FACULTY OF SCIENCE

SYLLABI

FOR

POST-M.SC. COURSE IN ACCELERATOR PHYSICS
(SEMESTER SYSTEM)

SESSION 2010-2011

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PANJAB UNIVERSITY, CHANDIGARH

Outlines of tests, syllabi and courses of reading in the subject of Post-M.Sc. Course in Accelerator Physics Semester System for the session 2010-2011.

**FIRST SEMESTER**

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<th>Paper Code</th>
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<td>PHY-AP 601</td>
<td>Beam Dynamics and Transport System</td>
<td>100</td>
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<td>PHY-AP 602</td>
<td>Accelerators</td>
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<td>PHY-AP 603</td>
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**SECOND SEMESTER**

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<td>PHY-AP 606</td>
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FIRST SEMESTER

PHY-AP 601: Beam Dynamics and Transport System
(40 Hours)

**Review** – Charged Particle dynamics – non-relativistic and relativistic formulas, Electric and Magnetic fields, modifications of fields by materials, Particle motion in electric and magnetic fields, Beam transport system.

**Linear Beam Dynamics:** Transverse beam control, Paraxial approximation for electric and magnetic fields, Electric and magnetic field lenses - Focussing properties of linear fields, Chromatic properties, Achromatic Lattices, Isochronus systems, Electrostatic aperture lens, Electrostatic immersion lens, Solenoidal Magnetic lens, Magnetic sector lens, Edge focussing, Magnetic quadrupole lens, Calculation of particle orbits in focusing fields- Transverse orbits in continuous linear focussing force, Betatron Oscillations, Azimuthal motion of particle in cylindrical beams, Paraxial ray equation.

**Beam transport system:** Transfer matrices of quadrupole lens, quadrupole doublet and triplet lenses, focussing in a thin lens array, quadrupole focussing channels, Periodic Focussing system: FODO Lattice, scaling of parameters, Non-linear dynamics.

Beam pulsing and bunching techniques, Particle beam parameters.

**Books:**

PHY-AP 602  : Accelerators (40 Hours)

Ion sources: Production of heavy negative ions, RF ion source, SNICS, charge exchange canal, Duoplasmatron ion source, heavy – ion stripping using Carbon foil and gas strippers.

Electrostatic accelerators: Electrostatic generators, charging system, insulating column, high voltage multiplier and rectiofier system, voltage measurements, Van-de-Graaff accelerator, Trandem electrostatic accelerator Pelletron, Trandetron.


Superconducting Accelerators, Various accelerator combinations, Radioactive ion beams, Polarized beams, Accelerators for Meson production.


Books:

**PHY-AP 603 : Accelerator based Analytical Techniques and Applications** (40 Hours)

**Analytical Techniques:** RBS, PIXE, PIGE, ERDA, NRA, RSA, Micro beam applications, AMS, Use of accelerator for Neutron generation, ADS. Medical applications- spot scanning system by proton therapy, Neutron radiation therapy, Isotope production, radioactive beam therapy, BNCT, X-ray radiography, neutron radiography.

Industrial applications – Ion implantation, Nuclear filters, material testing, radiation processing.

Detection of radiation and electronics (Seminar based) – Interaction of γ-rays, neutrons, electrons and heavy charged particles with matter, gas-filled detectors, Organic and inorganic scintillators, Semiconductor detectors for X-rays, γ-rays and charged particles, Associated electronics for singles and coincidence measurements. NIM and CAMAC instrumentation standards.

**Books:**

1. Radiation detection and Measurements by Glenn F. Knoll, John Wiley and Sons.
2. Techniques for Nuclear and Particle Physics experiments by W.R. Leo, Springer Verlag.

**PHY-AP 604: Accelerator Physics Laboratory** (9 Hours per week)

Experiments based on (a) Vacuum techniques (b) Cyclotron operation (c) Target preparation techniques and (d) Accelerator based analytical techniques.
SECOND SEMESTER

PHY- AP 605: Dissertation

The candidate is expected to do project work (duration = 10 weeks) at one of the National institutes having Accelerator facility. Project work will be carried out under the joint supervision of Scientist and assigned teacher.

PHY- AP 606: Workshop Training

The students will be trained in the Electronics, Electrical and Mechanical Workshops.

PHY- AP 607: μP and PC interfacing Laboratory

Experiments based on interfacing of μP and Personal Computer to control electronic gadgets necessary for Accelerator.

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