Visva-Bharati
Santiniketan

Department of Physics, Siksha-Bhavana offers

Internship in Physics (2025-2026)

For Under-Graduate Students appeared / appearing in B.Sc. (NEP-2020) Semester-IV Examination under any University

Topics

- Quantum Information Theory
- High Resolution Laser Spectroscopy
- Skill Development on Electrical Equipment, Circuits and House Wiring
- Assorted Topics for Familiarization and Skill Development
- Fundamentals of Image Processing
- Science and Fiction in Science Fiction
- Alpha Decay of ^{241}Am and its Measure using Silicon Detector
- Tools and Techniques in Nuclear Spectroscopy
- Analog Communication: Design and Testing of an AM Radio System
- Understanding Various Simple Physics Problems with Python Language
- Neutrino Oscillations in the Light of Quantum Mechanics

Duration: **120 Credit Hours**

No accommodation will be provided.

Last Date of enrolment: 25th May, 2025

For any query, contact Dr. Tanmoy Paul
(Mobile: 8617706457; Email: tanmoy.paul@visva-bharati.ac.in)

For details about the topics and enrolment procedure, see below.

Internship in Physics (2025-2026)

PROGRAMME DETAILS
&
STEP BY STEP PROCEDURE FOR ENROLMENT

➔ **Details of the Internship Topics (including abstract, mentor name) are given below. You may choose maximum 3 Internship Topics of your interest. If needed, mentor may be contacted.**

➔ **Fill in the Google Form within 25th May, 2025 (where you need to put the name of your preferred 3 Internship Topics).**

https://forms.gle/5upPcVnj8hCneoJy6

➔ **Shortlisted candidates will be notified with payment link by email to make payment within 14th June 2025.**

Internship Supervisor : Dr. Tanmoy Paul
Mobile: 8617706457
Email: tanmoy.paul@visva-bharati.ac.in

IP-1 (Mentor: Prof. Swapan Mandal)

1. Title of the UG Internship Programme: **Quantum Information Theory**
2. Nature of Internship Programme: Research based developing research aptitude
3. Description of the internship pogramme (200 words):

   Basics of quantum mechanics: Bases and linear independence, Linear operators and matrices, Pauli matrices, Inner and outer products, Eigenvectors and eigenvalues, Hermitian operators, Operator functions, Commutator and anti-commutator, Postulates of quantum mechanics, State space, Quantum measurement, Projective measurements, POVM measurements, Basic concepts of classical and quantum Phases, Superdense coding, The density operator, Ensembles of quantum states, Density operator, Reduced density operator, Schmidt decomposition and purifications, EPR.

   Quantum cryptography: Few examples of Classical cryptography, Necessity of quantum cryptography, Quantum key distribution BB84 protocol, System errors and identity verification, Error correction, Identity verification, Single-photon sources Practical demonstrations of quantum cryptography, Free-space quantum cryptography, Quantum cryptography in optical fibres and latest developments

   Quantum computing: Quantum bits (qubits), The concept of qubits, representation of qubits, Quantum logic gates and circuits, Single-qubit and two-qubit gates, implementations of qubit operations, Decoherence and error correction, quantum computers, Deutsch's, Grover's and Shor's algorithm, Quantum repeaters, Implementations of quantum computation, Latest developments

   Entangled states and quantum teleportation: Entangled states, basic concepts, entangled photon pairs, Single-photon interference experiments, Bell's theorem, Bell's inequality, Experimental evidence of Bell's theorem, Principles of teleportation, Experimental demonstration of teleportation and future prospects.

4. Objective (Bulleted form):
   - To provide the basic knowledge of quantum information theory
   - To have a glimpse of the tremendous developments of quantum computation
   - To provide the confidence for taking the challenges of Quantum Information theory as their future research area.
   - To enhance the capability of writing thesis, reports and articles etc.
5. Duration: 120 Hours
6. Mode of internship programme : Blended
7. Minimum Eligibility criteria: Physics/Mathematics Major students
8. Date of Start and Closure of Internship Programme: To decided after discussion with students
9. Total intake of interns/slot: Five
10. Selection process (if any): Through interview
11. Place of internship: Physics Department
12. Logistics (minimum) to be provided, if any: NA
13. Fee to be paid: Rs. 1000/-
14. Contact details of the Mentor: Email: swapan.mandal@visva-bharati.ac.in

IP-2 (Mentor: Dr. Amitava Bandyopadhyay)

1. Title of the UG Internship Programme: **High Resolution Laser Spectroscopy**
2. Nature of Internship Programme: Research based developing research aptitude
3. Description of the internship pogramme (200 words):

   Basic concepts: Einstein's idea of stimulated emission, A and B coefficients, Beer-Lambert's law, atomic energy levels, lifetime of an excited state, metastable states, laser rate equations, principle of laser actions and basic laser components, laser resonator, active medium

   Different types of lasers: Solid state lasers – Ruby laser, Nd-YAG laser, Nd-Glass laser, Ti-sapphire laser. Gas lasers – He-Ne laser, CO_2 laser. Dye laser, semiconductor diode laser etc.

   Applications: Mode locking, Q-switching, holography, laser isotope separation etc.

   Lasers in spectroscopy: Emission and absorption spectroscopy, wavelength tuning mechanisms, diode lasers in spectroscopy, molecular spectroscopy, atomic spectroscopy, laser induced fluorescence.

4. Objective (Bulleted form):
   - To provide the basic knowledge of lasers
   - To understand the continuous wave (CW) and pulse mode operation of lasers
   - To have a brief idea about the applications of lasers
   - To distinguish between emission and absorption spectroscopy
   - To study few examples of application of lasers in spectroscopy
5. Duration: 120 Hours
6. Mode of internship programme : Online
7. Minimum Eligibility criteria: Physics/Chemistry Major students
8. Date of Start and Closure of Internship Programme: To decided after discussion with students
9. Total intake of interns/slot: Two
10. Selection process (if any): Through interview
11. Place of internship: Physics Department
12. Logistics (minimum) to be provided, if any:
13. Fee to be paid: Rs. 500/-
14. Contact details of the Mentor: Mobile: 9874366033; Email: amitava.bandyopadhyay@visva-bharati.ac.in

IP-3 (Mentor: Dr. Rajkumar Singha)

1 Title of the Internship Programme: **Skill Development on Electrical Equipment, Circuits & House Wiring**

2. Nature of the Internship Programme: Skill based for enhancing employability.

3. Description of the internship programme (200 words): The aim of this particular internship programme is to develop the skill of the students particularly focusing the undergraduate student of any discipline. Certainly this skill and Hand-on experience on electrical and electronic circuits will be very much useful in today's life and enhance the scope of employability of the student in future. The curriculum of this internship also develops the theoretical understanding of the electrical & electronic circuits and design of the students who will opt this internship programme from departments other than science and technology. Most of the course will be offline. At the end of the internship programme, students will gain enough confidence to handle the electrical and electronic circuits. The course gives emphasis to develop the following skill and theoretical knowledge of the students at the end of the programme. Theoretical understanding of electrical and electronic components, circuits and network, practical use of detection and measuring instruments of electricity. Fabrication of electrical extension box and hand on training on electrical house wiring. Understanding of single phase and three phase electrical line, electrical coils and transformer, DC/AC motors, wire gauge, electrical protection, good grounding. Theoretical understanding and practical use of solid state devices and electronic components. Students have to design and fabricate a power supply during the course. Course also tries to deliver soft computing knowledge (Commercial soft tools for smaller circuits) for circuit design. Course also designed to accustom the student to detect the faults of electrical/electronic circuits. At the end of the course each intern must have to repair one faulty instrument. Hope this internship will enrich the skill and theoretical understanding of the interns.

4. Objective (Bulleted form):

- Understanding of electrical and electronic components, circuit and Network (Theory).
- Use of detection and measuring instruments of electricity (Practical).
- Fabrication of electrical extension box and hand on training on electrical house waring (Practical).
- Understanding of Single phase and three phase electrical line, DC/AC motors. Electrical coils and Transformer, wire gauge, electrical protection, good grounding. (Theory and Practical)
- Understanding and use of solid state devices and electronic components (Theory and Practical).
- Power supply design.
- Use of soft computing for circuit design.
- Detection of fault of electrical/electronic circuits.
- Repairing of instruments (Compulsory for each intern to repair one faulty instrument).

5. Duration: 120 Hours

6. Mode of Internship Programme: Blended

7. Minimum Eligibility Criteria: 4th SEM UG students of any discipline.

8. Date of Start and Closure of the Internship Programme: Summer Vacation of Visva-Bharati and Extended to Next month of the vacation.

9. Total intake of Intern/ Slot: 10

10. Selection Process: Online Interview on fixed date or Telephonic Conversation.

11. Place of Internship: Physics Department, Visva-Bharati (Offline mode only)

12. Logistics (minimum) to be provided, if any: Use of departmental laboratories and equipment. Also need the assistance of the laboratory staffs.

15. Fee to be paid: Rs. 1000/- (For purchasing components, tools and consumables)

16. Contact details of the Co-ordinator: Dr. Tanmoy Paul

17. Contact details of the Mentor: Mob: 70291 18397; Email: rksingha@gmail.com

IP-4 (Mentor: Dr. Arani Chakravarti)

1.Title of the UG internship programme: **Assorted topics for familiarization and skill development.**

2.Nature of the internship programme: Skill-based for enhancing employability

3.Description of the internship programme:
The stress will be on current topical skills to provide some exposure to technologies like 3d-printing, expert systems and circuit simulations with free software. The main target group are those who may not have formal training in the Sciences, but may enjoy the beauty of the subject through some acquaintance, while also developing a rudimentary skill-set which may enable them to set up their own enterprises. Rather than aiming to formally complete a set syllabus, the approach will be flexible so as not to violate the comfort zone of the student.

4. Objectives:

- acquaintance with LMS (Learning Management System)
- Learning decision making with an expert system like CLIPS which will not need the massive investments required for a full-fledged AI system
- introduction to 3d printing and how to model objects through code (Open SCAD) - and an idea of slicing
- electronics lab in the home through simulations (Gnu CAP) - some simple circuits
- miscellaneous open-ended discussions

5.Duration: 120 hours

6.Mode of internship programme: Online

7.Minimum eligibility criteria: At least UG third year

8.Date of start and closure of internship programme:15/06/2025 to 15/08/2025

9.Total intake of interns/slot:

10. Selection process:

11.Place of internship: Department of Physics, Visva-Bharati University.

12.Logistics to be provided, if any:

13.Fee to be paid: Rs. 500/-

14.Contact details of coordinator: Dr. Tanmoy Paul

15. Contact details of the Mentor: Email: arani.chakravarti@visva-bharati.ac.in

IP-5 (Mentor: Dr. Biswajit Pandey)

1. Title of the UG internship programme: **Fundamentals of Image Processing**

2. Nature of Internship Programme: Both Skill based for enhancing employability and Research based for developing research aptitude.

3. Description of the internship programme (200 words):

This internship program will provide an introduction to the fundamental concepts of image processing, focusing on the applications of the Fourier Transform and various thresholding techniques. Participants will gain hands-on experience in essential operations such as image smoothing, sharpening, and spatial filtering. The program will delve into frequency domain analysis, enabling students to separate image features by filtering specific frequencies. A key focus will be on image segmentation using thresholding methods, including Otsu's method, triclass thresholding, and entropic thresholding. Students will explore how these techniques help in distinguishing different components within an image. The internship will culminate in practical applications of these methods in pattern recognition, providing insights into real-world use cases. By the end of the program, students will have a solid understanding of how frequency-based filtering and thresholding techniques contribute to image analysis and feature extraction.

4. Objective:

- Understand the role of Fourier Transform in image processing.
- Perform basic image processing operations like smoothing, sharpening, and
- spatial filtering.
- Apply frequency domain filtering to extract image features.
- Learn image segmentation using thresholding techniques such as Otsu's method, triclass thresholding, and entropic thresholding.
- Implement these techniques in pattern recognition applications.
- Gain hands-on experience with image processing tools and programming.

5. Duration: 120 Hours

6. Mode of Internship Programme : Online

7. Minimum Eligibility criteria: Applicants should have good programming knowledge, preferably in Python. A fundamental understanding of mathematics, including linear algebra, basic calculus, and Fourier transform is must. Some familiarity with signals and systems, particularly frequency domain concepts, will be helpful but not mandatory. Most importantly, candidates should have a strong interest in image processing and digital image analysis.

8. Date of start and closure of Internship Programme: 15th June to 15th September, 2025

9. Total intake of Interns/slot: 2

10. Selection process (If any):

11. Place of internship: Department of Physics, Visva-Bharati University.

12. Logistics (minimum) to be provided, if any:

13. Fee to be paid: Rs. 500/-

14. Contact details of Mentor: Mobile: 7602198961; Email: biswap@visva-bharati.ac.in

IP-6 (Mentor: Prof. Manas Maity)

1. Title of the UG Internship programme: **Science and Fiction in Science Fiction.**
2. Nature of Internship programme: Research based developing research aptitude
3. Description of the internship programme (200 words): Science fiction is a very popular genre of literature. Encyclopedia Britannica defines science fiction as *a form of fiction that deals principally with the impact of actual or imagined science upon society or individuals.* While its definition and antiquity may be argued, it may be said that the industrial revolution and the consequent rapid development of science and technology caught popular imagination. People became thrilled and at the same time apprehensive about the impact of the rapid developments in science and technology in society.

   A brief outline of the study is

   - definition of science and scientific knowledge
   - a brief introduction to the genre of science fiction – its genesis and development
   - analysis of a few popular works of science fiction from the scientific point of view
   - impact of science fiction on popular imagination and society

4. Objective (Bulleted form):
   - Understanding the basic idea of science and scientific process
   - Development of science in the modern ear
   - Effect of the development of science & technology on popular psyche
   - study of a few popular science fiction and analysis of its scientific content
   - Developing the capability of writing thesis, reports and articles etc.
5. Duration: 120 Hours
6. Mode of internship programme : Online
7. Minimum Eligibility criteria: a) Students of science with interest in literature b) students of literature/ social science with basic background/interest in science
8. Date of Start and Closure of Internship Programme: to be decided after discussion
9. Total intake of interns/slot: 2-3
10. Selection process (if any): Through interview
11. Place of internship: Physics Department/ Anywhere
12. Logistics (minimum) to be provided, if any:
13. Fee to be paid: Rs. 500/-
14. Contact details of the Mentor: Email: manas.maity@visva-bharati.ac.in, Mobile: 9903612222

IP-7 (Mentor: Dr. Buddhadev Mukherjee)

1. Title of the UG internship programme: **Alpha decay of ^{241}Am and its measure using Silicon detector**

2. Nature of Internship Programme: Research-based for developing research aptitude

3. Description of the Internship programme (200 words):

Heavy nuclei, especially those of the naturally occurring radioactive series, decay through alpha emission. Only exceedingly rarely does any other spontaneous radioactive process result in the emission of nucleons. We do not, for example, observe deuteron emission as a natural decay process. There must be a special reason that chooses alpha emission over other possible decay modes. Here we will examine the alpha decay process using decay-spectroscopy with the help of a silicon detector-based alpha spectrometer. It will help us understand the nuclear structure of heavy nuclei. The study will be based on an alpha spectrometer with a compact integrated 1K-MCA (multi-channel analyser), one Silicon PN junction-based detector and a ^{241}AM alpha source. we will also study the energy loss of alpha particles in air. This whole work will comprise both theoretical and experimental ones.

4. Objective:

- To be familiar with different aspects of alpha decay, its properties and measurements
- To be familiar with the features of Silicon PN junction detector and ^{241}Am alpha source
- To be familiar with Vacuum pump and digital signal processing.
- To be familiar with different analysis software packages
- To be familiar with the handling of a large set of experimental data

5. Duration: 120 Hours

6. Mode of internship programme (Offline/Virtual/Blended): Blended

7. Minimum Eligibility criteria: Physics/Mathematics/Chemistry Major students

8. Date of Start and Closure of Internship Programme: During 5th & 6th Semester of UG

9. Total intake of interns/slot: 3

10. Selection process (if any): Through interview (online mode)

11. Place of internship: Physics Department

12. Logistics (minimum) to be provided, if any:

13. Fee to be paid: Rs. 1000/-

14. Contact details of the co-ordinator: Dr. Tanmoy Paul

15. Contact details of the Mentor: Email: buddhadev.mukherjee@visva-bharati.ac.in

IP-8 (Mentor: Dr. Anagha Chakrabarty)

1. Title of the UG internship programme: **Tools and Techniques in Nuclear Spectroscopy**

2. Nature of Internship Programme: Research based for developing research aptitude

3. Description of the Internship programme (200 words):

The atomic nucleus is a many body quantum mechanical system. The energy levels of an atomic nucleus are generated due to the mutual interactions of nucleons lying inside the nucleus. Depending upon the interaction types, the pattern of energy levels varies from nucleus to nucleus. As the atomic nucleus within the domain size of 10^{-15} meter, it is not possible to see the nucleus in naked eye using visible range of light wave. Hence, the other types of probes are used to study the different properties of atomic nucleus in an indirect way. In this present work, mapping of the existing pattern of energy levels of different nuclei will be made using the available nuclear spectroscopic tools and techniques. The spectroscopic data collected from in-beam gamma ray spectroscopic experiments carried out at different national laboratories would be thoroughly analyzed. The experimental results obtained from the analysis would be organized in a proper way so that the concerned nuclear energy levels can be correctly determined experimentally, and their features can be unveiled in a comprehensive way. Looking into the experimentally deduced structure of the nuclear levels, the possible interpretation of their origin will also be investigated.

4. Objective:

- To be familiar with different aspects of Nuclear Spectroscopy
- To be familiar with the features of different types of detectors
- To be familiar with different analysis software packages
- To be familiar with the handling of large set of experimental data
- To be involved with first hand training regarding how to address a specific research problem

5. Duration: 120 Hours

6. Mode of internship programme: Blended

7. Minimum Eligibility criteria: Physics/Mathematics/Chemistry Major students

8. Date of Start and Closure of Internship Programme: During 5^{th} & 6^{th} Semester of UG

9. Total intake of interns/slot: 3

10. Selection process (if any): Through interview (online mode), if required

11. Place of internship: Physics Department

12. Logistics (minimum) to be provided, if any:

13. Fee to be paid: Rs. 1000/-

14. Contact details of the Mentor: Email: anagha.chakraborty@visva-bharati.ac.in

IP-9 (Mentor: Dr. Subhasish Roy)

1. Title of the UG Internship programme: **Analog Communication: Design and Testing of an AM Radio System**
2. Nature of Internship Programme: **Research based developing research aptitude**
3. Description of the internship programme (200 words):
    - **Conceptual Learning:**
      The programme begins with an introduction to communication systems, covering the need for modulation and the types of modulation techniques, including AM, FM, and PM. (Online)
    - **Circuit Simulation**:
      Students will use simulation tools to model AM signal generation and demodulation. This stage includes waveform visualization, analysis of sidebands, and understanding modulation index. (Online)
    - **Hardware Implementation**:
      Participants will design and construct a basic AM modulator circuit using discrete components like BJTs or op-amps. Signal sources can include function generators or Arduino-based systems. (Offline)
    - **Demodulation Techniques**:
      The programme includes the design of a simple envelope detector using diodes and passive components to recover the original message signal. (Offline)
    - **System Integration and Documentation**:
      In the final phase, students will integrate the full AM system, test its performance, and document their results through diagrams, waveform analysis, and a final presentation. (Offline)

By the end of this internship, students will have a solid foundation in analog communication and hands-on electronics skills.

4. Objective (Bulleted form):
    - To introduce students to the fundamental concepts of analog communication systems
    - To explain the need for modulation in communication and the basic types (AM, FM, PM)
    - To enable students to simulate AM signal generation and demodulation using free online tools
    - To guide students in building a simple AM transmitter and receiver circuit using discrete components
    - To help students visualize and analyze real-time waveforms using simulation or lab instruments
    - To develop hands-on skills in circuit design, assembly, and testing

5. Duration: Days: 120 Hours
6. Mode of internship programme: Blended
7. Minimum Eligibility criteria: Physics Major students
8. Date of Start and Closure of Internship Programme: During Summer Vacation of Visva-Bharati
9. Total intake of interns/slot: 4
10. Selection process (if any): Through interview
11. Place of internship: Physics Department
12. Logistics (minimum) to be provided, if any:
13. Fee to be paid: Rs. 1000/-
14. Contact details of the Co-ordinator: Mobile: 9474978552; Email: subhasish.roy@visva-bharati.ac.in

IP-10 (Mentor: Dr. Swarup Kumar Majee)

1. Title of the UG internship programme: **Understanding various simple physics problems with python language**
2. Nature of Internship Programme: Research based
3. Description of the internship programme (200 words):
   Python language nowadays has become an important tool for solving a wide range of physics problems. In this project a student will explore how Python can be useful to understand and solve simple physics problems. By utilizing various Python libraries, such as NumPy, SciPy, and Matplotlib etc, one can easily model, simulate, and visualize fundamental concepts in various branches physics. One can write various simple algorithms to solve problems related to mechanics, electromagnetism, thermodynamics, and more. One can understand that Python is not only a powerful tool for solving physics problems but can also be used as a tool to intuitively realise the world of physics.

4. Objective (Bulleted form):
   - Student will learn the basic of Python Language.
   - Student will apply it on various simple physics problems.
   - They will realize the outcome of various physics problems via simulation without doing any real experiment.

5. Duration: 120 Hours
6. Mode of Internship Programme: Blended
7. Minimum Eligibility criteria: NA
8. Date of start and closure of Internship Programme: 1st July 2025 onwards
9. Total intake of Interns/slot: 2
10. Selection process: NA
11. Place of internship: Online and the Department of Physics
12. Logistics (minimum) to be provided, if any: NA
13. Fee to be paid: Rs. 1000/-
14. Contact details of Mentor: Mob: 8972889271 Email: swarup@visva-bharati.ac.in

IP-11 (Mentor: Dr. Swarup Kumar Majee)

1. Title of the UG internship programme: **Neutrino Oscillations in the Light of Quantum Mechanics**

2. Nature of Internship Programme: Research based
3. Description of the internship programme (200 words):

- Neutrino physics is an elementary particle that is electrically neutral and has an extremely small mass. It was theoretically incorporated by Pauli to understand the Nuclear Beta Decay Problem. These particles are heavily produced in a variety of natural processes, including nuclear reactions in the sun, cosmic ray interactions in the atmosphere, and radioactive decay. However, it is very difficult to detect neutrinos as they interact very weakly with matter.
- There are three known types of neutrinos -- electron neutrinos, muon neutrinos, and tau neutrinos, each corresponding to its respective charged lepton. Neutrino oscillations, a phenomenon where neutrinos change flavuor as they travel through space. This behavior is described by quantum mechanical principles -- the superposition of quantum states and the evolution of these states over time.
- Initially, neutrinos were thought to be massless, oscillation phenomenon implies that they possess mass. The study of neutrino oscillations has profound implications for both particle physics and our understanding of the universe, providing insights into the nature of neutrino masses and offering potential clues to new physics beyond the standard model.

4. Objective (Bulleted form):

- Student will learn the basic of Neutrino Physics.
- Student will apply Quantum Mechanics on Neutrino Oscillations.

5. Duration: 120 Hours
6. Mode of Internship Programme: Blended
7. Minimum Eligibility criteria: NA
8. Date of start and closure of Internship Programme: 1st July 2025 onwards
9. Total intake of Interns/slot: 2
10. Selection process: NA
11. Place of internship: Online and the Department of Physics
12. Logistics (minimum) to be provided, if any: NA
13. Fee to be paid: Rs. 1000/-
14. Contact details of Mentor: Mob: 8972889271 Email: swarup@visva-bharati.ac.in