INTER-UNIVERSITY ACCELERATOR CENTRE

Aruna Asaf Ali Marg, New Delhi - 110067

website: www.iuac.res.in

Course Schedule
Winter Semester, January 2020 - May 2020
Advanced Condensed Matter Physics, Advanced Nuclear Physics, Computational Techniques

Inter-University Accelerator Centre (IUAC) conducts specialized lecture courses for PhD (Physics) Programme at the Centre. The programme is divided into four periods with each period having two / three course modules. Students doing PhD (Physics) and interested young faculty members from any University, College or Research Institute pursuing PhD (Physics) Degree may attend the lectures for the modules of their interest. The minimum qualification required to attend the course work is M.Sc. in Physics. Some financial assistance towards travel and accommodation will be available for a limited number of cases. Typically number of scholars per course ranges from 7 to 15. Those interested may apply with their bio-data, research interest & a recommendation letter (which is compulsory) from their PhD Guide / Supervisor / HOD, and send / email to:

Coordinator (Teaching Programme)
INTER-UNIVERSITY ACCLERATOR CENTRE
Aruna Asaf Ali Marg,
New Delhi - 110067

Tel: 011-24126022 / 24 / 25 / 26 / 29

E-mail: academic@iuac.res.in

Period		Course Module		Lecturer
1	20st Jan. - 14th Feb., 2020	622A	Properties of Solids	Prof. Subhasis Ghosh, JNU
		624A	Nuclear Models-I	Dr. S. Muralithar, IUAC
		628A	Computational & Programming Techniques	Dr. J. Antony, IUAC
2	17th Feb. – 13th Mar., 2020	622B	Ion Beam Induced Modifications of Solids	Dr. Ambuj Tripathi, IUAC
		624C	Nuclear Reactions	Dr. Subir Nath, IUAC
		628B	Numerical analysis	Mr. Sugam Kumar, IUAC
3	23th Mar. – 17th Apr., 2020	622C	Thin Solid Films: Nucleation, Growth & Characterization	Prof. V.D. Vankar, Ex-IIT Delhi
		624B	Nuclear Models-II	Dr. R.P. Singh, IUAC
4	20nd Apr. – 15th May, 2020	622D	Experimental Techniques in Solid State Physics Research	Dr. D. Kabiraj, IUAC
		624D	Heavy Ion Reactions	Dr. N. Madhavan, IUAC

622 ADVANCED CONDENSED MATTER PHYSICS

622A PROPERTIES OF SOLIDS: Basic condensed matter physics; band theory of solids, impurities and defects in solids. Magnetic properties of materials; dia-, para-, ferro-, antiferro- and ferri-magnetism; soft and hard magnetic materials; Dielectric properties, piezo, pyro and ferroelectricity. Transport properties and Optical properties of solids: metals, insulators and semiconductors: intrinsic and extrinsic.

622B ION BEAM INDUCED MODIFICATIONS OF SOLIDS: Interaction of an energetic charged particle with matters; local density approximation in stopping power theory, electronic stopping cross section; Nuclear energy loss, energy transfer and simulation of range distribution by Monte-Carlo methods; Basic ion beam simulation programs, SRIM, limitations and modifications, Ion implantation, radiation damage and structure change; sputtering, phase transformations; Ion beam mixing; diffusion by vacancies, self-diffusion and impurity diffusion, impurity incorporation; Ion induced epitaxial crystallization, artificially struc - tured materials, buried layers and band structural engineering for new functional devices. Modification of superconducting properties; columnar defects, effects on critical current density.

622C THIN SOLID FILMS: NUCLEATION, GROWTH & CHARACTERIZATION: Homogeneous nucleation of films, critical radius, nucleation rate; Growth modes, island growth, zone models, columnar growth; Thin film deposition methods; Evaporation, point and surface sources; Sputtering: DC, RF; CVD techniques, reaction types, boundaries and flow, PLD, MBE for epitaxial films; Basic characterization; thickness, refractive index, and extinction coefficients measurement, optical and stylus based techniques; spectroscopic reflectance versus ellipsometry.

622D EXPERIMENTAL TECHNIQUES IN SOLID STATE PHYSICS RESEARCH: Basic characterization tools, Structural techniques, XRD; Microscopic measurements, SEM, TEM; analytical attachments EDS, SPM for topographic measurements with variants AFM, STM, MFM, STS; Spectroscopic techniques, Raman, Photoluminiscence, Ionoluminiscence; XPS, Transport measurements, van der Pauw method, two and four probe technique; Hall measurement, carrier density and mobility.

624 ADVANCED NUCLEAR PHYSICS

624A NUCLEAR MODELS-I: Two body forces, Infinite nuclear matter, Effective interactions (pairing + Quadrupole, Skyrme etc.). Single particle motion, Shell model with configuration mixing, Nilsson model, Strutinsky and shell corrections, experimental techniques in nuclear models.

624B NUCLEAR MODELS-II: Liquid drop model and collective motion, Rotation and vibration with particle coupling, Cranking models, Hartree-Fock models, Hartree-Fock Bogoliubov and quasi particles, Pairing and BCS equations.

624C NUCLEAR REACTIONS: Kinematics, optical model of elastic scattering, direct and compound nuclear reactions, nucleosynthesis in nuclear reactions, Hauser-Feshback description of compound nuclear reactions, inelastic scattering and transfer re - actions and their descriptions in distorted-waves Born Approximation and in coupled channels formalism, resonances (Isobaric Analogue, Giant and Molecular) break-up reactions.

624D HEAVY ION REACTIONS: Special features of heavy ions scattering (Q-and L-window), semi classical models, deflection functions, rainbow and Glory scattering, quasi elastic and transfer reactions, deep inelastic scattering, complete and incomplete fusion, fission.

628 COMPUTATIONAL TECHNIQUES

628A COMPUTATIONAL & PROGRAMMING TECHNIQUES: Basic concepts, microprocessors, standard buses, operating systems, multitasking, networking, Ethernet TCP/IP. Basic structure of a program, data structures, object oriented programming, optimization of program, introduction to C and Python.

628B NUMERICAL ANALYSIS: Errors - systematic & random, Mean & standard deviations, statistical distributions, propagation of errors, least square fit - straight line, polynomials, goodness of fit-chi-squared, errors in fitted parameters & reliability. Interpolations, numerical integration and differentiation, matrix inversion and diagonalization, solution of linear and non-linear equations, solution of ordinary differential equations, concept of Monte-Carlo method. Introduction to numerical analysis package (MATLAB or equivalent).