ADVANCE PHYSICS 7 (NUCLEAR PHYSICS)

PRE-REQUISITE: Modern Physics

CREDITE HOURS: 3+1

INTRODUCTION:

This class covers basic concepts of nuclear physics with emphasis on nuclear structure and interactions of radiation with matter. Topics include elementary quantum theory; nuclear forces; shell structure of the nucleus; alpha, beta and gamma radioactive decays; interactions of nuclear radiations (charged particles, gammas, and neutrons) with matter; nuclear reactions; fission and fusion.

COURSE OBJECTIVE:

The objectives of this course are to introduce students to the fundamental principles and concepts governing nuclear and particle physics and have a working knowledge of their application to real-life problems; and provide students with opportunities to develop basic knowledge and understanding of scientific phenomena, facts, laws, definitions, concepts, theories, scientific vocabulary, terminology, conventions, scientific quantities and their determination, order-of magnitude estimates, scientific and technological applications as well as their social, economic and environmental implications.

TOPICS COVERED:

Basic Properties of Nucleus:
Detectors:
Particle Accelerators:
Radio-Active Decay:
Nuclear Forces:
Nuclear Models:
Nuclear Reactions:
Neutron Physics:
Thermonuclear Reactions:

COURSE OUTLINE:

Basic Properties of Nucleus:
Size and mass of the nucleus, nuclear spin, magnetic dipole moment, electric quadrupole moment, parity and statistics.

Detectors:
Passage of charged particles through matter, ionization chamber, proportional counter, scintillation counter, semi-conductor detector, emulsion technique, bubble chamber.

Particle Accelerators:
Linear accelerator, Van de Graff, betatron, synchrocyclotorn, proton synchrotoron.

Radio-Active Decay:
Theory of alpha decay, and explanation of observed phenoma-measurement of -ray energy, the

magnetic lense spectrometer, Fermi theory of -decay, neutrino hypothesis, theory of gamma decay, multipolarity of gamma-rays, nuclear isomerism.

Nuclear Forces:

Yukawa theory, proton-proton and neutron-proton scattering, charge independence of nuclear force, isotopic spin.

Nuclear Models:

Liquid drop model, shell model, collective model.

Nuclear Reactions:

Conservation laws of nuclear reactions, Q-value of nuclear reaction, threshold energy, transmutation by photons, protons, deutrons and alpha particles, excited states of nucleus, energy levels, level width, Cross section from nuclear reactions, compound nucleus theory of nuclear reactions, limitations of compound nucleus theory, resonances, Breit-Wigner formula, direct reactions.

Neutron Physics:

Neutron sources, radioactive sources, photo neutron sources, charged particle sources, reactor as a neutron source, slow neutron detectors, fast neutron detectors, slowing down of neutron, nuclear fission, description of fission reaction, mass distribution of fission energy, average number of neutrons released, theory of fission and spontaneous fission.

Thermonuclear Reactions:

Fusion and thermonuclear process, energy released in nuclear fusion, carbon nitrogen & oxygen cycle, controlled nuclear fusion, D-D & D-T reactions.

Practical:

1. To determine the characteristic of G. M. tube and measure the range and maximum energy of particles.
2. Measurement of half-life of a radioactive source.
3. Characteristics of G.M. counter and study of fluctuations in random process.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

REFERENCE BOOKS:

1. Nuclei and particles by E. Serge. W. A. Banjamin Inc (1965).
2. A Text Book of Nuclear Physics by C.M.H. Smith, Pergamon Press Oxford (1966).
3. Nuclear Physics by A.E.S. Green, McGraw Hill Book Co. (1966).
4. Nuclear Physics by I. Kaplan, Addison-Wesley (1963).
5. The Atomic Nucleus by Evens, McGraw Hill, (1965).