

SEVA BHARATI MAHAVIDYALAYA

Affiliated under Vidyasagar University

Department of Physics

Under Choice Based Credit System (CBCS)

Programme Outcome (PO), Programme Specific Outcome (PSO) & Course Outcome (CO)

3-Year B.Sc. (General) in Physics

Programme Outcomes (POs)

Some of the characteristic attributes of a graduate in Physics are:

- **PO1: Basic knowledge and fundamental understanding about the field**
Good knowledge and understanding of major concepts, theoretical principles, experimental findings in Physics and its different subfields like Material science, Nuclear and Particle Physics, Condensed matter Physics, Atomic and Molecular Physics, Mathematical Physics and other related fields of study.
- **PO2: Practical knowledge and application of basic physics concepts**
Ability to use modern instrumentation and laboratory techniques to design and perform experiments is highly desirable in almost all the fields of Physics.
- **PO3: Linkages with related disciplines**
Use knowledge, understanding and skills in Physics for critical assessment of a wide range of ideas and complex problems as well as issues relating to the various sub fields of Physics.
- **PO4: Develop Technical Communication skills**
Ability to transmit complex technical information relating all areas in Physics in a clear and concise manner in writing and oral ability to present complex and technical concepts in a simple language for better understanding.
- **PO5: Skills in related field of specialization**
Skills in areas related to one's specialization and current developments in the academic field of Physics, including a critical understanding of the latest developments in the area of specialization.
- **PO6: Critical thinker and problem solver**
Developing analytical skills and popular communication ability to employ critical thinking and efficient problem-solving skills in all the basic areas of Physics.
- **PO7: Sense of investigation**

Capability for asking relevant/appropriate questions relating to the issues and problems in the field of Physics and planning, executing as well as reporting the results of a theoretical or experimental investigation.

➤ **PO8: Ability to use in Physics problem as a team worker**

Acquire the knowledge to solve any kind of Physics problem. Capable of working effectively in diverse teams in both classroom, laboratory, Physics workshop and in industry as well as field-based situations.

➤ **PO9: Skills in Mathematical modeling**

Demonstrate skills in identifying information needs, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources from the Physics labs around the world, analysis and interpretation of data using methodologies as appropriate to the subject of Physics in the area of the specialization.

➤ **PO10: Enhance the skills in interpretation and analysis of data**

Apply one's knowledge and understandings relating to Physics and skills to new/unfamiliar contexts and to identify as well as analyze problems, issues and seek solutions to real-life problems.

➤ **PO11: Acquire the knowledge to solve the Physics problem and related discipline**

Capable of identifying/mobilizing appropriate resources required for a project and manage a project through to completion, while observing responsible and ethical scientific conduct and safety as well as laboratory hygiene regulations and practices.

➤ **PO12: Digitally efficient and developing ICT skills**

Capable of using computers for simulation studies in Physics and computation as well as appropriate software for numerical and statistical analysis of data.

➤ **PO13: Demonstrate professional behavior with ethical awareness, objectivity and self-reading**

The graduate should be capable of demonstrating ability to think and analyze rationally with modern and scientific outlook and identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data.

➤ **PO14: Development of National and International perspective**

The graduates should be able to develop a national as well as international perspective for their career in the chosen field of the academic activities.

➤ **PO15: Procedural knowledge for professional subjects**

Procedural knowledge that creates different types of professionals related to the subject area of Physics, including research and development, teaching and government as well as public service, demonstrate subject-related and transferable skills that are relevant to some of the Physics related jobs and employment opportunities.

➤ **PO16: Lifelong learners**

Capable of self-paced and self-directed learning aimed at personal development and for improving knowledge/skill development and re-skilling in all areas of Physics.

Programme Specific Outcome (PSO)

The student graduating with the Degree B.Sc. General in Physics should be able to acquire

- A fundamental and systematic understanding of the academic field of Physics, its different learning areas and applications in basic Physics and its linkages with related disciplinary areas or subjects like Chemistry, Mathematics, Life sciences, Environmental Sciences.
- Procedural knowledge that creates different types of professionals related to the disciplinary or subject area of Physics, including professionals engaged in research and development, teaching and government as well as public service.
- Skills in areas related to one's specialization area within the disciplinary or subject area of Physics and current as well as emerging developments in the field of Physics.
- Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems.
- Identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.
- Recognize the importance of mathematical modeling simulation and computing, the role of approximation and mathematical approaches to describing the physical world.
- Plan and execute Physics-related experiments or investigations, analyze as well as interpret data or information collected using appropriate methods with relevant theories of Physics.

Demonstrate relevant generic skills and global competencies such as

- Problem-solving skills that are required to solve different types of Physics-related problems with well-defined solutions and tackle open-ended problems that belong to the disciplinary-area boundaries.
- Investigative skills, including skills of independent investigation of Physics-related issues and problems.
- Communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups or audiences of technical or popular nature.
- Analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Physics
- Students have also acquired the knowledge about the Information and Communication Technology (ICT) skills.
- Personal skills such as the ability to work both independently and in a group.

Demonstrate professional behavior such as

- Being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior. Promoting safe learning and working environment.
- The ability to identify the potential ethical issues in work-related situations.
- Appreciation of intellectual property, environmental and sustainability issues.

Course Outcomes (COs)

1st Year (Semester-I + Semester-II)		
Semester	Course	Course Outcome (CO)
I	<p style="text-align: center;"><i>Discipline Specific Core (DSC-1A)</i></p> <p style="text-align: center;"><i>DSC1A-T: Mechanics</i></p> <p style="text-align: center;"><i>DSC1A-P: Mechanics Lab</i></p>	<div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px 10px;">CO-1</div> <p>After going through the Course, the students should be able to</p> <ul style="list-style-type: none"> ➤ Acquire the knowledge of vectors and vector calculus. These basic mathematical structures are essential in solving problems in various branches of Physics as well as in Engineering. ➤ Understand Laws of Motion and their applications to various dynamical situations. ➤ Know about the Satellite in circular as well as Geosynchronous orbits and their applications. ➤ Gain the knowledge about Weightlessness and basic idea of Global Positioning System (GPS). ➤ Gain the knowledge about the Special Theory of Relativity (STR), constancy of speed of Light. <p>From the Laboratory Course, the students will know, how to perform experiments related to mechanics such as</p> <ul style="list-style-type: none"> ➤ To determine Elastic Constants by different methods. ➤ Able to perform various experiments for the determination of the value of acceleration due to gravity 'g'.
Semester	Course	Course Outcome (CO)
II	<p style="text-align: center;"><i>DSC-1B</i></p> <p style="text-align: center;"><i>DSC1B-T: Electricity and Magnetism</i></p>	<div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px 10px;">CO-2</div> <p>This Course will help in understanding basic concepts of Electricity and Magnetism as well as their applications</p> <ul style="list-style-type: none"> ➤ After going through this course, the students should know, how to use the vector calculus in solving the problems related to Electricity and Magnetism. ➤ Apply Gauss's Law of Electrostatics to solve a variety of problems. ➤ To know about the basic things of Magnetostatics. ➤ Can be able to explain the Laws and Phenomenon of Electromagnetic Induction. ➤ Know about Electromagnetic (EM) Wave Propagation, Transverse nature of EM waves.

	<p><i>DSC1B-P: Electricity and Magnetism Lab</i></p>	<p>In the Laboratory Course, the students will get an opportunity to verify various Laws in Electricity and Magnetism such as</p> <ul style="list-style-type: none"> ➤ Lenz's law, Faraday's law and learn about the construction as well as working of various measuring instruments. ➤ Should be able to verify various Circuit Laws, Network Theorems using simple electric circuits.
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2nd Year (Semester-III + Semester-IV)

Semester	Course	Course Outcome
III	<p><i>DSC-1C</i></p> <p><i>DSC1C-T: Thermal Physics and Statistical Mechanics</i></p> <p><i>DSC1C-P: Thermal Physics and Statistical Mechanics Lab</i></p>	<div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-3</div> <p>This basic Course of Thermal Physics and Statistical Mechanics will enable the students to understand various thermo-dynamical as well as statistical concepts and principles</p> <ul style="list-style-type: none"> ➤ Comprehend the basic concepts of thermodynamics, the concept of entropy and the associated theorems. ➤ Learn about the thermodynamic potentials, their physical interpretations and Maxwell's thermodynamic relations. ➤ Learn the basic aspects of Kinetic Theory of Gases. ➤ Gain the knowledge about the theory of radiation. ➤ Know the basic idea about the Statistical Mechanics, as well as Quantum Statistics. <p>In the Laboratory Course, the students are expected to do some basic experiments in Thermal Physics, such as</p> <ul style="list-style-type: none"> ➤ Determination of Co-efficient of Thermal Conductivity, Temperature Co-efficient of Resistance. ➤ Calibrate of a Thermocouple by studying the variation of Thermo-emf of a Thermocouple with temperature difference at its two junctions.
	<p><i>Skill Enhancement Course-1 (SEC-1)</i></p> <p><i>SEC1-T: Physics Workshop Skill</i></p>	<div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-4</div> <p>From this Skill Enhancement Course, the students can be able to</p> <ul style="list-style-type: none"> ➤ Learn how to use mechanical tools to make simple measurement of Length, Height, Time, Area and Volume. ➤ Obtain hand on experience of workshop practice by doing casting, foundry, machining, welding. ➤ Learn how to use various instruments for making electrical and electronic measurements using Multimeter, Oscilloscopes, Power Supply, Electronic Switches and Relays.

	<p>SECI-P: Physics Workshop Skill Lab</p> <p>OR</p> <p>SECI-T: Computational Physics</p> <p>SECI-P: Computational Physics Lab</p>	<p>➤ After successful completion of the Laboratory Course the students are expected to acquire skills and hands on experience as well as working knowledge on various machine tools, lathes, shapers, drilling machines, cutting tools, welding sets and also in different gear systems, pulleys etc.</p> <p style="text-align: center;">OR</p> <div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-5</div> <p>After completing this Skill Enhancement Course one can be able to learn</p> <ul style="list-style-type: none"> ➤ The importance of computers in solving problems in Physics. ➤ Acquire the knowledge how to plan for writing the algorithm for solving a problem. ➤ Gain the working knowledge about the Linux system, for example, the necessary commands. ➤ Can be able to learn, write and run FORTRAN programs in the Linux system. <p>After successfully completing the Laboratory Course one can have hands-on experience on computational tools, students are expected to do the following exercises:</p> <ul style="list-style-type: none"> ➤ To compile a frequency distribution and evaluate mean, standard deviation etc. ➤ To evaluate sum of finite series and the area under a curve.
Semester	Course	Course Outcome
IV	<p>DSC-1D</p> <p>DSC1D-T: Waves and Optics</p> <p>DSC1D-P: Waves and Optics Lab</p>	<div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-6</div> <p>This Course contains basics of Waves and Optics which will enable the students to understand various optical phenomena, principles, workings and applications of optical instruments</p> <ul style="list-style-type: none"> ➤ This course helps the student to recognize and use a mathematical oscillator equation and wave equation, as well as derive these equations for certain systems. ➤ To Understand the principle of superposition of waves describing the formation of standing waves. ➤ Know the basic idea about the Fluid Motion and Fluid Dynamics. ➤ Gain the knowledge about Sound Waves as well as Wave Optics. ➤ Can be able to explain several wave phenomena in our Everyday Life. <ul style="list-style-type: none"> ➤ In the Laboratory Course, the students will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton's Ring experiment, Fresnel Biprism etc. ➤ To measure the intensity using Photosensor and LASER in diffraction patterns of single and double slits.

	<p style="text-align: center;">Skill Enhancement Course-2 (SEC-2)</p> <p style="text-align: center;">SEC2-T: Electrical Circuits and Network Skills</p> <p style="text-align: center;">SEC2-P: Electrical Circuits and Network Skills Lab</p> <p style="text-align: center;">OR</p> <p style="text-align: center;">SEC2-T: Basic Instrumentation Skills</p> <p style="text-align: center;">SEC2-P: Basic Instrumentation Skills Lab</p>	<div style="text-align: right; border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">CO-7</div> <p>After the completion of the Course the student will acquire necessary skills, hands on experience and working knowledge on</p> <ul style="list-style-type: none"> ➤ The basic electricity principles both Alternating Current (AC) and Direct Current (DC), Voltage, Current, Resistance and Power. ➤ Understanding main electric circuit elements and their combinations. ➤ The operation of Generators and Transformers, DC Power sources. ➤ Basic design and interfacing DC or AC sources to control heaters and motors. ➤ Electrical wiring like different types of conductors and cables, basics of wiring-star and delta connection. ➤ Preparation of extension board. <p>From the Laboratory Exercises the students can acquire the knowledge about the</p> <ul style="list-style-type: none"> ➤ Hands on experience how to use practically of Voltmeters, Ammeters, Electric Circuit Elements, dc power sources. ➤ Skills to understand and operate Generators, Transformers and Electric Motors. ➤ Skills to do Electrical Wiring with assured electrical protection devices. <div style="text-align: right; border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">OR</div> <div style="text-align: right; border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">CO-8</div> <p>After the successful completion of the Course the students are expected to have the necessary working knowledge on the</p> <ul style="list-style-type: none"> ➤ Basics of Measurement like Instruments Accuracy, Precision, Sensitivity, Resolution Range etc. ➤ Specifications of a Multimeter and their significance. ➤ Specifications of an Electronic Voltmeter/ Multimeter and their significance. ➤ Block diagram of an ac millivoltmeter it's specifications and significance. ➤ Block diagram of basic Cathode Ray Oscilloscope (CRO), construction of CRT, specifications of a CRO and their significance. <p>From the Laboratory Course</p> <ul style="list-style-type: none"> ➤ The students will acquire the knowledge about the hands-on skills in the usage of Oscilloscopes, Multimeters, Multivibrators, Rectifiers, Amplifiers, Oscillators and High Voltage Probes. ➤ They also would have gained knowledge on the working and operations of LCR Bridge, Generators, Digital Meters and Counters.
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3rd Year (Semester-V + Semester-VI)

Semester	Course	Course Outcome
V	<p style="text-align: center;">Discipline Specific Elective (DSE-1A) Discipline-1: Physics</p> <p style="text-align: center;">DSE1A-T: Elements of Modern Physics</p> <p style="text-align: center;">DSE1A-P: Elements of Modern Physics Lab</p> <p style="text-align: center;">OR</p> <p style="text-align: center;">DSE1A-T: Mathematical Physics</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">CO-9</div> <p>This Course explains the failure of Classical Physics and need for Quantum Physics. After completing this course the students are able to</p> <ul style="list-style-type: none"> ➤ Know the main aspects of the inadequacies of Classical Mechanics and understand historical development of Quantum Mechanics. ➤ Discuss and interpret experiments that reveal the Dual Nature of Matter. ➤ Know about the instability of Atoms and observation of discrete Atomic Spectra. ➤ To understand the theory of quantum measurements, wave packets and uncertainty principle. ➤ Skill development on problem solving e.g. One-Dimensional Rigid Box, Tunneling through Potential Barrier, Step Potential, Rectangular Barrier. ➤ Understand the properties of Nuclei and to calculate the decay rates of Nuclear Reactions. ➤ Understand the Nuclear Processes e.g. Fission and Fusion to produce Nuclear Energy in Nuclear Reactor and Stellar Energy in Stars. <p>In the Laboratory Course, the students will get an opportunity to grasp the basic foundation of various experiments establishing the Quantum Physics and interpreting them. Such as,</p> <ul style="list-style-type: none"> ➤ Measurement of Planck's Constant by more than one method. ➤ Verification of the Photoelectric Effect and determination of the Work Function of a Metal. <p style="text-align: center;">OR</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">CO-10</div> <p>Training in mathematical tools like calculus, integration, series solution approach, special function will prepare the students to solve Ordinary Differential Equation (ODE), Partial Differential Equation (PDE) for the modeling of Physical Phenomena. This course help the students to</p> <ul style="list-style-type: none"> ➤ Understand how to model a given Physical Phenomena such as Pendulum Motion, Rocket Motion, Stretched String, etc. ➤ Learn the Fourier analysis of periodic functions and their applications in physical problems such as Vibrating Strings etc. ➤ Learn about the special functions and their applications in various physical problems such as in Quantum Mechanics.

	<p><i>DSE1A-P: Mathematical Physics Lab</i></p> <p>OR</p> <p><i>DSE1A-T: Quantum Mechanics</i></p> <p><i>DSE1A-P: Quantum Mechanics Lab</i></p> <p>OR</p> <p><i>DSE1A-T: Medical Physics</i></p>	<p>The Laboratory Course highlights the use of computational methods to solve physical problems, use of computer language as a tool in solving physics related problems, students can be able to use the operating systems such as Linux or Microsoft Windows.</p> <ul style="list-style-type: none"> ➤ They can use the Software in Curve Fittings, in solving system of Linear Equations, Generating and Plotting Special Functions. ➤ Know about the basic theory of Errors and their analysis as well as estimation with examples of simple experiments in Physics. <p style="text-align: center;">OR</p> <div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px 10px;">CO-11</div> <p>This Course will enable the students to get familiar with Quantum Mechanics formulation</p> <ul style="list-style-type: none"> ➤ After an exposition of inadequacies of Classical Mechanics in explaining microscopic phenomena Quantum Theory formulation is introduced through Schrodinger Equation. ➤ The interpretation of wave function of quantum particle and its probabilistic nature. ➤ The students get exposed to solving Non-Relativistic Hydrogen Atom for its Spectrum and Eigenfunctions. ➤ Study the influence of Electric and Magnetic Fields on an Atom. ➤ This basic course will form a firm basis to understand quantum many body problems. <p>In the Laboratory Course, with the exposure in computational programming in the computer lab, the students will be in a position to solve Schrodinger Equation for ground state energy and wave functions of various simple quantum mechanical one dimensional and three-dimensional potentials.</p> <ul style="list-style-type: none"> ➤ By the study of Electron Spin Resonance, the students can be able to determine the Magnetic Field as a function of the Resonance Frequency. ➤ They can be able to study the Zeeman Effect with External Magnetic Field and Hyperfine Splitting. <p style="text-align: center;">OR</p> <div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px 10px;">CO-12</div> <p>This Course will enable the students to focus on the application of Physics to Clinical Medicine such as,</p> <ul style="list-style-type: none"> ➤ Essential Physics of Medical Imaging, Radiological Physics, Therapeutic Systems and Radiation Therapy. ➤ Gain a broad and fundamental understanding of Physics while developing particular expertise in medical applications. ➤ Learn about the Human Body, its Anatomy, Physiology and Bio-Physics.
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	<p><i>DSE1A-P: Medical Physics Lab</i></p>	<ul style="list-style-type: none"> ➤ He/ She will study the Diagnostic and Therapeutic applications like the ECG, Radiation Physics, X-ray Technology, Ultrasound and Magnetic Resonance Imaging (MRI). ➤ Imparts functional knowledge regarding need for Radiological Protection and the sources of an approximate level of radiation exposure for treatment purposes. <p>In the Laboratory Course, the students will be exposed to the workings of various Medical Devices. The Hands-on Experience will be very useful for the students when He/ She enter the job market.</p> <ul style="list-style-type: none"> ➤ He/ She gets familiarized with various Detectors used in Medical Imaging, Medical Diagnostics. ➤ Understanding the working of a manual Hg Blood Pressure monitor and can be able to measure the Blood Pressure. ➤ Understanding the working of a manual Optical Eye-testing machine and to learn Eye testing. ➤ Correction of Myopia (Short Sightedness) using a combination of lenses on an Optical Bench/Bread-Board. ➤ Correction of Hypermetropia/Hyperopia (Long Sightedness) using a combination of lenses on an Optical Bench/Bread-Board.
	<p><i>Skill Enhancement Course-3 (SEC-3)</i></p> <p><i>SEC-3T: Renewable Energy and Energy Harvesting</i></p> <p><i>SEC-3P: Renewable Energy and Energy Harvesting Lab</i></p>	<div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px 10px;">CO-13</div> <p>From this Course the students are expected to learn not only the theories of the Renewable Sources of Energy, but also to have Hands-on Experiences on them wherever possible. After completing this course, the students gain knowledge on</p> <ul style="list-style-type: none"> ➤ Fossil Fuels and Nuclear Energy, their limitation, need of Renewable Energy, Non-Conventional Energy Sources. ➤ Solar Energy, its importance, storage of Solar Energy. ➤ Wind Energy Harvesting and Fundamentals of Wind Energy. ➤ Ocean Energy Potential against Wind and Solar, Tide Energy Technologies, Ocean Thermal Energy. ➤ Geothermal Resources, Geothermal Technologies. ➤ Hydropower Resources, Hydropower Technologies. ➤ Piezoelectric Energy Harvesting applications and Human Power. ➤ Electromagnetic Energy Harvesting. ➤ Environmental Issues and Renewable Sources of Energy and their Sustainability. <p>From the Laboratory Course the students can acquire the knowledge about</p> <ul style="list-style-type: none"> ➤ Demonstration of training modules on Solar Energy, Wind Energy, etc. ➤ Conversion of vibration to voltage using Piezoelectric Materials. ➤ Conversion of Thermal Energy into Voltage using Thermoelectric Modules.

Semester	Course	Course Outcome
VI	<p><i>Discipline Specific Elective (DSE-1B)</i> <i>Dicipline-1: Physics</i></p> <p><i>DSE1B-T: Solid State Physics</i></p> <p><i>DSE1B-P: Solid State Physics Lab</i></p> <p>OR</p> <p><i>DSE1B-T: Digital and Analog Circuits and Instrumentation</i></p> <p><i>DSE1B-P: Digital and Analog Circuits and Instrumentation Lab</i></p>	<div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-14</div> <p>At the end of this Course the students are expected to learn and assimilate the following</p> <ul style="list-style-type: none"> ➤ A brief idea about Crystalline and Amorphous Substances. ➤ Knowledge of Lattice Vibrations and Phonons. ➤ Knowledge of different types of Magnetism. ➤ Secured an understanding about the Dielectric and Ferroelectric properties of Materials. ➤ Understanding about the Band Theory of Solids and must be able to differentiate Insulators, Conductors and Semiconductors. ➤ Understand the basic ideas about Superconductors and their classifications. <p>From the Laboratory Course the students can be able</p> <ul style="list-style-type: none"> ➤ To carry out experiments based on the theory that, they can be able to measure the Magnetic Susceptibility, Dielectric Constant, Trace Hysteresis Loop. ➤ They will also employ the Four-Probe method to measure Electrical Conductivity. ➤ Hall Effect Experimental set-up to determine the Hall Co-efficient of a Semiconductor Material. <div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">OR</div> <div style="text-align: center; border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-15</div> <p>From this Course the students can be able to</p> <ul style="list-style-type: none"> ➤ Understand the Digital as well as Analog Circuits and difference between them. ➤ Various Logic GATES and their realization using Diodes and Transistors. ➤ Conceptualization of Boolean Algebra and its use in constructing Logic Circuits by various methods and their applications. ➤ Learn the Physics of Semiconductor Devices. ➤ Learn different types of Operational Amplifiers. ➤ Learn to understand and use various instruments like: CRO, Power Supply, Half Wave and Full Wave Rectifiers, Zener Diodes, Multivibrators and their applications. <p>From the Laboratory Course the students can acquire the knowledge about how</p> <ul style="list-style-type: none"> ➤ To measure Voltage and Frequency of a periodic waveform using a CRO. ➤ To verify and design AND, OR, NOT as well as XOR gates using NAND gates. ➤ To minimize a given Logic Circuit.

<p style="text-align: center;">OR</p> <p style="text-align: center;"><i>DSE1B-T: Nuclear and Particle Physics</i></p> <p style="text-align: center;"><i>DSE1A-P: Nuclear and Particle Physics Lab</i></p>	<p style="text-align: center;">OR</p> <div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-16</div> <p>After completing this Course, the students can have</p> <ul style="list-style-type: none"> ➤ Skills to describe and explain the properties of Nuclei and derive them from various Models of Nuclear Structure. ➤ To understand, explain and derive the various theoretical formulation of Nuclear Disintegration. ➤ Skills to develop basic understanding of the interaction of various Nuclear Radiation with Matter having low and high energy. ➤ Develop basic knowledge about the Elementary Particles as fundamental constituent of Matter, their properties, Conservation Laws during their interactions with Matter. <p>In the Laboratory Course the students can be able to develop basic understanding of Nuclear Reactions and Decays with the help of Theoretical Formulation and Laboratory Experiments.</p> <ul style="list-style-type: none"> ➤ Ability to understand, construct and operate simple Detector systems for Nuclear Radiation and training to work with various types of Nuclear Accelerators.
<p style="text-align: center;"><i>Skill Enhancement Course-4 (SEC-4)</i></p> <p style="text-align: center;"><i>SEC4-T: Weather Forecasting</i></p> <p style="text-align: center;"><i>SEC4-P: Weather Forecasting Lab</i></p>	<div style="border: 1px solid black; width: fit-content; margin: 0 auto; padding: 2px;">CO-17</div> <p>From this Course one can, be able to</p> <ul style="list-style-type: none"> ➤ Acquire the basic knowledge about the elements of the Atmosphere, Variation of Pressure and Temperature with Height. ➤ Learn basic Techniques to measure Temperature and its relation with Cyclones and Anti-Cyclones. ➤ Knowledge of simple techniques to measure Wind Speed and its Directions, Humidity and Rainfall. ➤ Knowledge of Global Wind Systems, Jet Streams, Local Thunderstorms, Tropical Cyclones, Tornadoes and Hurricanes. ➤ Knowledge of climate and its classification. ➤ Understanding various causes of climate change like Global Warming, Air Pollution, Aerosols, Ozone Depletion, Acid Rain. ➤ Uncertainties in predicting Weather based on Statistical Analysis. <p>From the Laboratory Course, the students can be able to learn about the</p> <ul style="list-style-type: none"> ➤ Working Principle of a Weather Station, Study of Synoptic Charts and Weather Reports. ➤ Processing and Analysis of Weather data. ➤ Exercises in reading of Pressure Charts, Surface Charts, Wind Charts and their analysis. ➤ Develop ability to do Weather Forecasts using input data.

	<p>OR</p> <p><i>SEC4-T: Radiation Safety</i></p> <p><i>SEC4-P: Radiation Safety Lab</i></p>	<p>OR</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>CO-18</p> </div> <p>After completing this Course, the students can</p> <ul style="list-style-type: none"> ➤ Be aware and understand the Hazards of Radiation and the Safety measures to guard against these Hazards. ➤ Revise or learn the basic aspects of the Atomic and Nuclear Physics, especially the radiations that originate from the Atom and the Nucleus. ➤ Have knowledge about radiation protection standards and principles of the ‘International Commission on Radiological Protection’ (ICRP). ➤ Justification, Optimization, Limitation, Introduction of Safety and Risk Management of Radiation. ➤ Nuclear Waste and Disposal Management, brief idea about ‘Accelerator Driven Sub-Critical System’ (ADS) for Waste Management. ➤ Learn about the devices which apply radiations in Medical Sciences, such as MRI, PET. <p>In the Laboratory Course the students are expected to do the following experiments</p> <ul style="list-style-type: none"> ➤ Study the background radiation levels using Radiation Meter. ➤ Characteristics of Geiger Muller (GM) Counter with the Operating Voltage and the Statistical distribution of Beta or Gamma Ray emitted from a Radioactive Source.
	<p>OR</p> <p><i>SEC4-T: Applied Optics</i></p> <p><i>SEC4-P: Applied Optics Lab</i></p>	<p>OR</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p>CO-19</p> </div> <p>This Course will enable the students to get</p> <ul style="list-style-type: none"> ➤ Familiar with Optical Phenomena and Technology. ➤ Knowledge about the types of LASERS and its applications in developing LED, Holography. ➤ The idea of Propagation of Electromagnetic Wave (EM) in a Nonlinear Media. Such as, Fiber Optics. <p>In the Laboratory Course, the experiments will allow the students to discuss in peer groups in order to develop their cooperative skills and reinforce their understanding of concepts which enable the students to practice thinking in a logical process, which is essential in science. After completion of this course the students can be able to perform the Experiments</p> <ul style="list-style-type: none"> ➤ On LASER, Photonics and Fiber Optics. ➤ On Semiconductor Sources and Detectors. ➤ On Fourier Optic Holography and Interferometry.

Generic Elective Courses offered for other Disciplines like the combination of Mathematics-Physics-Chemistry (MPC) and Chemistry-Mathematics-Physics (CMP)

1st Year (Semester-I + Semester-II) for the Students of Mathematics (H)		
Semester	Course	Course Outcome
I	<p>Generic Elective-1 (GE-1)</p> <p>GE1-T: Elements of Modern Physics</p> <p>GE1-P: Elements of Modern Physics Lab</p>	<div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">CO-20</div> <p>This Course comprehend the failure of Classical Physics and need for Quantum Physics.</p> <ul style="list-style-type: none"> ➤ Formulate the basic theoretical problems in One-, Two- and Three-Dimensional Physics and solve them. ➤ Learn to apply the basic skills developed in Quantum Physics to various problems in Nuclear Physics and Atomic Physics. ➤ Size as well as Structure of Atomic Nucleus and its relation with Atomic Weight, Stability of Nucleus, Law of Radioactive Decay. ➤ Learn about Fission, Fusion and Thermonuclear Reactions. <p>After completing this Laboratory Course, the students can be able</p> <ul style="list-style-type: none"> ➤ To determine the value of Boltzmann constant using V-I characteristic of PN junction diode. ➤ To determine value of Planck's Constant using LEDs of at least 4 different colours. ➤ Study of Photo-Electric Effect: Photo Current versus Intensity and Wavelength of Light, Maximum energy of Photo-Electrons versus Frequency of Light. ➤ To determine the value of e/m by Magnetic Focusing or Bar Magnet.
Semester	Course	Course Outcome
II	<p>Generic Elective-2 (GE-2)</p> <p>GE2-T: Thermal Physics and Statistical Mechanics</p>	<div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">CO-21</div> <p>After completing this Course, the students can be able to</p> <ul style="list-style-type: none"> ➤ Learn the basic concepts of Thermodynamics, the First and the Second Law of Thermodynamics. ➤ Know the concept of Entropy and the associated theorems, the Thermodynamic Potentials and their physical interpretations. ➤ Know the fundamentals of the Kinetic Theory of Gases, Maxwell-Boltzman Distribution Law. ➤ Have a knowledge of the Real Gas equations, Van der Waal equation of State, the Joule-Thompson effect. ➤ Learn about the Black Body radiations, Stefan-Boltzmann's Law, Rayleigh-Jean's Law, Planck's law and their significances. ➤ Learn the Quantum Statistical distributions, such as the Bose-Einstein Statistics and the Fermi-Dirac Statistics.

	<p>GE2-P: <i>Thermal Physics and Statistical Mechanics Lab</i></p>	<p>In the Laboratory, the students are expected to perform the following experiments:</p> <ul style="list-style-type: none"> ➤ To determine the co-efficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method. ➤ To determine the temperature co-efficient of Resistance by Platinum Resistance Thermometer. ➤ To determine the coefficient of Linear Expansion by Travelling Microscope.
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2nd Year (Semester-III + Semester-IV) for the Students of Chemistry (H)

Semester	Course	Course Outcome
<p align="center">III</p>	<p>Generic Elective-3 (GE-3)</p> <p>GE3-T: <i>Solid State Physics</i></p> <p>GE3-P: <i>Solid State Physics Lab</i></p>	<p align="center" style="border: 1px solid black; padding: 5px;">CO-22</p> <p>From this Course the students can be able to</p> <ul style="list-style-type: none"> ➤ Learn basics of Crystal Structure and Physics of Lattice Dynamics. ➤ Learn the Physics of different types of Material like Magnetic Materials, Dielectric Materials, Metals and their properties. ➤ Understand the Physics of Insulators, Semiconductor and Conductors. ➤ Comprehend the basic theory of Superconductors. Type-I and Type-II superconductors and their physical properties. <p>After completing the Laboratory Course, the students can be able to perform the following experiments</p> <ul style="list-style-type: none"> ➤ To Measure the Susceptibility of Paramagnetic solution using Quinck's Tube Method. ➤ To study the B-H curve of iron using a Solenoid and determine the Energy Loss. ➤ To measure the Resistivity of a Semiconductor (Ge) Crystal with Temperature by Four-Probe method and to determine its Band Gap.
Semester	Course	Course Outcome
<p align="center">IV</p>	<p>Generic Elective-4 (GE-4)</p> <p>GE4-T: <i>Electricity and Magnetism</i></p> <p>GE4-P: <i>Electricity and Magnetism Lab</i></p>	<p align="center" style="border: 1px solid black; padding: 5px;">CO-23</p> <p>After going through the Course, the students should be able to</p> <ul style="list-style-type: none"> ➤ Demonstrate Coulomb's Law for the Electric Field and apply this Law in different systems. ➤ Apply Gauss's Law of Electrostatics to solve a variety of problems. ➤ Demonstrate a working understanding of Capacitors. ➤ Describe the Magnetic Field produced by Magnetic Dipoles and Electric Currents. <p>In the Laboratory Course the students will get an opportunity</p> <ul style="list-style-type: none"> ➤ To use a Multimeter for measuring Resistances, AC and DC Voltages, DC Current, Checking Electrical Fuses. ➤ To study the Characteristics of a Series RC, series LCR as well as parallel LCR circuit. ➤ To verify the Thevenin, Norton and Maximum Power Transfer Theorems.

