INTER-UNIVERSITY ACCELERATOR CENTRE

Aruna Asaf Ali Marg, New Delhi-110 067 | Website: www.iuac.res.in

Course Schedule

Monsoon Semester-I August 2020 - December 2020
Advanced Classical & Quantum Mechanics, Experimental Physics, Accelerator Physics

Inter-University Accelerator Center (IUAC) conducts specialized lecture courses for PhD (Physics) Programme at the center. The programme is divided into five periods with each period having two / three courses 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. Considering the safety of all concerned, the courses will be taught 'online' as per requirement.

The minimum qualification required to attend the course work is M.Sc. (Physics). Some financial assistance towards travel and accommodation will be available for a limited number of cases. Those interested may apply with their bio-data, research interest and a recommendation letter (which is compulsory) from their PhD Guide Supervisor, 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.	17th Aug. – 11th Sept., 2020	611B	Advanced Quantum Mechanics	Prof. Hari Prakash, Ex University of Allahbad
		626A	Ion Sources	Dr G. Rodrigues, IUAC
2.	14th Sept. – 2nd Oct., 2020	617A	Detectors & Transducers	Dr Akhil Jhingan, IUAC
		626B	Accelerators and their Applications	Dr P.K. Kulriya, IUAC
3.	5th Oct. – 30th Oct., 2020	617B	Signal Processing	Dr. Kundan Singh, IUAC
		617C	Vacuum Techniques	Mr. Ashok Kothari, IUAC
		626C	Beam Optics and Beam Transport	Mr. Rajeev Mehta, IUAC
4.	2th Nov. – 20th Nov., 2020	617D	Data Acquisition System	Dr Ambar Chatterjee, Ex BARC, Mumbai
		626D	Cryogenics and Superconductivity	Dr. Soumen Kar, IUAC
5.	30th Nov. – 25th Dec., 2020	611A	Advanced Classical Mechanics	Prof. O.S.K.S. Sastri, Central Univ. of HP
		617E	Engineering Drawing	Mr. Kishore Kr Mistri, IUAC

COURSE CONTENT

611 ADVANCED CLASSICAL & QUANTUM MECHANICS

611A ADVANCED CLASSICAL MECHANICS: Particle motion in 1, 2 & 3 dimensions; conservation laws; non-inertial frames, Generalized coordinates; Lagrangian methods and examples; two body problem; bound states and scattering, Small oscillations; Hamiltonian formalism; canonical transformations; Hamilton-Jacobi theory, Special relativity and relativistic kinematics.

611B ADVANCED QUANTUM MECHANICS: One-dimensional Schrödinger equation; particle in a square-well potential; bound states; transmission and reflection from step potentials; W.K.B. method for bound states; tunneling; harmonic oscillator; operator method of solution. Two-level and other finite-dimensional Hilbert space problems. Three-dimensional Schrödinger equation, angular momentum, algebra of angular momentum; square well in 3 dimensions; hydrogen atom. Perturbation theory. Atoms in electric magnetic fields; spin-orbit coupling; scattering theory, General Symmetries in nuclei with special reference to isospin and parity.

617 EXPERIMENTAL PHYSICS

617A DETECTORS & TRANSDUCERS: Energy loss of charged particles in matter; range & straggling, energy, position & time detection for charged particles with solid state detectors, gas detectors - ionization chamber, multi-wire proportional counter; Interaction of radiation with matter; semi-conductor gamma detector, scintillation detectors, channel electron multipliers and micro-channel plates. Particle identification techniques & time of flight.

617B SIGNAL PROCESSING: Transmission lines, impedance matching; Noise, filters, pre-amplifiers, amplifiers, pole-zero cancellation, Base line restoration, Pile up rejection, introduction to NIM Standards. Timing measurement, Leading edge and constant fraction discriminators, coincidence measurements, gates, Time-amplitude converter, analog-digital conversion.

617C VACUUM TECHNIQUES: Basic elements of vacuum science, viscous and molecular flow, conductance, pumping speed etc. Displacement & containment pumps, Design of ultra-high vacuum system, vacuum measurement system, vacuum measurement gauges, Control & interlock system, Leak detection techniques.

617D DATA ACQUISITION SYSTEM: Data collection using CAMAC and VME; Hardware conditions and configurations; Event mode data collection and multi-dimensional histograms; Software conditions; Analysis of experimental data and extraction of physics results; Available open source

617E ENGINEERING DRAWING: Projections, Sectional drawing, Representation of fasteners, Tolerance, Welding & drawing. Practical demonstration of fabricating a vacuum component.

626 ACCELERATOR PHYSICS

626A ION SOURCES: Production of charged particles, space charge limitation; extraction & focusing geometries, positive and negative ion sources, radio frequency sources, penning ionization source, Duoplasmatron, sputter ion source, ECR source (room temperature and superconducting).

626B ACCELERATORS & THEIR APPLICATIONS: Electrostatic accelerators - Cockroft-Walton, Van-de-Graaff, Principle of tandem accelerator, Pelletron accelerator; Pulsed accelerators - cyclotron, synchrotron; Radio frequency linear accelerators; Superconducting linac, Radio frequency quadrupole; Drift tube linac; Storage rings; Future trends. Trace element analysis: various methods, RBS - measurement of elemental ratios & concentrations, channeling RBS, ERDA - depth resolution & sensitivity, high resolution sub monolayer thickness studies, Nuclear Reaction Analysis (NRA), Particle Induced X-ray emission (PIXE) studies, Accelerator Mass Spectrometry (AMS), Medical applications of accelerators.

626C BEAM OPTICS AND BEAM TRANSPORT: Motion of charged particles in electric and magnetic fields; Phase space - longitudinal and transverse, and Liouville's theorem, Focusing devices: Einzel lens, solenoid magnet, quadrupole; magnetic and electric sector fields; Matrix method, Aberrations, Design of a beam line for beam transport; Computer simulations.

626D CRYOGENICS & SUPERCONDUCTIVITY: Introduction to cryogenics and its application to accelerators, achieving low temperature, liquifaction of gases; Basic thermodynamic processes, various thermodynamic cycles, commercial. liquifiers/refrigeration, critical components. Heat transfer at low temperature: conduction, convection, radiation processes, insulation, LN2 / LHe storage vessels, cryostat design - properties of materials at low temperature, heat load calculation; Basic superconductivity, superconducting magnet; Cryogenic instrumentation - temperature sensor, liquid helium / nitrogen level, flow sensors.