Govt. LCS PG College, Ambagarh Chowki

Department of Physics

Program Outcomes (PO) & Course Learning Outcomes (CLO)

Bachelor of Science:(NEP-2020)

Program Outcomes (PO)

The learning outcomes of the undergraduate degree course in physics are as follows:

In-depth disciplinary knowledge: The student will acquire comprehensive knowledge and understanding of the fundamental concepts, theoretical principles and processes in the main and allied branches of physics.

Hands-on/ Laboratory Skills: Comprehensive hands-on/ laboratory exercises will impart analytical, computational and instrumentation skills. The students will be able to demonstrate mature skills for the collation, evaluation, analysis and presentation of information, ideas, concepts as well as quantitative and/or qualitative data.

Role of Physics: The students will develop awareness and appreciation for the significant role played by physics in current societal and global issues. They will be able to address and contribute to such issues through the skills and knowledge acquired during the programme.

Communication and Skills: Various DSCs, DSEs, SECs, and GEs have been designed to enhance student's ability to write methodical, logical and precise reports. The courses will, in addition, guide the student to communicate effectively through presentations, writing laboratory/ project reports and dissertations.

Critical and Lateral Thinking: The programme will develop the ability to apply the underlying concepts and principles of physics and allied fields beyond the classrooms to real life applications, innovation and creativity.

Research skills: The course provides an opportunity to students to hone their research and innovation skills through assignment/internship/dissertation. It will enable the students to demonstrate mature skills in literature survey, information management skills, data analysis and research ethics.

Course Learning Outcomes (CLO) for DSC

Semester: I

Course Title: PHSC-01T: Mechanics

After going through the course, the student should be able to:

- Analyze and apply the laws of motion to various dynamical situations.
- Explain and demonstrate the principle of conservation of momentum and energy including their application in real-world scenario such as collision and energy transformation.
- Evaluate and calculate moment of inertia for objects of different shapes and analyze how these properties affect the motion of rotating bodies.
- Analyze flow of fluids.
- Describe special relativistic effects and their effects on the mass and energy of a moving object.

Course Title: PHSC-01P: Mechanics (Practical)

After the completion of the course, Students are expected to understand working mechanism and laws of **classical mechanics**. The Students will be able to:

- Assemble required parts/devices and arrange them to perform experiments.
- Record/ observe data as required by the experimental objectives.
- Analyze recorded data and formulate it to get desired results.
- Interpret results and check for attainment of proposed objectives related to laws of mechanics and its applications.

Semester: II

Course Title: PHSC-02T: Electricity and Magnetism

After going through the course, the student should be able to:

- State various laws related with electrostatics, dielectric, electric current, magnetism and electromagnetic induction.
- Apply vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
- Compare rise and decay of current in LR, CR, LCR circuits.
- Apply Biot-Savart law for calculation of magnetic field in simple geographic situations.
- Derive and analyze Maxwell's equations.

Course Title: PHSC-02P: Electricity & Magnetism (Practical)

After the completion of the course, Students are expected to understand working

laws of **Electricity, Magnetism and EMWs**. The students will also be able to:

- **Verify various circuit laws, network theorems**, using simple electric circuits. Assemble required parts/devices and arrange them to perform experiments.
- **Verify various laws in electricity and magnetism** such as **Lenz's law, Faraday's law** and learn about the construction, working of various measuring instruments.
- Record/ observe data as required by the experimental objectives. Analyze recorded data and formulate it to get desired results.
- Interpret results and check for attainment of proposed objectives related to laws of Electricity, Magnetism and its applications.

Semester: III

Course Title: PHSC-03T: Heat and Thermodynamics

After going through the course, the student should be able to:

- Demonstrate a deep comprehension of the fundamental principles of **thermodynamics**, including concepts such as **energy, entropy and laws of thermodynamics**.
- Apply the **laws of thermodynamics** to analyze and solve problems related with **energy transfer, heat engines, refrigeration system** and other thermodynamic processes.
- Analyze basic aspects of **kinetic theory** and transport phenomenon in gases.

Course Title: PHSC-03P: Heat and Thermodynamics (Practical)

- **Lab Proficiency:** Thermometers, pressure gauges, calorimeters, heat transfer apparatus, experimental setup, data acquisition.
- **Hands-on Learning:** Heat transfer, work done, entropy, phase transitions, experiments.
- **Data Analysis:** Experimental data, theoretical discrepancies, analysis.
- **Predictive Skills:** Thermodynamic behavior, varying conditions, experimentation.
- **Theory-Practice Integration:** Theoretical knowledge, practical lab work, synthesis, applications.

Semester: IV

Course Title: PHSC-04T: Waves and Optics

After going through the course, the student should be able to:

- Analyze the behavior of **waves propagating** through different mediums and predict how factors such as density, elasticity, and temperature affect wave propagation.
- Demonstrate an understanding of **interference phenomena**, including constructive and destructive interference, and apply this knowledge to solve problems involving wave superposition.
- Explain the concept of **diffraction** and its implications for wave propagation, including how waves bend around obstacles and spread out after passing through narrow openings.
- Describe the **polarization of waves**, including linear, circular, and elliptical polarization, and apply polarization concepts to analyze and manipulate electromagnetic waves.

Course Title: PHSC-04P: Waves and Optics (Practical)

After the completion of the course, students are expected to understand laws and principles behind various **optical phenomena**, specially related to **wave nature of light**. The students will also be able to:

- Gain proficiency in operating laboratory equipment such as **light source i.e. mercury, sodium and Laser, spectrometers, polarimeter**, demonstrating competence in setting up experiments, calibrating instruments, and collecting accurate data.
- Develop a deep understanding of optical principles such as **refraction, diffraction, dispersion, and interference**, as well as their applications in various scientific disciplines.
- Analyze recorded data and formulate it to get desired results.

Semester: V

Course Title: PHSC-05T: Introduction to Quantum Mechanics

At the end of this course, the students will be able to:

- Explain the basic **postulates of quantum mechanics**.
- Explain the concept of the **wave packet**.
- Describe the principle of **Heisenberg's uncertainty principle** and its applications.
- Gain knowledge about **physical quantities as operators**.
- Apply the **Schrodinger equation** to various quantum systems.

Course Title: PHSC-05 P: Introduction to Quantum Mechanics (Practical)

After the completion of the course, get opportunity to perform the following experiments on measurement and verification basic concepts of **Quantum**

mechanics. The students are expected to:

- Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives.
- Analyze recorded data and formulate it to get desired results.
- Interpret results and check for attainment of proposed objectives related to **laws of Quantum Mechanics** and its applications.
- Apply the learnt concepts for different problems in **laser systems, nuclear physics and EMW related problems**.

Semester: VI

Course Title: PHSC-06 T: Solid State Physics and Solid State Devices

At the end of this course, the students will be able to:

- To give knowledge of some basic **electronic components and circuits**. Understand the basic principles and industrial applications of **semiconductor diode, zener diode and transistor**.
- Use **diodes and transistors** in electronic circuits.
- Understand the construction working and applications of **transistor**.
- Understand the construction and working principles of various **instruments** that are used in the physics laboratory.
- Gain knowledge on importance of a **filter circuit**. Describe the working of **oscillators**.

Course Title: PHSC-06 P: Solid State Physics and Solid State Devices

After the completion of the course, the students are expected to:

- Assemble required parts/devices and arrange them to perform experiments. Record/ observe data as required by the experimental objectives.
- Analyze recorded data and formulate it to get desired results.
- Interpret results and check for attainment of proposed objectives related to **theory of semiconductors**.
- Apply theory and principle of **semiconductors** for various **device applications**.
- **Verify various I/P, O/P and other characteristics of various semiconductor (solid state) devices** and interpret the phenomena.

Semester: VII

Course Title: PHSC-07: Classical Mechanics

At the end of this course, the students will be able to:

- The ideas and concepts in **classical physics**.
- Explain **Newtonian Mechanics, Lagrangian, and Hamiltonian formulation**.
- Gain knowledge about **central force problems** and its application in **scattering phenomena**.
- Explain **small oscillations** and its applications. Apply mechanics to solve various physical problems.

Semester: VIII

Course Title: PHSC-08: Quantum Mechanics

At the end of this course, the students will be able to:

- Explore **uncertainty relations** and states with minimum uncertainty. Learn and apply **commutation relationships**.
- Master **matrix representation of operators** and solve the **harmonic oscillator**. Comprehend **angular momentum** in quantum mechanics.
- Explore **spin angular momentum** and **Pauli's matrices**. Master the concept of **Clebsch-Gordan coefficients**.
- Analyze **central force problems** and **spherically symmetric potentials in 3D**. Explore parity, square-well potentials, and **hydrogen atom solutions**.

Course Learning Outcomes (CLO) for DSE

Semester: III

Course Title: PHSE-01: Introduction to Statistical Mechanics

- Differentiate between **macrostate and microstate** and calculate their numbers.
- Comprehend the concept of **ensembles** and its requirement in study of physical phenomenon.
- Correlate and compare the **classical and quantum statistical distribution laws**.
- Apply concepts of statistical distribution laws for different physical systems.

Semester: *IV*

Course Title: PHSE-02: Mathematical Physics-I

- Revise and apply the knowledge of **calculus, vectors, vector calculus, probability and probability distributions** in various cases.
- Illustrate proficiency in writing and solving **Differential equation** and

solving them for a given physical system.

- Apply and interpret the **curvilinear coordinates** in problems with spherical and cylindrical symmetries.
- Use **Dirac Delta function** for various physical situation, especially in quantum mechanical approaches.

Semester: *V*

Course Title: PHSE-03: Nuclear Physics

- Describe **nuclear constituents** and their intrinsic properties. Analyze **binding energy variations** with mass number and understand the **N/Z plot**.
- Explain and apply **nuclear models** for clear understanding of stability of nuclei and nuclear processes. Differentiate **alpha, beta, and gamma decay** and interpret energy spectra.
- Apply **conservation laws** to compute **Q-values**, and analyze **reaction mechanism**. Explain significance of **scattering and reaction cross section**.
- Calculate and compare **nuclear fission, and fusion energy**. Describe **nuclear detectors and particle accelerators**.
- Gain insights into cutting-edge research, **accelerator technology**, and interdisciplinary applications and apprehend the role of accelerators in advancing scientific knowledge and contributing to societal well-being.

Semester: *VI*

Course Title: PHSE-04 T: Numerical Methods and C Programming

- Analyses the **convergence of solutions** to numerical methods. Understand the principles of **Gaussian elimination, pivoting, and iterative methods** to solve linear systems.
- Use **interpolation methods**. Perform **numerical differentiation and integration** using **Newton-Cotes formulae**.
- Explain the roles of **compilers, interpreters, and operating systems**. Learn the basics of **C programming**.

Course Title: PHSE-04 P: Numerical Methods and C Programming

- Get **experimental Knowledge of computational methods** in physics.
- Learn **C language**.
- Use **C programming to solve various equations**.
- Perform **Interpolation and curve fittings** through various tools.

Semester: *VII*

Course Title: PHSE-05: Mathematical Physics-II

- Apply **Fourier analysis** of periodic functions in physical problems such as vibrating strings etc.
- Solve the **beta, gamma and the error functions** and their applications in doing integrations.
- Relate basic **theory of errors**, their analysis, and estimation with examples of simple experiments in Physics.
- Solve **partial differential equations** with the examples of important partial differential equations in Physics.

Semester: *VII*

Course Title: PHSE-06: Classical Electrodynamics & Electromagnetic Theory

- Calculate the **reflection and transmission of waves** at the media interface.
- Understand the aspects related to **Polarized lights** and its generation as the superposition of different waves.
- Understanding the **plasma state**, the concept of **Debye screening**, and **collective behavior**.

Semester: *VII*

Course Title: PHSE-07 T: DIGITAL ELECTRONICS

- Understand basics of **logic gates, Boolean algebra**, and simplifying complex **Boolean functions**.
- Learn about **combinational circuits, logic families, and digital ICs**.
- Understand the working of **flip-flops** and thus **memory**.
- Capable to know the various sequential circuits an **ADs & DAs** (presumably A/D and D/A converters).

Course Title: PHSE-07 P: DIGITAL ELECTRONICS (Practical)

After completion of this course a student will be able to-

- Understand the working of **logic gates** and realization of Functions.
- Clarify the concept of **combinational logic circuits**.
- Understand the differences between **MUX, DMUX, Encoder and Decoder** and their uses.
- Familiar with basic memory elements (**Flip-flop**).
- Understand the concept of **counters and shift registers**. Able to use **D/A and A/D convertors**.

Semester: *VII*

Course Title: PHSE-08 T: Operational Amplifier & Its Applications

After completion of the course students will be able to-

- The Idea and concepts of **differential amplifier**.
- Basic concepts of **Ideal operational amplifier and Practical operational amplifier** with its electrical parameters.
- Gain the knowledge of **op-amp with feedback** and its effect on different parameters.
- Understand the concept of various **oscillators** and their applications.
- Know the uses of **Timer circuits** and their applications.

Course Title: PHSE-08 P: Operational Amplifier & Its Applications

After completion of this course a student will be able to-

- Understand the working of **differential amplifier** and its inverting and non-inverting configurations.
- Know the importance of **negative feedback**.
- Know the uses of **op-amp IC**. Understand the idea of **Oscillators**.
- Understand the working of **active filters**.
- Have the idea about **Multi-vibrators**.

Semester: *VIII*

Course Title: PHSE-09 T: Solid State Physics

By course end, students will master:

- **Energy band concept** in solids, including energy gap analysis.
- **Bloch function, Kronig-Penny model** application for electron description.
- **Hall Effect** in semiconductors, **Fermi-Dirac distribution** temperature impact, and **free electron gas** behavior in 3D.
- **Zone schemes** exploration, **Fermi surface** construction, and understanding of nearly free electrons, holes, and open orbits.

Course Title: PHSC-09 P: Solid State Physics (Practical)

After the completion of the course, the Students are expected to:

- Analyses recorded data and formulate it to get desired results.
- Interpret results and check for attainment of proposed objectives related to **theory of semiconductors**.
- Apply theory and principle of **semiconductors** for various **device applications**.

Various **electronics experiments** and some advanced experiments in Physics.

Semester: *VIII*

Course Title: PHSE-10: Atomic and Molecular Physics

- Explain **Vector atom model** and use it for analyzing **hydrogen spectra**.
- Analyze various spectra and check for possibility of a given transition.
- Explain and Apply **Raman's effect and spectroscopy** for various application.
- Appreciate the extraordinary characteristic of **lasers** and differentiate it from an ordinary light.
- Explore more about scientific contribution of **Sir C V Raman**.

Semester: *VIII*

Course Title: PHSE-11: Statistical Mechanics

At the end of this course, the students will be able to:

- Explain the connection between **statistics and thermodynamics**. Define the **phase space** of the classical system.
- Define three different types of **Ensembles** and discuss corresponding theories. Define **partition functions** for different canonical systems.
- Explain **energy, energy-density fluctuations**, and correspondence of various ensembles. Explain statistics of different **quantum mechanical ensembles**.
- Discuss **Bose-Einstein (BE) Condensate** w.r.t. liquid Helium II. Define and discuss **electron gas** behavior w.r.t. **Fermi Dirac Statistics**.
- Discuss **Virial expansion** of the equation of state. Discuss **Brownian motion and Einstein and Smoluchowski theory**.

Semester: *VIII*

Course Title: PHSE-12 T: Microprocessor

After completion of this course a student will be able to:

- Understand the basics of **digital computer**. Clarify the concept of **memories** used in computer system.
- Familiar with **buses and registers** available in microprocessor.
- Understand the **addressing modes, data transfer group, arithmetic group, logical group** etc. Know about **Assembly Language, High-Level** and Area of applications of various languages.
- Able to use **Assembly Language for programming of microprocessor**.

Course Title: PHSE-12 P: Microprocessors (Practical)

After completion of this course a student will be able to-

- Understand the working of **logic gates** and realization of Functions.
- Clarify the concept of **combinational logic circuits**.
- Understand the differences between **MUX, DMUX, Encoder and Decoder** and their use.
- Familiar with basic memory elements (**Flip-flop**).

Course Learning Outcomes (CLO) for GE

Semester: *I*

Course Title: PHGE-01 T – Mechanics

- After going through the course, the student should be able to: Analyze and apply the laws of motion to various dynamical situations.
- Explain and demonstrate the principle of conservation of momentum and energy including their application in real-world scenario such as collision and energy transformation.
- Evaluate and calculate moment of inertia for objects of different shapes and analyze how these properties affect the motion of rotating bodies.
- Analyze flow of fluids.
- Describe special relativistic effects and their effects on the mass and energy of a moving object.

Course Title: PHGE-01 P - Mechanics

After the completion of the course, Students are expected to understand working mechanism and laws of classical mechanics. The Students will be able to:

- Assemble required parts/devices and arrange them to perform experiments.
- Record/ observe data as required by the experimental objectives.
- Analyze recorded data and formulate it to get desired results.
- Interpret results and check for attainment of proposed objectives related to laws of mechanics and its applications.

Semester: *II*

Course Title: PHGE-02 T - Electricity and Magnetism

After going through the course, the student should be able to:

- State various laws related with electrostatics, dielectric, electric current, magnetism and electromagnetic induction.

- Apply vector (electric fields, Coulomb's law) and scalar (electric potential, electric potential energy) formalisms of electrostatics.
- Compare rise and decay of current in LR, CR, LCR circuits.
- Apply Biot-Savart law for calculation of magnetic field in simple geographic situations.
- Derive and analyze Maxwell's equations.

Course Title: PHGE-02 P - Electricity & Magnetism

After the completion of the course, Students are expected to understand working laws of Electricity, Magnetism and EMW's (Electromagnetic Waves). The students will also be able to:

- Verify various circuit laws, network theorems, using simple electric circuits. Assemble required parts/devices and arrange them to perform experiments.
- Verify various laws in electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments.
- Record/ observe data as required by the experimental objectives. Analyze recorded data and formulate it to get desired results.
- Interpret results and check for attainment of proposed objectives related to laws of Electricity, Magnetism and its applications.

Course Learning Outcomes (CLO) for VAC

Semester: *I/III/V*

Course Title: PHVAC-01 - Renewable Energy and Energy Harvesting

Objective of the course is to impart students; the knowledge of renewable energy and they are expected to learn about:

- Energy crisis at national and international scenario.
- Renewable sources of energy and their importance.
- Availability of renewable energy resources in India.
- Knowledge about energy harvesting technology.

Course Learning Outcomes (CLO) for SEC

Semester: *II/IV/V/VI*

Course Title: PHSEC-01 - Basic Electrical Skill

On successful completion of the course, student is expected to enhance his electrical skill through:

- Understanding importance of accuracy in measuring physical quantities.
- Using basic mechanical tools.
- Using various measuring instruments.
- Fault finding and repairing simple domestic appliances.

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Bachelor of Science: (Non-NEP)

COURSE OUTCOME

The purpose of the B.Sc. (Physics) program is

- To provide basic theoretical and practical knowledge in Physics.
- This will help the student to further pursue higher education and research in Physics and to work for Industry or Academia.

Program Outcome (PO)

Major Program outcome of B. Sc Physics:

- To gain knowledge about Fundamentals and application of Physical Phenomenon like Laws of Motion, Optics, Mechanics, and Electronics.
- To develop problem solving, critical thinking and analytical skills.
- To be able to record and analyze the results of experiments.
- To develop understanding about the role of physical sciences in human society.

B. Sc. I year

PSO: 01- Paper-I: Mechanics Oscillation and Properties of Matter

The paper aims at imparting knowledge about:

- The concepts of Frame of Reference of different coordinates
- The laws and apply them in calculations of the motion of simple and oscillation systems
- The Cathode Ray Oscilloscope theory
- The concepts of friction and the concepts of elasticity, fluid mechanics and be able to perform calculations using them

PSO: 02- Paper-II: Electricity, Magnetism and Electromagnetic Theory

The paper aims at imparting knowledge about:

- The concepts of Circuit theory.
- The knowledge regarding Electricity, Dielectric medium.
- Magnetization and Electromagnetic behavior.
- Demonstrating quantitative problem solving skills.

B. Sc. II year

PSO 03- Paper-I: Thermodynamics, Kinetic Theory and Statistical Physics

The paper covers the topic related to thermodynamics, kinetic theory and Statistical physics.

Student will be able to

- Comprehend the basic concepts of thermodynamics and its applications in physical situation.
- Learn about situations in low temperature.
- Understand the concepts of Thermal and Statistical mechanics.
- Understand the concepts of Statistical system and its impact on surrounding.
- Understand the Particle behavior and its consequences according to the Statistical Physics.
- Demonstrate quantitative problem solving skills in all the topics covered

PSO 04- Paper-II: Waves Acoustics and Optics

- Students will appreciate the role of Physics in 'interdisciplinary areas related to materials, Acoustics etc.
- Students will understand the concepts of lens system and interference.
- To apply the laws of light to formulate the relations necessary to analyze lens formulae
- To study about LASER and its applications
- To demonstrate quantitative problem solving skills in all the topics covered.

B. Sc. III year

PSO 05: Paper I: Relativity, Quantum Mechanics Atomic Molecular and Nuclear Physics

Student will be able to

- Understand laws of Relativity, Quantum mechanics and apply them in atomic Physics
- Understand the concepts Molecular Physics
- Understand laws and application of Nuclear Physics
- Demonstrate quantitative problem solving skills in all the topics covered

PSO 06: Paper II: Solid State Physics, Solid State Devices and Electronics.

Student will be able to

- Understand the concepts of Solid State Systems
- Understand the concepts of Statistical system in Solid State System and its impact on surrounding
- Demonstrate quantitative problem solving skills in all the topics covered
- Understand the basics of transistor biasing and their applications