



**THIRD YEAR BACHLOR OF SCIENCE MAJOR  
PHYSICS REVISED SYLLABUS ACCORDING TO  
CBCS NEP 2020**

**COUERSE TITLE: NUCLEAR PHYSICS  
SEMESTER: VI  
W.E.F. 2025-2026**

**Recommended by the Board of Studies in PHYSICS  
And**

**Approved by the Academic Council**

Devrukh Shikshan Prasarak Mandal's

Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and  
Vid. Dadasaheb Pitre Science College (Autonomous), Devrukh.  
Tal.Sangmeshwar, Dist. Ratnagiri-415804, Maharashtra, India

**Semester VI****Academic Council Item No: 02/2025**

|                                               |   |                                                                                                                                                                    |
|-----------------------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name of the Implementing Institute            | : | Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce, and Vid. Dadasaheb Pitre Science College (Autonomous), Devrukh. Tal. Sangmeshwar, Dist. Ratnagiri-415804, |
| Name of the Parent University                 | : | University of Mumbai                                                                                                                                               |
| Name of the Programme                         | : | Bachelor of Science                                                                                                                                                |
| Name of the Department                        | : | Physics                                                                                                                                                            |
| Name of the Class                             | : | Third Year                                                                                                                                                         |
| Semester                                      | : | Sixth                                                                                                                                                              |
| Paper                                         | : | II                                                                                                                                                                 |
| No. of Credits                                | : | 02                                                                                                                                                                 |
| Title of the Course                           | : | <b>Nuclear Physics</b>                                                                                                                                             |
| Course Code                                   | : | S311PHT                                                                                                                                                            |
| Name of the Vertical in adherence to NEP 2020 | : | Major                                                                                                                                                              |
| Eligibility for Admission                     | : | Any student admitted to Third year of B. Sc, degree programme in adherence to Rules and Regulations of the University of Mumbai and Government of Maharashtra      |
| Passing Marks                                 | : | 40%                                                                                                                                                                |
| Mode of Assessment                            | : | Formative and Summative                                                                                                                                            |
| Level                                         | : | 5.5                                                                                                                                                                |
| Pattern of Marks Distribution for TE and CIA  | : | 60:40                                                                                                                                                              |
| Status                                        | : | NEP-CBCS                                                                                                                                                           |
| To be implemented from Academic Year          | : | 2025-2026                                                                                                                                                          |
| Ordinances /Regulations (if any)              |   |                                                                                                                                                                    |

**Syllabus for Third Year of Bachelor of Science in Physics**  
**(With effect from the academic year 2025-2026)**

**Semester-VI**

**Course Title: Nuclear Physics**

**Type of Vertical: Major**

**Paper No – Physics Paper – II**

**No. of Credits – 02**

**Course Code: S311PHT**

After completing the course, the learner will be able to...

| Course Outcome | Course Learning Outcome                                                                                                                                                                                                                                                                                |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO-01          | Understand the properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus.                                                                                                                                                                                |
| CO-02          | Describe about the process of radioactivity, all radioactive decay and their detail study                                                                                                                                                                                                              |
| CO-03          | Know about the nuclear models and their roles in explaining the ground state properties of the nucleus –(i) the liquid drop model, its justification so far as the nuclear properties are concerned, the semi-empirical mass formula, (ii) the shell model, evidence of shell structure, magic numbers |
| CO-04          | Understand fission and fusion well as nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.                                                                                                                                                                      |
| CO-05          | Learn about the principles and basic constructions of particle accelerators such as the betatron and synchrotron.                                                                                                                                                                                      |

**Syllabus for Third Year of Bachelor of Science in Physics****(With effect from the academic year 2025-2026)****SEMESTER-VI****Paper No.– II****Course Title: Nuclear Physics****No. of Credits - 02****Type of Vertical: Major****COURSE CODE: S311PHT**

| <b>COURSE CONTENT</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |                        |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------|
| <b>Module</b>         | <b>Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Credits</b> | <b>No. of Lectures</b> |
| <b>1</b>              | <p><b>Alpha Decay</b><br/>Velocity, energy, and Absorption of alpha particles: Range, Ionization and stopping power, Nuclear energy levels. Range of alpha particles, alpha particle spectrum, Fine structure, long range alpha particles.</p> <p><b>Ref- IK: 13. 1, 13.2, 13.5, SBP: 4. II. 1, 4. II. 2, 4. II. 3, 1.II.3</b></p> <p><b>Beta Decay</b><br/>Introduction, Velocity and energy of beta particles, Energy levels and decay schemes, Continuous beta ray spectrum-Difficulties encountered to understand it, Pauli's neutrino hypothesis, Detection of neutrino, Energetics of beta decay.</p> <p><b>Ref - IK: 14.1, 14.7, SBP: 4. III. 1, 4. III. 2, 4. III. 3, 4. III. 5, SNG : 5.5.</b></p> <p><b>Gamma decay</b><br/>Introduction, selection rules, Internal conversion, nuclear isomerism, Mossbauer effect.</p> <p><b>Ref - SBP: 4. IV. 1, 4. IV.2, 4. IV. 3, 4. IV. 4, 9.4</b></p> | <b>01</b>      | <b>15</b>              |
| <b>2</b>              | <p><b>Nuclear Models</b><br/>Liquid drop model, Weizsacker's semi-empirical mass formula(Omit derivation), Mass parabolas - Prediction of stability against beta decay for members of an isobaric family, Stability limits against spontaneous fission. Shell model (Qualitative), Magic numbers in the nucleus.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>01</b>      | <b>15</b>              |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |    |    |
|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----|
|  | <b>Ref - SBP: 5.1, 5.3, 5.4, 5.5.</b><br><b>Nuclearenergy</b><br>Introduction, Asymmetric fission - Mass yield, Emission of delayed neutrons, Energy released in the fission of U235, Fission of lighter nuclei, Fission chain reaction, Neutron cycle in a thermal nuclear reactor (Four Factor Formula), Nuclear power and breeder reactors, Natural fusion Possibility of controlled fusion.<br><br><b>Ref- SBP: 6.1, 6.3 to 6.9, 9.6, 9.7, 8.1,8.2,8.3</b><br><b>Particle Accelerators</b><br>Synchrotron, Betatron and Idea of Large Hadron Collider.<br><br><b>Ref- SBP: 1.I.4 (i), 1.I.4 (ii), 1.I.4 (iii), 1.I.4 (iv), 6.9</b> |    |    |
|  | Total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 02 | 30 |

### References

1. SBP: Nuclear Physics, S.B. Patel (Wiley Eastern Ltd.).
2. IK: Nuclear Physics, Irving Kaplan (2<sup>nd</sup> Ed.) (Addison Wesley).
3. SNG: Nuclear Physics, S. N. Ghoshal (S. Chand & Co.)
4. DCT: Nuclear Physics, D. C. Tayal (Himalayan Publishing House) 5<sup>th</sup> ed.

### Additional References

1. Modern Physics: Kenneth Krane (2<sup>nd</sup> Ed.), John Wiley & Sons.
2. Atomic & Nuclear Physics: A B Gupta & Dipak Ghosh Books & Allied (P) Ltd.

### Access to the Course

The course is available for all the students admitted for Bachelor of Science.

### Methods of Assessment

The assessment pattern would be 60:40, 60% for Semester End Examination (SEE) and 40% for Continuous Internal Assessment (CIA). The structure of the SEE and CIA would be as recommended by the Board of Studies and approved by the Board of Examination and the Academic Council of the college.

### Pattern of Evaluation

The Examination/Evaluation pattern shall be framed by the Board of Examination with its final approval from the Academic Council of the College.

Nya. Tatyasaheb Athalye Arts, Ved. S. R. Sapre Commerce and Vid. Dadasaheb Pitre Science College, Devrukh (An Autonomous College Affiliated with University of Mumbai)