physics Seminar		0	1	3	0	0	0	100	100	0:0:4	4
4	PY 508	Physics Project		Three months			300				300	0:0:8	8
		Total		6	3	3	30	20	50	550	600	20	20

List of Elective papers for IV semester

Note: A student has to choose any two elective papers from following electives.

1. PHYSICS OF NANOMATERIALS PY 509
2. BIO-PHYSICS PY 510
3. COMPUTATIONAL METHODS AND PROGRAMMING IN 'C' LANGUAGE PY 511
4. LASER PHYSICS PY 512
5. Microprocessor and its Applications PY 513
6. RENEWABLE ENERGY RESOURCES PY 514

Department of Physics

w.e. f. Session 2015-16

Elective 01 Physics of Nanomaterials

PY 509 **L T P**
3 1 0

Unit 1 Introduction to Nonostructure Materials 08

Nanoscience & nanotechnology , Size dependence of properties, Moor's law, Surface energy and Melting point (quasi melting) of nanoparticles,

Unit 2 Band structure of solids 08

Free electron theory (qualitative idea) and its features, Idea of band structure, insulators, semiconductors and conductors, Energy band gaps of semiconductors, Effective masses and Fermi surfaces, Localized particles, Donors, Acceptors and Deep traps, Mobility, Excitons, Density of states, Variation of density of states with energy and Size of crystal.

Unit 3 Quantum Size Effect 08

Quantum confinement, Nanomaterials structures, Two dimensional quantum system, Quantum well, Quantum wire and Quantum dot, Fabrication techniques.

Unit 4 Characterization techniques of Nanomaterials 08

Determination of particle size, XRD (Scherrer's formula), Increase in width of XRD peaks of nanoparticles, Shift in absorption spectra peak of nanoparticles, Shift in photoluminescence peaks, Electron Microscopy: Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Scanning Probe Microscopy (SPM), Scanning Tunneling Electron Microscopy (STEM), and Atomic Force Microscopy (AFM).

Unit 5 Synthesis of Nanomaterials 08

Key issue in the synthesis of Nanomaterials, Different approaches of synthesis, Top down and Bottom up approaches, Cluster beam evaporation, Ball Milling, Chemical bath deposition with capping agent, Carbon nanotubes (CNT)- Synthesis, Properties and Applications.

Text and References Books

1. Nanostructures & Nanomaterials, Synthesis, Properties & Applications by Guozhong Cao, Imperial College Press.
2. Introduction to Nanotechnology, by Charles P. Poole, Jr. Frank J. Owens, John Wiley & Sons Inc. Publication.
3. Quantum Wells, Wires and Dots by Paul Harrison, John Wiley & Sons Ltd.
4. Quantum Dot Hetrostructures, by D. Bimberg, M. Grundman, N.N. Ledenstov.
5. Introduction to Nanoscience and Nanotechnology by Hornyak G.L., Tibbals H.F., Dutta J., Moore J.J., CRC Press.
6. Carbon Nanotechnology by Liming Dai
7. Carbon Nanotubes: Properties and Applications by Michael J. O'. Connell.

Department of Physics

w.e. f. Session 2015-16

Elective 02 Biophysics

PY 510 **L T P**
3 1 0

Unit1 Physics of Polymers & Polyelectrolytes 08

Evolution of biosphere, aerobic and anaerobic concepts, models of evolution of living organisms. Nomenclature, definitions of molecular weights, polydispersity, degree of polymerization, possible geometrical shapes, chirality in biomolecules, structure of water and ice, hydrogen bond and hydrophobocity. Concepts and examples, Debye-Huckel theory, screening length in electrostatic interactions.

Unit2 Static Properties 08

Random flight model, freely-rotating chain model, scaling relations, concept of various radii (i.e., radius of gyration, hydrodynamic radius, end-to-end length), end-to-end length distributions, concept of segments and Kuhn segment length, excluded volume interactions and chain swelling, Gaussian coil, concept of theta and good solvents with examples, importance of second virial coefficient.

Unit3 Transport Properties (a) Diffusion: 08

Irreversible thermodynamics, Gibbs-Duhem equation, phenomenological forces and fluxes, osmotic pressure and second virial coefficient, generalized diffusion equation, Stokes-Einstein relation, diffusion in three-component systems, balance of thermodynamic and hydrodynamic forces, concentration dependence, Smoluchowski equation and reduction to Fokker-Planck equation, concept of impermeable and free-draining chains.

(b) Viscosity and Sedimentation: Einstein relation, intrinsic viscosity of polymer chains, Huggins equation of viscosity, scaling relations, Kirkwood-Riseman theory, irreversible thermodynamics and sedimentation, sedimentation equation, concentration dependence.

Unit4 Physics of Proteins 08

Nomenclature and structure of amino acids, conformations of polypeptide chains, primary, secondary and higher-order structures, Ramachandran map, peptide bond and its consequences, pH-pK balance, protein polymerization models, helix-coil transitions in thermodynamic and partition function approach, coil-globule transitions, protein folding, protein denaturation models, binding isotherms, binding equilibrium, Hill equation and Scatchard plot.

Unit5Physics of Enzymes & Nucleic Acids 08

Chemical kinetics and catalysis, kinetics of simple enzymatic reactions, enzyme-substrate interactions, cooperative properties. Structure of nucleic acids, special features and properties, DNA and RNA, Watson-Crick picture and duplex stabilization model, thermodynamics of melting and kinetics of denaturation of duplex, loops and cyclization of DNA, ligand interactions, genetic code and protein biosynthesis, DNA replication.

References:

1. M.V. Volkenstein, *General Biophysics.*
2. C.R. Cantor and P.R. Schimmel, *Biophysical Chemistry Part III: The Behavior of Biological Macromolecules*.
3. C. Tanford, *Physical Chemistry of Macromolecules.*
4. S.F. Sun, *Physical Chemistry of Macromolecules: Basic Principles and Issues.*

Department of Physics

w.e. f. Session 2015-16

Elective 03 Computational methods & programming in 'C' language

PY 511 **L T P**
3 1 0

Unit 1 08

Computational methods: Methods for determination of zeros of linear and nonlinear algebraic equations and transcendental equations, Bisection method, Muller's method, Quotient-difference method, Newton-Raphson method Solution of simultaneous linear equations, consistency of a system of linear equation, Gaussian elimination, LU decomposition method, matrix inversion, Jacobi iterative method, Gauss-Seidel method, convergence of Gauss-Seidel method

Unit 2 08

Diagonalization of matrices, Eigen values and eigenvectors of matrices, Power and Jacobi method. Finite differences, Newton's formula for interpolation, Gauss, Stirling, Bessel's, Everett's formulae, Divided differences, Newton's general interpolation formula, Lagrange's interpolation formula.

Unit 3 08

Numerical differentiation, Numerical integration, Trapezoidal rule, Simpson 1/3and 3/8 rules, Boole's and waddles rules, Newton-Cote's formula, Euler- Maclaurin formula, Gauss quadrature formula. Method of Least square curve fitting, straight line and quadratic equation fitting, curve fitting of curves $y = ax^b$, $y = ae^{bx}$, $xy^a = b$ and $y = ab^x$, curve fitting by sum of exponentials, data fitting with cubic splines.

Unit 4 08

Numerical solution of ordinary differential equations, Euler, Picard and Runge- Kutta methods, Predictor and corrector method, elementary ideas of solutions of partial differential equations, solution of Laplace equation

Unit 5 08

Programming: elementary information about digital computer principles, compilers, interpreters and operating systems, Fortran programming, flow charts, integer and floating point, arithmetic expressions, built in functions, executable and non executable statements, IF statements, GO TO statements, DO loop and implied DO loop, simple computer programmes.

Text and References Books

1. Introductory Methods of Numerical analysis by S. S. Shastri Numerical Analysis by Rajaraman.
2. Numerical Methods by E. Balagurusamy.
3. Fortran Programming by Rajaraman.
4. Numerical methods for scientific & Eng. Computatioans by Jain, Iyengar.

Department of Physics

w.e. f. Session 2015-16

Elective 04 Laser Physics

PY 512 **L T P**
3 1 0

Unit1 Introduction 08

Masers versus lasers, components of a laser system, amplification by population inversion, oscillation condition, types of lasers: solid-state (Ruby, Nd: YAG, semiconductor), gas (He-Ne, CO_2 and Excimer), liquid (organic dye) lasers.

Unit2 Atom-Field Interactions 08

Lorentz theory, Einstein's rate equations, applications to laser transitions with pumping, two, three and four-level schemes, threshold pumping and inversion.

Unit3 Optical Resonators 08

Closed versus open cavities, modes of a symmetric confocal optical resonator, stability, quality factor.

Unit4 Coherence & Pulsed Operation of Lasers 08

Concepts of coherence and correlation functions, coherent states of the electromagnetic field, minimum uncertainty states, unit degree of coherence, Poisson photon statistics. Q-switching, electro-optic and acousto-optic modulation, saturable absorbers, mode- locking.

Unit5 Applications of Lasers 08

Introduction to atom optics, Doppler cooling of atoms, introduction to nonlinear optics: self-(de) focusing, second-harmonic generation (phase-matching conditions).

References:

1. K. Thyagarajan and A.K. Ghatak, *Lasers: Theory and Applications.*
2. A.K. Ghatak and K. Thyagarajan, *Optical Electronics.*
3. W. Demtroeder, *Laser Spectroscopy.*
4. B.B. Laud, *Lasers and Nonlinear Optics.*
5. M. Sargent III, M.O. Scully and W.E. Lamb, Jr., *Laser Physics.*
6. M.O. Scully and M.S. Zubairy, *Quantum Optics.*
7. P. Meystre and M. Sargent III, *Elements of Quantum Optics.*
8. L. Mandel and E. Wolf, *Optical Coherence and Quantum Optics.*

Department of Physics

w.e. f. Session 2015-16

Elective 05 Microprocessor and its applications

PY 513 **L T P**
3 1 0

Unit1 The 8086 Microprocessor 08

Register organization of 8086, 8086 Architecture, Pin configuration, Physical Memory organization, General bus operation, I/O address capability, Special purpose activities, minimum and maximum mode of 8086 systems with timings.

Unit2 Instruction set of 8086 and programming 08

Addressing modes of 8086, Instruction set of 8086, Assembler directives and operators. Simple programs like addition of two numbers, BCD addition, find the largest number, addition of two 3 x 3 matrices, move the string of data, find the number of positive numbers and negative numbers from, a given series of signed numbers etc.

Unit3 Special Architectural features 08

Stack structure of 8086, Interrupts and interrupt service routine, Interrupt programming, Macros (Programming is not expected).

Unit4 Programmable Peripheral Devices and their Interfacing 08

(i) Programmable peripheral interface 8255.
(ii) Programmable Communication interface 8251 USART.
(iii) Programmable DMA interface 8257.
(iv) Programmable interrupt Controller 8259.

Unit5 32 bit Processor 08

Features of 80386, 80486, 80586 (Pentium), MMX (Multimedia Extension).

Reference Books:

1. Advance Microprocessor and Peripherals: A. K. Ray, K. M. Bhurchandi., Tata McGraw Hill, New Delhi.
2. Microprocessor and Interfacing: Dauglas V.Hall, McGraw Hill International Edition.
3. Architecture, Programming and Design: Yu Cheng Liu, G.A. Gibson, 2nd Edition. PHI Publications.

Department of Physics

w.e. f. Session 2015-16

Elective 06 Renewable Energy Resources

PY 514 **L T P**
3 1 0

Unit1 Solar Energy 08

Solar Energy conversion systems and their applications, Fundamentals of photovoltaic energy conversion, Principles of photo voltaic cell, Materials and fabrication technologies of P.V cell, P. V. Systems: configuration, output power and conversion efficiency, Basic P.V. system for power generation, Applications and limitations of P.V. systems.

Unit2 Biomass Energy Conversion Technologies 08

Origin of biomass, Biomass energy resources, Biomass energy conversion processes, generation of gaseous fuels from biomass, digesters and their designs, Energy from Cereals, grains, sugar, fruits, starch etc.

Unit3 Wind Energy & Ocean Energy 08

Introduction to wind energy, Nature & Origin of winds, Power in a wind stream, principles and basic components of wind mill, Efficiency of wind turbine, horizontal and vertical axis wind mills, performance of wind mills, merits and limitations of wind energy conversions. Ocean as the potential energy resource: various ocean energy conversion technologies, Introduction to OTEC, Principle of OTEC, Ocean waves, energy and power from ocean waves, origin of tidal energy, Tidal energy conversion, tidal energy conversion schemes.

Unit4 Geothermal Energy 08

Geothermal energy as a renewable source of energy, Types of geothermal resources, Origin of geothermal resources, Hydro geothermal, Geopressure geothermal and Petro geothermal resources, Basics of geothermal electric power plant.

Unit 5 Emerging trends in Renewable Energy sources 08

Fuel Cells: Principle and operation of fuel cell, classification and types of fuel cells, Phosphoric acid fuel cell (PAFC), Alkaline fuel cell (AFC), Molton carbonate fuel cell (MCFC), Solid oxide fuel cell (SOFC), Fuels for fuel cells, Performance characteristics of fuel cells, Practical fuel cell power plant. **Hydrogen Energy:** Hydrogen as clean source of energy, sources Production, storage, Use of hydrogen as fuel, conversion to energy, Applications. **Magneto hydrodynamics Energy:** MHD generator, Basic principle,(H-12 M-20)

Reference Books:

1. Energy Technology Non-Conventional, Renewable and Conventional, S. Rao, Dr. B. B. Parulekar, Khanna Publications, 3rd Ed, 2005
2. Non-Conventional Energy Sources, G. D. Rai, Khanna Publications, 2000
3. Solar Energy Utilisation, G.D.Rai, Khanna Publishers (1996)
4. Non-Conventional Energy Resources, Khan B. H., Tata McGraw Hill. 2006
5. Solar Energy Conversion, S. P. Sukhatne(2nd editions)
6. Solar Cells M.A.Green
7. Hydrogen as an Energy carrier Technologies systems Economy-Winter & Nitch
8. Solar Energy Conversion – A. E. Dixnon & J. D. Leslie.
9. Biomass Energy – S.H.Pawar, L.J.Bhosale, A.B.Sabale, S.K.Goel.