

**UNIVERSITY OF MADRAS**  
**B.Sc. DEGREE COURSE IN PHYSICS**  
**SYLLABUS WITH EFFECT FROM 2020-2021**

**BPS-CSC15**

**CORE-XV: NUCLEAR & RADIATION PHYSICS**  
(Common to B.Sc. Physics with Computer Applications-V Sem.)

Lecture: 60 Hours

Tutorial: 15 Hours

Credits:4

**Course Objective:**

To study the basic structure of nucleus and nuclear models

To analyse the radioactivity of nuclear substances and radiation hazard

To introduce the concept of elementary particles.

**Learning outcomes:**

On completion of the course the students will be able to

- Describe the nuclear models
- Understand the half life and mean life of radioactive substances and the mechanism of radiation
- Appreciate the production of nuclear energy through nuclear fission
- Understand the aspects of Radiation Physics and the impact on the environment
- Be familiar with the conservation laws associated with elementary particles.

**UNIT I: GENERAL PROPERTIES OF NUCLEI**

**(10 Hours)**

Nuclear size, charge, mass-Determination of nuclear radius-Mirror nucleus method-Mass defect and Binding energy-Packing Fraction - Nuclear Spin - Magnetic dipole moment -Electric quadrupole moment-Nuclear models-Liquid drop model-Weizacker semi empirical mass formula-Shell model and Magic numbers-Collective model-Nuclear forces-Meson theory of Nuclear Force (qualitative).

**UNIT II: RADIOACTIVITY**

**(15 Hours)**

Natural Radioactivity-Law of Disintegration-half life and mean life period-units of Radioactivity-Transient and Secular equilibrium-Radiocarbon Dating-Age of Earth - Alpha rays-Characteristics-Geiger-Nuttal law- $\alpha$ -ray Spectra-Gamow's Theory of  $\alpha$ -decay (qualitative study)-Beta rays-Characteristics-Beta ray spectra-Neutrino hypothesis-Violation of Parity Conservation-Experimental Verification with  $Co_{60}$ -gamma rays and Internal conversion-Nuclear Isomerism.

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**UNIT III: RADIATION DETECTORS AND PARTICLE ACCELERATOR (10 Hours)**

Ionisation chamber-G.M.Counter-Quenching and Resolving time-Scintillation Counter-Photo Multiplier Tube – Thermoluminescence -Thermoluminescence Dosimetry (TLD)- Linear Accelerator-Cyclotron-Synchrocyclotron -Betatron.

**UNIT IV: RADIATION PHYSICS (15 Hours)**

Nuclear fission - Chain reaction - Reactor theory – Critical size of a reactor - General aspect of reactor design - Classification of reactors - Pressurized heavy water reactor – Fast breeder reactor - Radiation hazards - Biological effects of radiation – Radiation sickness - Radiation units and Operational limits - Radiation Survey Meters -Pocket Dosimeter - Control of Radiation hazards - Radioisotopes used for therapy - Nuclear medicine - Industrial applications – Food preservatives.

**Unit V: ELEMENTARY PARTICLES (10 Hours)**

Classification of Elementary Particles-Fundamental Interaction-Elementary Particle- Quantum Numbers - Isospin and Strangeness - Conservation laws and Symmetry-Basic Ideas about Quark-Quark Model.

**BOOKS FOR STUDY**

1. Nuclear Physics ,Tayal D.C., Himalaya Publishing House, Mumbai(2006).
2. Elements of Nuclear Physics ,M L Pandya & R P S Yadav KedarNathRamNath (2000)
3. Atomic and Nuclear Physics, N. Subramanyam and Brijlal, S Chand & Co., New Delhi (1996).
4. Nuclear and Particle Physics-An Introduction, Satadal Bhattacharya, University Press (India) Pvt Ltd., Hyderabad.
5. Modern Atomic and Nuclear Physics, AB Gupta, Books and Allied 2014
6. Nuclear Physics, R.C.Sharma, K.Nath & Co., Meerut (2000)

**BOOKS FOR REFERENCE**

1. Nuclear Physics, R.R.Roy and B.P.Nigam, New Age International (P) Ltd., New Delhi(1997).
2. Introduction to Modern Physics, H.S.Mani &G.K.Mehta, East West press
3. Fundamentals of Elementary Particle Physics, Longo, McGraw-Hill.
4. Nuclear Physics, S N Ghoshal, S Chand & Co. Edition, ( 2003).
5. Nuclei and Particles ,Serge., W.A. Benjamin, USA
6. <https://nptel.ac.in/courses/115103101/>
7. [https://nptel.ac.in/content/storage2/nptel\\_data3/html/mhrd/ict/text/115104043/lec33.pdf](https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/115104043/lec33.pdf)
8. <https://nptel.ac.in/courses/115102017/>