



# PROGRAMME OUTCOMES (PO) and COURSE OUTCOMES (CO) : POs-Cos

**Department of Physics, Hooghly Women's College**

**2018-2019**

## **PROGRAMME OUTCOMES (PO) and COURSE OUTCOMES (CO) : PO-CO**

**Academic Year: 2018-2019**

**Department: *Department of Physics, Hooghly Women's College***

**Programme name: *B.Sc. (Hons.), Choice Based Credit System under The University of Burdwan***

### **Program Outcomes (PO) :**

The B.Sc. (Hons.) Program provides comprehensive theoretical and practical insights across various fundamental science disciplines. It is ideal for students with a robust foundation in Science and Mathematics, catering to those interested in pursuing diverse and interdisciplinary science careers. The program follows a well-structured curriculum for the holistic development of students, aiming not only to deepen their subject knowledge but also to cultivate a sense of responsibility, along with strong moral and ethical values, fostering the growth of responsible citizens. Programme outcomes may be like,

- This programme helps to develop scientific aptitude among the students and thus can prove to be highly beneficial for the society and also for the development of the nation.
- This programme helps to develop critical thinking, creativity, analytical and problem solving skills among the students.
- The students will be able to learn necessary computational skill, use of technology and use of ICT required for an effective learning experience and further progress to higher studies.
- After completion of this programme the students will be able to pursue higher studies in basic sciences or social sciences (M.Sc.) in different Universities, IIT's, IISER's, NIT's and other reputed institutes of higher learning in India and abroad, and then choose research career for the welfare of mankind and society. Students have also the option to enroll themselves for different applied science/ technical courses, B.Ed. and some other professional job oriented courses such as BCA, MCA, MBA, Marketing etc.
- Students after completion of this programme have the eligibility to join jobs in Indian Civil Services as IAS, IFS, IPS etc., WBCS, UPSC, Banking Sector, Railways, Airlines, technical jobs at research institutes or as school teacher through SSC.
- After completion of the B.Sc. degree there are various other options available for the science students. Often, they are recruited by big MNC's and different reputed companies in IT sector. Many students are directly recruited by some reputed companies through campus recruitment drive every year. They may even become entrepreneur and choose to start their own business or industrial units.
- The students will be able to engage themselves in independent thinking and lifelong learning in the present context of scientific and technological advancement.

**Course Outcomes (CO):**Name of Programme : **3-Year B.Sc. HONOURS PROGRAMME IN PHYSICS (Under CBCS)**Year of Introduction/Implementation: **Session 2017-2018** (The syllabus of this course has been framed by the University of Burdwan)

| Semester | Course Code | Course Name             | Theory / Practical | Course Outcome (CO)   |
|----------|-------------|-------------------------|--------------------|---|
| I        | CC-I        | Mathematical Physics-I  | Theory             | This course will acquaint the students with basic mathematical tools like vectors, matrices and calculus which are extremely essential to study theoretical and experimental physics.   |
|          |             |                         | Practical          | The students will learn basics of programming in Sci-Lab/Python, a universally accepted open source programming language. It will also help in interdisciplinary research in future.  |
|          | CC-II       | Mechanics               | Theory             | This course in Classical Mechanics serves as the foundation for further progress towards study of physics at graduate or post-graduate level. Newtonian mechanics forms the basis of this course. The study of nature through different conservation principles are introduced with detailed treatment. The Physics of rotational motion of a rigid body are also introduced.   |
|          |             |                         | Practical          | In this course the students will be familiar with some basic apparatus used in physics laboratory. They will learn how to make systematic experimental observation, data collection, recording of data and other basic laboratory practices in this course. They will learn how to plot graphs and determine different parameters from the graph. They will also learn how to estimate errors in experimental data. They will learn the importance of working as a group in any laboratory. They will perform some experiments to verify different laws and to determine different physical quantities related to the Theory portion of the course. |
| II       | CC-II       | Electricity & Magnetism | Theory             | The students will learn fundamental properties of charged particles and electric fields in this course. This course will also give students an understanding of the phenomena of electricity, magnetism, electromagnetic induction and electrical circuits which are extremely essential for higher studies in physics and also important for various engineering applications. This course builds the basis for studying more advanced topics in electromagnetic theory.   |
|          |             |                         | Practical          | The students will strengthen their skill of experimental work in this course. They will be familiar with various electrical components, power supply, multimeter and various other measuring  |

|     |        |                         |           |   |
|-----|--------|-------------------------|-----------|---|
|     |        |                         |           | instruments. They will be able to perform experiments on various topics of electricity and magnetism in this course. They will learn about precautions to be taken during performing an experiment and will be able to identify different sources of error. They will also learn how to analyze experimental data.  |
|     | CC-III | Wave & Optics           | Theory    | The students will gain basic knowledge about vibration, wave motion and wave theory of light. Study of classical harmonic oscillator and wave propagation in vacuum and material media, and phenomena of interference and diffraction of light are important for further progress to more advanced topics of Physics.   |
|     |        |                         | Practical | In this laboratory course the students will be acquainted with spectrometer, a very important optical instrument and some other optical instruments like Fresnel's biprism and Newton's ring experiment. They will learn how to level a spectrometer and how to take readings from it. They will also be familiar with various light sources used in physics laboratory. They will be able to determine some well known physical quantities like refractive index etc. by performing laboratory work. |
| III | CC-IV  | Mathematical Physics-II | Theory    | In this course the students will learn more advanced topics of mathematical physics like Fourier series, some special functions, special integrals, integral transforms, partial differential equations and probability. All these topics are very important for studying theoretical aspects of various branches of physics.   |
|     |        |                         | Practical | In this course the students will learn more advanced computational techniques using different packages of SciLab/Python/Frotran. They will learn various numerical analysis techniques like use of array, numerical solution of problems of matrix algebra, numerical integration, interpolation, solution of differential equation and curve fitting. This course will immensely benefit the students for higher studies and research career in Physics.   |
|     | CC-V   | Thermal Physics         | Theory    | Thermodynamics is introduced in this course and this covers fundamental laws of nature. Problems related to conversion of heat into work or the vice versa give rise to thermodynamics. Students will learn the principle of operation of engines and refrigerators in this course.<br>The students learn the basic distribution laws which are obeyed by the molecules in the Thermal Physics  |

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|----|--------|--------------------------------------|-----------|--|
|    |        |                                      | Practical | <p>part and the application to explain the basic laws of ideal gas. The limitation to explain different observed phenomena with ideal gas prescription leads the study of real gas and also conduction of heat in this course.</p> <p>In this course the student will perform different experiments on heat and thermodynamics. This laboratory course will further enrich their experimental skill learned so far.</p>  |
|    | CC-VI  | Digital System & Applications        | Theory    | <p>This topic intends to make the students familiar with the digital world. Starting from the introductory ideas of ICs, fundamental Gates and different number systems, the topic in steps is extended to implementation of different logic circuits. The students will be familiar with the basics of hardware; learn Counters, Registers, Flip-Flops, Data Processing Circuits and Computer Organization.</p>   |
|    |        |                                      | Practical | <p>This course will give the students hand on training of fabrication of the basic electronic components like different Gates, Flip-Flops, Shift Registers, Multiplexers using standard ICs.</p>   |
|    | SEC-1  | Renewable Energy & Energy Harvesting | Theory    | <p>In this course students will learn about alternative energy sources like solar energy, wind power etc. and energy conservation and applications.</p>  |
| IV | CC-VII | Mathematical Physics- III            | Theory    | <p>The students will learn the mathematical tools required for study of some advanced topics of theoretical physics. They will learn complex analysis, variational calculus. This is one of the fundamental concepts of physics which every student of physics should learn.</p>   |
|    |        |                                      | Practical | <p>The students will learn some advanced level programming with SciLab/Python in this course. They will learn to handle Gaussian integration, delta function, numerical solution of first and second order differential equation, some special functions, solution of some basic partial differential equations and evaluation of Fourier coefficients. This course will prepare the students for higher studies and research in theoretical and computational physics.</p>        |
|    | CC-IX  | Elements of Modern Physics           | Theory    | <p>The students will be introduced to the fascinating world of quantum physics in this course. One cannot have any other tool except this branch to probe the physics in the micro world. The students will become familiar with the mathematical tools and their physical implications and have a good practice in solving problems using those tools. The students will learn basics of nuclear structure, radioactivity, nuclear fission &amp; fusion. They will also learn</p> |

|   |        |                                      |                                |  |
|---|--------|--------------------------------------|--------------------------------|--|
|   |        |                                      | Practical                      | <p>fundamental principle of Laser and its applications in this course. This course is extremely important from theoretical as well as application point of view.</p> <p>This laboratory course will introduce the students to some advanced level experiments. The students will learn to determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of <math>e/m</math> of electron and behavior of tunnel diode</p>   |
|   | CC-X   | Analog Systems & Applications        | <p>Theory</p> <p>Practical</p> | <p>This course forms the basis of electronics which is undoubtedly at the heart of most of the technological advances of the present era. The students will understand the basic concepts of semiconductor physics and its application. They will learn about the operation, characteristics and various applications of different type of diodes, transistors, field effect transistors, OPAMP and oscillators. They will also have an idea about working of amplifier and regulated power supply.</p> <p>This laboratory course will provide the student with adequate exposure to some essential laboratory equipments like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for higher studies or research in experimental Physics.</p> |
|   | SEC-2  | Electrical Circuits & Network Skills | Theory                         | The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode   |
| V | CC-XI  | Quantum Mechanics & Applications     | <p>Theory</p> <p>Practical</p> | <p>The already introduced Quantum Mechanics finds application in this course and hence this is the appropriate course to introduce Atomic Physics so that the students get continuity in their progress. Student will also learn the behavior of atoms in magnetic and electric field. This course is essential for progress to higher studies and research career in physics.</p> <p>The student will learn some advanced computational techniques and applying them to solve various problems related to quantum mechanics using SciLab/C++/Python in this course.</p>   |
|   | CC-XII | Solid State Physics                  | Theory                         | The study of the solid state encompasses the understanding of the organizational, mechanical, magnetic and electrical properties of the substance as well as the forces that bind the units into the solid state. By far the most important subfield of solid  |

|    |           |                               |           |  |
|----|-----------|-------------------------------|-----------|--|
|    |           |                               | Practical | <p>state physics in the 20th century is the study of semiconductors and solid state electronics. The syllabus also covers Superconductivity, the ability of certain materials to conduct electric current with practically zero resistance. Superconductors have been employed in, or proposed for use in, an enormous variety of applications.</p> <p>All the Experiments of this course are related to investigation of fundamental and electrical and magnetic properties of solids. The determinations of BH loop area of ferromagnetic substance, dielectric constant of a material, study and verification of temperature dependence of resistance of semiconductor etc by experiments will boost up the interest of the students.</p> |
|    | DSE-1 (1) | Advanced Mathematical Physics | Theory    | The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of Linear Vector Space, Matrices: Eigen Value & Eigen Vector Problems, Cartesian Tensors, General Tensors, Symmetric – Asymmetric Tensors etc.   |
|    |           |                               | Practical | The student will learn some advanced computational techniques & simulation based techniques using SciLab/C++   |
|    | DSE-2 (5) | Classical Dynamics            | Theory    | This course is aimed for solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of advanced mechanics. Students will learn to apply the Hamiltonian, Lagrangian theory in various real life mechanical systems including systems with small oscillations. Here students will also learn about the Special theory of Relativity.  |
| VI | CC-XIII   | Electromagnetic Theory        | Theory    | The students will go through a very important training in Electromagnetic Theory which is one of the fundamental components of classical physics. The important set of relations of Electrostatics, Magnetostatics, Electro-magnetic Induction, taught in earlier Semesters find application in this topic. The electromagnetic wave is generated naturally from the Maxwell's relations and the students will get the explanation of polarization and related optical and other aspects from this theory.   |
|    |           |                               | Practical | The behavior of electromagnetic wave after refraction as established through well known laws can be verified in the laboratory. Also the theoretical predictions on polarization of electromagnetic waves find verification through the experiments referred in this course.   |
|    | CC-XIV    | Statistical Mechanics         | Theory    | In Statistical Mechanics, the students will get an   |

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|-----------|------------------------------|--|-----------|---|
|           |                              |  | Practical | <p>entry into the world of mechanics comprising of a collection of particles and will understand how to study the gross behavior of a system. This approach also establishes the laws of thermodynamics which are the fundamental rules of nature. The Quantum Statistical Mechanics gives the approaches to treat identical elementary particles which are frequently involved in theoretical and experimental research .</p> <p>The students will use C/C++/SciLab/Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers etc. The approach is extended also to the study of different distributions in statistical mechanics.</p> |
| DSE-3 (6) | Nuclear and Particle Physics |  | Theory    | <p>The students of UG level will get the first lesson of Nuclear Physics in this topic. The contents are very important from the viewpoints of both theory and applications. Since it is very difficult to set up Nuclear Physics Laboratory at the UG level, the students are taught very carefully so that they may get the necessary inputs to carry on the study in Masters and in the Research level.</p>  |
| DSE-4 (8) | Astronomy & Astrophysics     |  | Theory    | <p>In this course students will study various aspects of astrophysics, e.g. The Sun, Milky Way, Galaxies, and Large Scale Structures &amp; Expanding Universe. Those are the basic foundations of Astronomy &amp; Astrophysics and will help the students to pursue advanced study in this field.</p>   |





# PROGRAMME OUTCOMES (PO) and COURSE OUTCOMES (CO) : POs-Cos

**Department of Physics, Hooghly Women's College**

**2019-2020**

## PROGRAMME OUTCOMES (PO) and COURSE OUTCOMES (CO) : PO-CO

**Academic Year: 2019-2020**

**Department: *Department of Physics, Hooghly Women's College***

**Programme name: *B.Sc. (Hons.), Choice Based Credit System under The University of Burdwan***

### **Program Outcomes (PO) :**

The B.Sc. (Hons.) Program provides comprehensive theoretical and practical insights across various fundamental science disciplines. It is ideal for students with a robust foundation in Science and Mathematics, catering to those interested in pursuing diverse and interdisciplinary science careers. The program follows a well-structured curriculum for the holistic development of students, aiming not only to deepen their subject knowledge but also to cultivate a sense of responsibility, along with strong moral and ethical values, fostering the growth of responsible citizens.

#### **➤ Followings may be considered as programme outcomes (PO):**

**PO-1:** This programme helps to develop scientific aptitude among the students and thus can prove to be highly beneficial for the society and also for the development of the nation.

**PO-2:** This programme helps to develop critical thinking, creativity, analytical and problem solving skills among the students.

**PO-3:** The students will be able to learn necessary computational skill, use of technology and use of ICT required for an effective learning experience and further progress to higher studies.

**PO-4:** After completion of this programme the students will be able to pursue higher studies in basic sciences or social sciences (M.Sc.) in different Universities, IIT's, IISER's, NIT's and other reputed institutes of higher learning in India and abroad, and then choose research career for the welfare of mankind and society. Students have also the option to enroll themselves for different applied science/ technical courses, B.Ed. and some other professional job oriented courses such as BCA, MCA, MBA, Marketing etc.

**PO-5:** Students after completion of this programme have the eligibility to join jobs in Indian Civil Services as IAS, IFS, IPS etc., WBCS, UPSC, Banking Sector, Railways, Airlines, technical jobs at research institutes or as school teacher through SSC.

**PO-6:** After completion of the B.Sc. degree there are various other options available for the science students. Often, they are recruited by big MNC's and different reputed companies in IT sector. Many students are directly recruited by some reputed companies through campus recruitment drive every year. They may even become entrepreneur and choose to start their own business or industrial units.

**PO-7:** The students will be able to engage themselves in independent thinking and lifelong learning in the present context of scientific and technological advancement.

**Course Outcomes (CO) :**

Name of Programme : **THREE-YEAR B.Sc. HONOURS PROGRAMME IN PHYSICS (Under CBCS)**

Year of Introduction/Implementation: **Session 2017-2018** (The syllabus of this course has been framed by the University of Burdwan)

| Semester | Course Code | Course Name             | Theory / Practical | Course Outcome (CO)   |
|----------|-------------|-------------------------|--------------------|---|
| I        | CC-I        | Mathematical Physics-I  | Theory             | This course will acquaint the students with basic mathematical tools like vectors, matrices and calculus which are extremely essential to study theoretical and experimental physics.   |
|          |             |                         | Practical          | The students will learn basics of programming in Sci-Lab/Python, a universally accepted open source programming language. It will also help in interdisciplinary research in future.  |
|          | CC-II       | Mechanics               | Theory             | This course in Classical Mechanics serves as the foundation for further progress towards study of physics at graduate or post-graduate level. Newtonian mechanics forms the basis of this course. The study of nature through different conservation principles are introduced with detailed treatment. The Physics of rotational motion of a rigid body are also introduced.   |
|          |             |                         | Practical          | In this course the students will be familiar with some basic apparatus used in physics laboratory. They will learn how to make systematic experimental observation, data collection, recording of data and other basic laboratory practices in this course. They will learn how to plot graphs and determine different parameters from the graph. They will also learn how to estimate errors in experimental data. They will learn the importance of working as a group in any laboratory. They will perform some experiments to verify different laws and to determine different physical quantities related to the Theory portion of the course. |
| II       | CC-II       | Electricity & Magnetism | Theory             | The students will learn fundamental properties of charged particles and electric fields in this course. This course will also give students an understanding of the phenomena of electricity, magnetism, electromagnetic induction and electrical circuits which are extremely essential for higher studies in physics and also important for various engineering applications. This course builds the basis for studying more advanced topics in electromagnetic theory.   |

|     |        |                         |           |   |
|-----|--------|-------------------------|-----------|---|
|     |        |                         | Practical | The students will strengthen their skill of experimental work in this course. They will be familiar with various electrical components, power supply, multimeter and various other measuring instruments. They will be able to perform experiments on various topics of electricity and magnetism in this course. They will learn about precautions to be taken during performing an experiment and will be able to identify different sources of error. They will also learn how to analyze experimental data. |
|     | CC-III | Wave & Optics           | Theory    | The students will gain basic knowledge about vibration, wave motion and wave theory of light. Study of classical harmonic oscillator and wave propagation in vacuum and material media, and phenomena of interference and diffraction of light are important for further progress to more advanced topics of Physics.   |
|     |        |                         | Practical | In this laboratory course the students will be acquainted with spectrometer, a very important optical instrument and some other optical instruments like Fresnel's biprism and Newton's ring experiment. They will learn how to level a spectrometer and how to take readings from it. They will also be familiar with various light sources used in physics laboratory. They will be able to determine some well known physical quantities like refractive index etc. by performing laboratory work.           |
| III | CC-IV  | Mathematical Physics-II | Theory    | In this course the students will learn more advanced topics of mathematical physics like Fourier series, some special functions, special integrals, integral transforms, partial differential equations and probability. All these topics are very important for studying theoretical aspects of various branches of physics.   |
|     |        |                         | Practical | In this course the students will learn more advanced computational techniques using different packages of SciLab/Python/Frotran. They will learn various numerical analysis techniques like use of array, numerical solution of problems of matrix algebra, numerical integration, interpolation, solution of differential equation and curve fitting. This course will immensely benefit the students for higher studies and research career in Physics.   |
|     | CC-V   | Thermal Physics         | Theory    | Thermodynamics is introduced in this course and this covers fundamental laws of nature. Problems related to conversion of heat into work or the vice versa give rise to thermodynamics. Students will   |

|    |        |                                      |           |  |
|----|--------|--------------------------------------|-----------|--|
|    |        |                                      | Practical | <p>learn the principle of operation of engines and refrigerators in this course.</p> <p>The students learn the basic distribution laws which are obeyed by the molecules in the Thermal Physics part and the application to explain the basic laws of ideal gas. The limitation to explain different observed phenomena with ideal gas prescription leads the study of real gas and also conduction of heat in this course.</p> <p>In this course the student will perform different experiments on heat and thermodynamics. This laboratory course will further enrich their experimental skill learned so far.</p> |
|    | CC-VI  | Digital System & Applications        | Theory    | <p>This topic intends to make the students familiar with the digital world. Starting from the introductory ideas of ICs, fundamental Gates and different number systems, the topic in steps is extended to implementation of different logic circuits. The students will be familiar with the basics of hardware; learn Counters, Registers, Flip-Flops, Data Processing Circuits and Computer Organization.</p>   |
|    |        |                                      | Practical | <p>This course will give the students hand on training of fabrication of the basic electronic components like different Gates, Flip-Flops, Shift Registers, Multiplexers using standard ICs.</p>   |
|    | SEC-1  | Renewable Energy & Energy Harvesting | Theory    | <p>In this course students will learn about alternative energy sources like solar energy, wind power etc. and energy conservation and applications.</p>  |
| IV | CC-VII | Mathematical Physics- III            | Theory    | <p>The students will learn the mathematical tools required for study of some advanced topics of theoretical physics. They will learn complex analysis, variational calculus. This is one of the fundamental concepts of physics which every student of physics should learn.</p>   |
|    |        |                                      | Practical | <p>The students will learn some advanced level programming with SciLab/Python in this course. They will learn to handle Gaussian integration, delta function, numerical solution of first and second order differential equation, some special functions, solution of some basic partial differential equations and evaluation of Fourier coefficients. This course will prepare the students for higher studies and research in theoretical and computational physics.</p>  |
|    | CC-IX  | Elements of Modern Physics           | Theory    | <p>The students will be introduced to the fascinating world of quantum physics in this course. One cannot have any other tool except this branch to probe the physics in the micro world. The students will become familiar with the mathematical tools and</p>  |

|   |        |                                      |                                |  |
|---|--------|--------------------------------------|--------------------------------|--|
|   |        |                                      | Practical                      | <p>their physical implications and have a good practice in solving problems using those tools. The students will learn basics of nuclear structure, radioactivity, nuclear fission &amp; fusion. They will also learn fundamental principle of Laser and its applications in this course. This course is extremely important from theoretical as well as application point of view.</p> <p>This laboratory course will introduce the students to some advanced level experiments. The students will learn to determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of <math>e/m</math> of electron and behavior of tunnel diode</p>  |
|   | CC-X   | Analog Systems & Applications        | <p>Theory</p> <p>Practical</p> | <p>This course forms the basis of electronics which is undoubtedly at the heart of most of the technological advances of the present era. The students will understand the basic concepts of semiconductor physics and its application. They will learn about the operation, characteristics and various applications of different type of diodes, transistors, field effect transistors, OPAMP and oscillators. They will also have an idea about working of amplifier and regulated power supply.</p> <p>This laboratory course will provide the student with adequate exposure to some essential laboratory equipments like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for higher studies or research in experimental Physics.</p> |
|   | SEC-2  | Electrical Circuits & Network Skills | Theory                         | The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode   |
| V | CC-XI  | Quantum Mechanics & Applications     | <p>Theory</p> <p>Practical</p> | <p>The already introduced Quantum Mechanics finds application in this course and hence this is the appropriate course to introduce Atomic Physics so that the students get continuity in their progress. Student will also learn the behavior of atoms in magnetic and electric field. This course is essential for progress to higher studies and research career in physics.</p> <p>The student will learn some advanced computational techniques and applying them to solve various problems related to quantum mechanics using SciLab/C++/Python in this course.</p>   |
|   | CC-XII | Solid State Physics                  | Theory                         | The study of the solid state encompasses the   |

|    |           |                               |           |   |
|----|-----------|-------------------------------|-----------|---|
|    |           |                               | Practical | <p>understanding of the organizational, mechanical, magnetic and electrical properties of the substance as well as the forces that bind the units into the solid state. By far the most important subfield of solid state physics in the 20th century is the study of semiconductors and solid state electronics. The syllabus also covers Superconductivity, the ability of certain materials to conduct electric current with practically zero resistance. Superconductors have been employed in, or proposed for use in, an enormous variety of applications.</p> <p>All the Experiments of this course are related to investigation of fundamental and electrical and magnetic properties of solids. The determinations of BH loop area of ferromagnetic substance, dielectric constant of a material, study and verification of temperature dependence of resistance of semiconductor etc by experiments will boost up the interest of the students.</p> |
|    | DSE-1 (1) | Advanced Mathematical Physics | Theory    | <p>The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of Linear Vector Space, Matrices: Eigen Value &amp; Eigen Vector Problems, Cartesian Tensors, General Tensors, Symmetric – Asymmetric Tensors etc.</p>   |
|    |           |                               | Practical | <p>The student will learn some advanced computational techniques &amp; simulation based techniques using SciLab/C++</p>   |
|    | DSE-2 (5) | Classical Dynamics            | Theory    | <p>This course is aimed for solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of advanced mechanics. Students will learn to apply the Hamiltonian, Lagrangian theory in various real life mechanical systems including systems with small oscillations. Here students will also learn about the Special theory of Relativity.</p>  |
| VI | CC-XIII   | Electromagnetic Theory        | Theory    | <p>The students will go through a very important training in Electromagnetic Theory which is one of the fundamental components of classical physics. The important set of relations of Electrostatics, Magnetostatics, Electro-magnetic Induction, taught in earlier Semesters find application in this topic. The electromagnetic wave is generated naturally from the Maxwell's relations and the students will get the explanation of polarization and related optical and other aspects from this theory.</p>   |
|    |           |                               | Practical | <p>The behavior of electromagnetic wave after refraction as established through well known laws can be verified in the laboratory. Also the theoretical predictions on polarization of electromagnetic waves</p>  |

|           |                              |           |  |  |
|-----------|------------------------------|-----------|--|--|
|           |                              |           |  | find verification through the experiments referred in this course.   |
| CC-XIV    | Statistical Mechanics        | Theory    |  | In Statistical Mechanics, the students will get an entry into the world of mechanics comprising of a collection of particles and will understand how to study the gross behavior of a system. This approach also establishes the laws of thermodynamics which are the fundamental rules of nature. The Quantum Statistical Mechanics gives the approaches to treat identical elementary particles which are frequently involved in theoretical and experimental research . |
|           |                              | Practical |  | The students will use C/C++/SciLab/Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers etc. The approach is extended also to the study of different distributions in statistical mechanics.  |
| DSE-3 (6) | Nuclear and Particle Physics | Theory    |  | The students of UG level will get the first lesson of Nuclear Physics in this topic. The contents are very important from the viewpoints of both theory and applications. Since it is very difficult to set up Nuclear Physics Laboratory at the UG level, the students are taught very carefully so that they may get the necessary inputs to carry on the study in Masters and in the Research level.  |
| DSE-4 (8) | Astronomy & Astrophysics     | Theory    |  | In this course students will study various aspects of astrophysics, e.g. The Sun, Milky Way, Galaxies, and Large Scale Structures & Expanding Universe. Those are the basic foundations of Astronomy & Astrophysics and will help the students to pursue advanced study in this field.   |





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**Department of Physics, Hooghly Women's College**

**2020-2021**

## **PROGRAMME OUTCOMES (PO) and COURSE OUTCOMES (CO) : PO-CO**

**Academic Year: 2020-2021**

**Department: *Department of Physics, Hooghly Women's College***

**Programme name: *B.Sc. (Hons.), Choice Based Credit System under The University of Burdwan***

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**PO-2:** This programme helps to develop critical thinking, creativity, analytical and problem solving skills among the students.

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**PO-4:** After completion of this programme the students will be able to pursue higher studies in basic sciences or social sciences (M.Sc.) in different Universities, IIT's, IISER's, NIT's and other reputed institutes of higher learning in India and abroad, and then choose research career for the welfare of mankind and society. Students have also the option to enroll themselves for different applied science/ technical courses, B.Ed. and some other professional job oriented courses such as BCA, MCA, MBA, Marketing etc.

**PO-5:** Students after completion of this programme have the eligibility to join jobs in Indian Civil Services as IAS, IFS, IPS etc., WBCS, UPSC, Banking Sector, Railways, Airlines, technical jobs at research institutes or as school teacher through SSC.

**PO-6:** After completion of the B.Sc. degree there are various other options available for the science students. Often, they are recruited by big MNC's and different reputed companies in IT sector. Many students are directly recruited by some reputed companies through campus recruitment drive every year. They may even become entrepreneur and choose to start their own business or industrial units.

**PO-7:** The students will be able to engage themselves in independent thinking and lifelong learning in the present context of scientific and technological advancement.

**Course Outcomes (CO) :**

Name of Programme : **THREE-YEAR B.Sc. HONOURS PROGRAMME IN PHYSICS (Under CBCS)**

Year of Introduction/Implementation: **Session 2017-2018** (The syllabus of this course has been framed by the University of Burdwan)

| Semester | Course Code | Course Name             | Theory / Practical | Course Outcome (CO)   |
|----------|-------------|-------------------------|--------------------|---|
| I        | CC-I        | Mathematical Physics-I  | Theory             | This course will acquaint the students with basic mathematical tools like vectors, matrices and calculus which are extremely essential to study theoretical and experimental physics.   |
|          |             |                         | Practical          | The students will learn basics of programming in Sci-Lab/Python, a universally accepted open source programming language. It will also help in interdisciplinary research in future.  |
|          | CC-II       | Mechanics               | Theory             | This course in Classical Mechanics serves as the foundation for further progress towards study of physics at graduate or post-graduate level. Newtonian mechanics forms the basis of this course. The study of nature through different conservation principles are introduced with detailed treatment. The Physics of rotational motion of a rigid body are also introduced.   |
|          |             |                         | Practical          | In this course the students will be familiar with some basic apparatus used in physics laboratory. They will learn how to make systematic experimental observation, data collection, recording of data and other basic laboratory practices in this course. They will learn how to plot graphs and determine different parameters from the graph. They will also learn how to estimate errors in experimental data. They will learn the importance of working as a group in any laboratory. They will perform some experiments to verify different laws and to determine different physical quantities related to the Theory portion of the course. |
| II       | CC-II       | Electricity & Magnetism | Theory             | The students will learn fundamental properties of charged particles and electric fields in this course. This course will also give students an understanding of the phenomena of electricity, magnetism, electromagnetic induction and electrical circuits which are extremely essential for higher studies in physics and also important for various engineering applications. This course builds the basis for studying more advanced topics in electromagnetic theory.   |

|     |        |                         |           |   |
|-----|--------|-------------------------|-----------|---|
|     |        |                         | Practical | The students will strengthen their skill of experimental work in this course. They will be familiar with various electrical components, power supply, multimeter and various other measuring instruments. They will be able to perform experiments on various topics of electricity and magnetism in this course. They will learn about precautions to be taken during performing an experiment and will be able to identify different sources of error. They will also learn how to analyze experimental data. |
|     | CC-III | Wave & Optics           | Theory    | The students will gain basic knowledge about vibration, wave motion and wave theory of light. Study of classical harmonic oscillator and wave propagation in vacuum and material media, and phenomena of interference and diffraction of light are important for further progress to more advanced topics of Physics.   |
|     |        |                         | Practical | In this laboratory course the students will be acquainted with spectrometer, a very important optical instrument and some other optical instruments like Fresnel's biprism and Newton's ring experiment. They will learn how to level a spectrometer and how to take readings from it. They will also be familiar with various light sources used in physics laboratory. They will be able to determine some well known physical quantities like refractive index etc. by performing laboratory work.           |
| III | CC-IV  | Mathematical Physics-II | Theory    | In this course the students will learn more advanced topics of mathematical physics like Fourier series, some special functions, special integrals, integral transforms, partial differential equations and probability. All these topics are very important for studying theoretical aspects of various branches of physics.   |
|     |        |                         | Practical | In this course the students will learn more advanced computational techniques using different packages of SciLab/Python/Frotran. They will learn various numerical analysis techniques like use of array, numerical solution of problems of matrix algebra, numerical integration, interpolation, solution of differential equation and curve fitting. This course will immensely benefit the students for higher studies and research career in Physics.   |
|     | CC-V   | Thermal Physics         | Theory    | Thermodynamics is introduced in this course and this covers fundamental laws of nature. Problems related to conversion of heat into work or the vice versa give rise to thermodynamics. Students will   |

|    |        |                                      |           |  |
|----|--------|--------------------------------------|-----------|--|
|    |        |                                      | Practical | <p>learn the principle of operation of engines and refrigerators in this course.</p> <p>The students learn the basic distribution laws which are obeyed by the molecules in the Thermal Physics part and the application to explain the basic laws of ideal gas. The limitation to explain different observed phenomena with ideal gas prescription leads the study of real gas and also conduction of heat in this course.</p> <p>In this course the student will perform different experiments on heat and thermodynamics. This laboratory course will further enrich their experimental skill learned so far.</p> |
|    | CC-VI  | Digital System & Applications        | Theory    | <p>This topic intends to make the students familiar with the digital world. Starting from the introductory ideas of ICs, fundamental Gates and different number systems, the topic in steps is extended to implementation of different logic circuits. The students will be familiar with the basics of hardware; learn Counters, Registers, Flip-Flops, Data Processing Circuits and Computer Organization.</p>   |
|    |        |                                      | Practical | <p>This course will give the students hand on training of fabrication of the basic electronic components like different Gates, Flip-Flops, Shift Registers, Multiplexers using standard ICs.</p>   |
|    | SEC-1  | Renewable Energy & Energy Harvesting | Theory    | <p>In this course students will learn about alternative energy sources like solar energy, wind power etc. and energy conservation and applications.</p>  |
| IV | CC-VII | Mathematical Physics- III            | Theory    | <p>The students will learn the mathematical tools required for study of some advanced topics of theoretical physics. They will learn complex analysis, variational calculus. This is one of the fundamental concepts of physics which every student of physics should learn.</p>   |
|    |        |                                      | Practical | <p>The students will learn some advanced level programming with SciLab/Python in this course. They will learn to handle Gaussian integration, delta function, numerical solution of first and second order differential equation, some special functions, solution of some basic partial differential equations and evaluation of Fourier coefficients. This course will prepare the students for higher studies and research in theoretical and computational physics.</p>  |
|    | CC-IX  | Elements of Modern Physics           | Theory    | <p>The students will be introduced to the fascinating world of quantum physics in this course. One cannot have any other tool except this branch to probe the physics in the micro world. The students will become familiar with the mathematical tools and</p>  |

|   |        |                                      |                                |  |
|---|--------|--------------------------------------|--------------------------------|--|
|   |        |                                      | Practical                      | <p>their physical implications and have a good practice in solving problems using those tools. The students will learn basics of nuclear structure, radioactivity, nuclear fission &amp; fusion. They will also learn fundamental principle of Laser and its applications in this course. This course is extremely important from theoretical as well as application point of view.</p> <p>This laboratory course will introduce the students to some advanced level experiments. The students will learn to determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of <math>e/m</math> of electron and behavior of tunnel diode</p>  |
|   | CC-X   | Analog Systems & Applications        | <p>Theory</p> <p>Practical</p> | <p>This course forms the basis of electronics which is undoubtedly at the heart of most of the technological advances of the present era. The students will understand the basic concepts of semiconductor physics and its application. They will learn about the operation, characteristics and various applications of different type of diodes, transistors, field effect transistors, OPAMP and oscillators. They will also have an idea about working of amplifier and regulated power supply.</p> <p>This laboratory course will provide the student with adequate exposure to some essential laboratory equipments like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for higher studies or research in experimental Physics.</p> |
|   | SEC-2  | Electrical Circuits & Network Skills | Theory                         | The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode   |
| V | CC-XI  | Quantum Mechanics & Applications     | <p>Theory</p> <p>Practical</p> | <p>The already introduced Quantum Mechanics finds application in this course and hence this is the appropriate course to introduce Atomic Physics so that the students get continuity in their progress. Student will also learn the behavior of atoms in magnetic and electric field. This course is essential for progress to higher studies and research career in physics.</p> <p>The student will learn some advanced computational techniques and applying them to solve various problems related to quantum mechanics using SciLab/C++/Python in this course.</p>   |
|   | CC-XII | Solid State Physics                  | Theory                         | The study of the solid state encompasses the   |

|    |           |                               |           |   |
|----|-----------|-------------------------------|-----------|---|
|    |           |                               | Practical | <p>understanding of the organizational, mechanical, magnetic and electrical properties of the substance as well as the forces that bind the units into the solid state. By far the most important subfield of solid state physics in the 20th century is the study of semiconductors and solid state electronics. The syllabus also covers Superconductivity, the ability of certain materials to conduct electric current with practically zero resistance. Superconductors have been employed in, or proposed for use in, an enormous variety of applications.</p> <p>All the Experiments of this course are related to investigation of fundamental and electrical and magnetic properties of solids. The determinations of BH loop area of ferromagnetic substance, dielectric constant of a material, study and verification of temperature dependence of resistance of semiconductor etc by experiments will boost up the interest of the students.</p> |
|    | DSE-1 (1) | Advanced Mathematical Physics | Theory    | <p>The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of Linear Vector Space, Matrices: Eigen Value &amp; Eigen Vector Problems, Cartesian Tensors, General Tensors, Symmetric – Asymmetric Tensors etc.</p>   |
|    |           |                               | Practical | <p>The student will learn some advanced computational techniques &amp; simulation based techniques using SciLab/C++</p>   |
|    | DSE-2 (5) | Classical Dynamics            | Theory    | <p>This course is aimed for solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of advanced mechanics. Students will learn to apply the Hamiltonian, Lagrangian theory in various real life mechanical systems including systems with small oscillations. Here students will also learn about the Special theory of Relativity.</p>  |
| VI | CC-XIII   | Electromagnetic Theory        | Theory    | <p>The students will go through a very important training in Electromagnetic Theory which is one of the fundamental components of classical physics. The important set of relations of Electrostatics, Magnetostatics, Electro-magnetic Induction, taught in earlier Semesters find application in this topic. The electromagnetic wave is generated naturally from the Maxwell's relations and the students will get the explanation of polarization and related optical and other aspects from this theory.</p>   |
|    |           |                               | Practical | <p>The behavior of electromagnetic wave after refraction as established through well known laws can be verified in the laboratory. Also the theoretical predictions on polarization of electromagnetic waves</p>  |

|           |                              |                         |  |  |
|-----------|------------------------------|-------------------------|--|--|
|           |                              |                         |  | find verification through the experiments referred in this course.   |
| CC-XIV    | Statistical Mechanics        | Theory<br><br>Practical |  | <p>In Statistical Mechanics, the students will get an entry into the world of mechanics comprising of a collection of particles and will understand how to study the gross behavior of a system. This approach also establishes the laws of thermodynamics which are the fundamental rules of nature. The Quantum Statistical Mechanics gives the approaches to treat identical elementary particles which are frequently involved in theoretical and experimental research .</p> <p>The students will use C/C++/SciLab/Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers etc. The approach is extended also to the study of different distributions in statistical mechanics.</p> |
| DSE-3 (6) | Nuclear and Particle Physics | Theory                  |  | The students of UG level will get the first lesson of Nuclear Physics in this topic. The contents are very important from the viewpoints of both theory and applications. Since it is very difficult to set up Nuclear Physics Laboratory at the UG level, the students are taught very carefully so that they may get the necessary inputs to carry on the study in Masters and in the Research level.  |
| DSE-4 (8) | Astronomy & Astrophysics     | Theory                  |  | In this course students will study various aspects of astrophysics, e.g. The Sun, Milky Way, Galaxies, and Large Scale Structures & Expanding Universe. Those are the basic foundations of Astronomy & Astrophysics and will help the students to pursue advanced study in this field.   |





# PROGRAMME OUTCOMES (PO) and COURSE OUTCOMES (CO) : POs-Cos

**Department of Physics, Hooghly Women's College**

**2021-2022**

## **PROGRAMME OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO) and COURSE OUTCOMES (CO) : PO-PSO-CO**

**Academic Year: 2021-2022**

**Department: *Department of Physics, Hooghly Women's College***

**Programme name: *B.Sc. (Hons.), Choice Based Credit System under The University of Burdwan***

### **Program Outcomes (PO) :**

The B.Sc. (Hons.) Program provides comprehensive theoretical and practical insights across various fundamental science disciplines. It is ideal for students with a robust foundation in Science and Mathematics, catering to those interested in pursuing diverse and interdisciplinary science careers. The program follows a well-structured curriculum for the holistic development of students, aiming not only to deepen their subject knowledge but also to cultivate a sense of responsibility, along with strong moral and ethical values, fostering the growth of responsible citizens.

#### **➤ Followings may be considered as programme outcomes (PO):**

**PO-1:** This programme helps to develop scientific aptitude among the students and thus can prove to be highly beneficial for the society and also for the development of the nation.

**PO-2:** This programme helps to develop critical thinking, creativity, analytical and problem solving skills among the students.

**PO-3:** The students will be able to learn necessary computational skill, use of technology and use of ICT required for an effective learning experience and further progress to higher studies.

**PO-4:** After completion of this programme the students will be able to pursue higher studies in basic sciences or social sciences (M.Sc.) in different Universities, IIT's, IISER's, NIT's and other reputed institutes of higher learning in India and abroad, and then choose research career for the welfare of mankind and society. Students have also the option to enroll themselves for different applied science/ technical courses, B.Ed. and some other professional job oriented courses such as BCA, MCA, MBA, Marketing etc.

**PO-5:** Students after completion of this programme have the eligibility to join jobs in Indian Civil Services as IAS, IFS, IPS etc., WBCS, UPSC, Banking Sector, Railways, Airlines, technical jobs at research institutes or as school teacher through SSC.

**PO-6:** After completion of the B.Sc. degree there are various other options available for the science students. Often, they are recruited by big MNC's and different reputed companies in IT sector. Many students are directly recruited by some reputed companies through campus recruitment drive every year. They may even become entrepreneur and choose to start their own business or industrial units.

**PO-7:** The students will be able to engage themselves in independent thinking and lifelong learning in the present context of scientific and technological advancement.

### Program Specific Outcomes (PSO) :

➤ **Followings may be considered as Program Specific Outcomes (PSO):**

**PSO-1:** The students will acquire a scientific knowledge of the fundamental principles of Physics through study of Classical Mechanics, Electromagnetic Theory, Optics, Heat and Thermodynamics, Statistical Mechanics, Solid State Physics, Nuclear Physics, Modern Physics, Quantum Mechanics and other areas of Physics.

**PSO-2:** The students will learn use of appropriate level of technology for : a) experimental design and implementation, b) analysis of experimental data, and c) numerical and mathematical methods in problem solving, d) different computational techniques and apply them for experimental data analysis and solving theoretical problems.

**PSO-3:** The students will acquire a fair amount of computational skill using open source software packages such as SciLab, Gnuplot, Python, etc. in both Linux and Windows platform. This will not only prepare them for higher studies or research in any branch of Physics but also make them ready for various kind of job in IT sector and other industries.

**PSO-4:** The students will learn effective communication skill to present their knowledge of physics from basic concepts to specific advanced areas in the form of preparation of laboratory note book, project work, seminar presentation, poster presentation, wall magazines, models and other modes.

**PSO-5:** The students will learn to work independently as well as a group during laboratory sessions, projects and student seminars.

**PSO-6:** Students will get academic exposure through the various Internships offered by reputed National Research Institutes during their UG tenure. They will be able to utilize the small summer/ winter recesses through their involvement in small projects under careful guidance of reputed faculties and may get the flavor of the current trend of research.

**PSO-7:** The student will acquire a purposeful knowledge of scientific literature and ethical issues related to physics.

### Course Outcomes (CO) :

Name of Programme : **THREE-YEAR B.Sc. HONOURS PROGRAMME IN PHYSICS (Under CBCS)**

Year of Introduction/Implementation: **Session 2017-2018** (The syllabus of this course has been framed by the University of Burdwan)

| Semester | Course Code | Course Name            | Theory / Practical | Course Outcome (CO)   |
|----------|-------------|------------------------|--------------------|---|
| I        | CC-I        | Mathematical Physics-I | Theory             | This course will acquaint the students with basic mathematical tools like vectors, matrices and calculus which are extremely essential to study theoretical and experimental physics. |
|          |             |                        | Practical          | The students will learn basics of programming in Sci-Lab/Python, a universally accepted open source programming language. It will also help in  |

|    |        |                         |           |   |
|----|--------|-------------------------|-----------|---|
|    |        |                         |           | interdisciplinary research in future.   |
|    | CC-II  | Mechanics               | Theory    | This course in Classical Mechanics serves as the foundation for further progress towards study of physics at graduate or post-graduate level. Newtonian mechanics forms the basis of this course. The study of nature through different conservation principles are introduced with detailed treatment. The Physics of rotational motion of a rigid body are also introduced.   |
|    |        |                         | Practical | In this course the students will be familiar with some basic apparatus used in physics laboratory. They will learn how to make systematic experimental observation, data collection, recording of data and other basic laboratory practices in this course. They will learn how to plot graphs and determine different parameters from the graph. They will also learn how to estimate errors in experimental data. They will learn the importance of working as a group in any laboratory. They will perform some experiments to verify different laws and to determine different physical quantities related to the Theory portion of the course. |
| II | CC-II  | Electricity & Magnetism | Theory    | The students will learn fundamental properties of charged particles and electric fields in this course. This course will also give students an understanding of the phenomena of electricity, magnetism, electromagnetic induction and electrical circuits which are extremely essential for higher studies in physics and also important for various engineering applications. This course builds the basis for studying more advanced topics in electromagnetic theory.   |
|    |        |                         | Practical | The students will strengthen their skill of experimental work in this course. They will be familiar with various electrical components, power supply, multimeter and various other measuring instruments. They will be able to perform experiments on various topics of electricity and magnetism in this course. They will learn about precautions to be taken during performing an experiment and will be able to identify different sources of error. They will also learn how to analyze experimental data.   |
|    | CC-III | Wave & Optics           | Theory    | The students will gain basic knowledge about vibration, wave motion and wave theory of light. Study of classical harmonic oscillator and wave propagation in vacuum and material media, and phenomena of interference and diffraction of light are important for further progress to more advanced topics of Physics.   |

|     |       |                               |           |  |
|-----|-------|-------------------------------|-----------|--|
|     |       |                               | Practical | In this laboratory course the students will be acquainted with spectrometer, a very important optical instrument and some other optical instruments like Fresnel's biprism and Newton's ring experiment. They will learn how to level a spectrometer and how to take readings from it. They will also be familiar with various light sources used in physics laboratory. They will be able to determine some well known physical quantities like refractive index etc. by performing laboratory work.  |
| III | CC-IV | Mathematical Physics-II       | Theory    | In this course the students will learn more advanced topics of mathematical physics like Fourier series, some special functions, special integrals, integral transforms, partial differential equations and probability. All these topics are very important for studying theoretical aspects of various branches of physics.  |
|     |       |                               | Practical | In this course the students will learn more advanced computational techniques using different packages of SciLab/Python/Frotran. They will learn various numerical analysis techniques like use of array, numerical solution of problems of matrix algebra, numerical integration, interpolation, solution of differential equation and curve fitting. This course will immensely benefit the students for higher studies and research career in Physics.  |
|     | CC-V  | Thermal Physics               | Theory    | Thermodynamics is introduced in this course and this covers fundamental laws of nature. Problems related to conversion of heat into work or the vice versa give rise to thermodynamics. Students will learn the principle of operation of engines and refrigerators in this course.<br>The students learn the basic distribution laws which are obeyed by the molecules in the Thermal Physics part and the application to explain the basic laws of ideal gas. The limitation to explain different observed phenomena with ideal gas prescription leads the study of real gas and also conduction of heat in this course. |
|     |       |                               | Practical | In this course the student will perform different experiments on heat and thermodynamics. This laboratory course will further enrich their experimental skill learned so far.  |
|     | CC-VI | Digital System & Applications | Theory    | This topic intends to make the students familiar with the digital world. Starting from the introductory ideas of ICs, fundamental Gates and different number systems, the topic in steps is extended to implementation of different logic circuits. The  |

|      |                               |                                      |  |   |
|------|-------------------------------|--------------------------------------|--|---|
|      |                               |                                      | Practical  | <p>students will be familiar with the basics of hardware; learn Counters, Registers, Flip-Flops, Data Processing Circuits and Computer Organization.</p> <p>This course will give the students hand on training of fabrication of the basic electronic components like different Gates, Flip-Flops, Shift Registers, Multiplexers using standard ICs.</p>   |
|      | SEC-1                         | Renewable Energy & Energy Harvesting | Theory   | In this course students will learn about alternative energy sources like solar energy, wind power etc. and energy conservation and applications.  |
| IV   | CC-VII                        | Mathematical Physics-III             | Theory   | The students will learn the mathematical tools required for study of some advanced topics of theoretical physics. They will learn complex analysis, variational calculus. This is one of the fundamental concepts of physics which every student of physics should learn.   |
|      |                               |                                      | Practical  | The students will learn some advanced level programming with SciLab/Python in this course. They will learn to handle Gaussian integration, delta function, numerical solution of first and second order differential equation, some special functions, solution of some basic partial differential equations and evaluation of Fourier coefficients. This course will prepare the students for higher studies and research in theoretical and computational physics.  |
|      | CC-IX                         | Elements of Modern Physics           | Theory   | The students will be introduced to the fascinating world of quantum physics in this course. One cannot have any other tool except this branch to probe the physics in the micro world. The students will become familiar with the mathematical tools and their physical implications and have a good practice in solving problems using those tools. The students will learn basics of nuclear structure, radioactivity, nuclear fission & fusion. They will also learn fundamental principle of Laser and its applications in this course. This course is extremely important from theoretical as well as application point of view. |
|      |                               |                                      | Practical  | This laboratory course will introduce the students to some advanced level experiments. The students will learn to determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of e/m of electron and behavior of tunnel diode   |
| CC-X | Analog Systems & Applications | Theory                               | This course forms the basis of electronics which is undoubtedly at the heart of most of the technological advances of the present era. The students will understand the basic concepts of semiconductor physics and its application. They will learn about the |   |

|   |        |                                      |           |   |
|---|--------|--------------------------------------|-----------|---|
|   |        |                                      | Practical | <p>operation, characteristics and various applications of different type of diodes, transistors, field effect transistors, OPAMP and oscillators. They will also have an idea about working of amplifier and regulated power supply.</p> <p>This laboratory course will provide the student with adequate exposure to some essential laboratory equipments like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for higher studies or research in experimental Physics.</p> |
|   | SEC-2  | Electrical Circuits & Network Skills | Theory    | The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode  |
| V | CC-XI  | Quantum Mechanics & Applications     | Theory    | The already introduced Quantum Mechanics finds application in this course and hence this is the appropriate course to introduce Atomic Physics so that the students get continuity in their progress. Student will also learn the behavior of atoms in magnetic and electric field. This course is essential for progress to higher studies and research career in physics.   |
|   |        |                                      | Practical | The student will learn some advanced computational techniques and applying them to solve various problems related to quantum mechanics using SciLab/C++/Python in this course.  |
|   | CC-XII | Solid State Physics                  | Theory    | The study of the solid state encompasses the understanding of the organizational, mechanical, magnetic and electrical properties of the substance as well as the forces that bind the units into the solid state. By far the most important subfield of solid state physics in the 20th century is the study of semiconductors and solid state electronics. The syllabus also covers Superconductivity, the ability of certain materials to conduct electric current with practically zero resistance. Superconductors have been employed in, or proposed for use in, an enormous variety of applications.  |
|   |        |                                      | Practical | All the Experiments of this course are related to investigation of fundamental and electrical and magnetic properties of solids. The determinations of BH loop area of ferromagnetic substance, dielectric constant of a material, study and verification of temperature dependence of resistance of semiconductor etc by experiments will boost up the interest of the students.   |

|    |           |                               |           |  |
|----|-----------|-------------------------------|-----------|--|
|    |           |                               |           |  |
|    | DSE-1 (1) | Advanced Mathematical Physics | Theory    | The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of Linear Vector Space, Matrices: Eigen Value & Eigen Vector Problems, Cartesian Tensors, General Tensors , Symmetric – Asymmetric Tensors etc.  |
|    |           |                               | Practical | The student will learn some advanced computational techniques & simulation based techniques using SciLab/C++   |
|    | DSE-2 (5) | Classical Dynamics            | Theory    | This course is aimed for solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of advanced mechanics. Students will learn to apply the Hamiltonian, Lagrangian theory in various real life mechanical systems including systems with small oscillations. Here students will also learn about the Special theory of Relativity.  |
| VI | CC-XIII   | Electromagnetic Theory        | Theory    | The students will go through a very important training in Electromagnetic Theory which is one of the fundamental components of classical physics. The important set of relations of Electrostatics, Magnetostatics, Electro-magnetic Induction, taught in earlier Semesters find application in this topic. The electromagnetic wave is generated naturally from the Maxwell's relations and the students will get the explanation of polarization and related optical and other aspects from this theory. |
|    |           |                               | Practical | The behavior of electromagnetic wave after refraction as established through well known laws can be verified in the laboratory. Also the theoretical predictions on polarization of electromagnetic waves find verification through the experiments referred in this course.   |
|    | CC-XIV    | Statistical Mechanics         | Theory    | In Statistical Mechanics, the students will get an entry into the world of mechanics comprising of a collection of particles and will understand how to study the gross behavior of a system. This approach also establishes the laws of thermodynamics which are the fundamental rules of nature. The Quantum Statistical Mechanics gives the approaches to treat identical elementary particles which are frequently involved in theoretical and experimental research .                                 |
|    |           |                               | Practical | The students will use C/C++/SciLab/Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers etc. The approach is extended also to the study of different distributions in statistical mechanics.  |



|           |                              |        |   |
|-----------|------------------------------|--------|---|
| DSE-3 (6) | Nuclear and Particle Physics | Theory | The students of UG level will get the first lesson of Nuclear Physics in this topic. The contents are very important from the viewpoints of both theory and applications. Since it is very difficult to set up Nuclear Physics Laboratory at the UG level, the students are taught very carefully so that they may get the necessary inputs to carry on the study in Masters and in the Research level. |
| DSE-4 (8) | Astronomy & Astrophysics     | Theory | In this course students will study various aspects of astrophysics, e.g. The Sun, Milky Way, Galaxies, and Large Scale Structures & Expanding Universe. Those are the basic foundations of Astronomy & Astrophysics and will help the students to pursue advanced study in this field.  |





# PROGRAMME OUTCOMES (PO) and COURSE OUTCOMES (CO) : POs-Cos

**Department of Physics, Hooghly Women's College**

**2022-2023**

# Hooghly Women's College

## *Department of Physics*

### **PROGRAMME OUTCOMES (PO), PROGRAM SPECIFIC OUTCOMES (PSO) and COURSE OUTCOMES (CO) : PO-PSO-CO**

**Programme : B.Sc. (Hons.) (CBCS under The University of Burdwan)**

#### *Program Outcomes (PO) :*

The B.Sc. (Hons.) Program provides comprehensive theoretical and practical insights across various fundamental science disciplines. It is ideal for students with a robust foundation in Science and Mathematics, catering to those interested in pursuing diverse and interdisciplinary science careers. The program follows a well-structured curriculum for the holistic development of students, aiming not only to deepen their subject knowledge but also to cultivate a sense of responsibility, along with strong moral and ethical values, fostering the growth of responsible citizens.

➤ Followings may be considered as programme outcomes (PO):

**PO-1:** This programme helps to develop scientific aptitude among the students and thus can prove to be highly beneficial for the society and also for the development of the nation.

**PO-2:** This programme helps to develop critical thinking, creativity, analytical and problem solving skills among the students.

**PO-3:** The students will be able to learn necessary computational skill, use of technology and use of ICT required for an effective learning experience and further progress to higher studies.

**PO-4:** After completion of this programme the students will be able to pursue higher studies in basic sciences or social sciences (M.Sc.) in different Universities, IIT's, IISER's, NIT's and other reputed institutes of higher learning in India and abroad, and then choose research career for the welfare of mankind and society. Students have also the option to enroll themselves for different applied science/ technical courses, B.Ed. and some other professional job oriented courses such as BCA, MCA, MBA, Marketing etc.

**PO-5:** Students after completion of this programme have the eligibility to join jobs in Indian Civil Services as IAS, IFS, IPS etc., WBCS, UPSC, Banking Sector, Railways, Airlines, technical jobs at research institutes or as school teacher through SSC.

**PO-6:** After completion of the B.Sc. degree there are various other options available for the science students. Often, they are recruited by big MNC's and different reputed companies in IT sector. Many students are directly recruited by some reputed companies through campus recruitment drive every year. They may even become entrepreneur and choose to start their own business or industrial units.

**PO-7:** The students will be able to engage themselves in independent thinking and lifelong learning in the present context of scientific and technological advancement.

**Program Specific Outcomes (PSO) :**

**Programme : B.Sc. (Hons. in Physics) (CBCS under The University of Burdwan)**

➤ Followings may be considered as Program Specific Outcomes (PSO):

**PSO-1:** The students will acquire a scientific knowledge of the fundamental principles of Physics through study of Classical Mechanics, Electromagnetic Theory, Optics, Heat and Thermodynamics, Statistical Mechanics, Solid State Physics, Nuclear Physics, Modern Physics, Quantum Mechanics and other areas of Physics.

**PSO-2:** The students will learn use of appropriate level of technology for : a) experimental design and implementation, b) analysis of experimental data, and c) numerical and mathematical methods in problem solving, d) different computational techniques and apply them for experimental data analysis and solving theoretical problems.

**PSO-3:** The students will acquire a fair amount of computational skill using open source software packages such as SciLab, Gnuplot, Python, etc. in both Linux and Windows platform. This will not only prepare them for higher studies or research in any branch of Physics but also make them ready for various kind of job in IT sector and other industries.

**PSO-4:** The students will learn effective communication skill to present their knowledge of physics from basic concepts to specific advanced areas in the form of preparation of laboratory note book, project work, seminar presentation, poster presentation, wall magazines, models and other modes.

**PSO-5:** The students will learn to work independently as well as a group during laboratory sessions, projects and student seminars.

**PSO-6:** Students will get academic exposure through the various Internships offered by reputed National Research Institutes during their UG tenure. They will be able to utilize the small summer/ winter recesses through their involvement in small projects under careful guidance of reputed faculties and may get the flavor of the current trend of research.

**PSO-7:** The student will acquire a purposeful knowledge of scientific literature and ethical issues related to physics.

**Course Outcomes (CO) :**

**Programme : B.Sc. (Hons. in Physics) (CBCS under The University of Burdwan)**

Name of Programme : **THREE-YEAR B.Sc. HONOURS PROGRAMME IN PHYSICS (Under CBCS)**

Year of Introduction/Implementation: **Session 2017-2018** (The syllabus of this course has been framed by the University of Burdwan)

| Semester | Course Code | Course Name            | Theory / Practical | Course Outcome (CO)   |
|----------|-------------|------------------------|--------------------|---|
| I        | CC-I        | Mathematical Physics-I | Theory             | This course will acquaint the students with basic mathematical tools like vectors, matrices and calculus which are extremely essential to study theoretical and experimental physics. |
|          |             |                        | Practical          | The students will learn basics of programming in SciLab/Python, a universally accepted open source  |

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|    |        |                         |           | programming language. It will also help in interdisciplinary research in future.  |
|    | CC-II  | Mechanics               | Theory    | This course in Classical Mechanics serves as the foundation for further progress towards study of physics at graduate or post-graduate level. Newtonian mechanics forms the basis of this course. The study of nature through different conservation principles are introduced with detailed treatment. The Physics of rotational motion of a rigid body are also introduced.   |
|    |        |                         | Practical | In this course the students will be familiar with some basic apparatus used in physics laboratory. They will learn how to make systematic experimental observation, data collection, recording of data and other basic laboratory practices in this course. They will learn how to plot graphs and determine different parameters from the graph. They will also learn how to estimate errors in experimental data. They will learn the importance of working as a group in any laboratory. They will perform some experiments to verify different laws and to determine different physical quantities related to the Theory portion of the course. |
| II | CC-II  | Electricity & Magnetism | Theory    | The students will learn fundamental properties of charged particles and electric fields in this course. This course will also give students an understanding of the phenomena of electricity, magnetism, electromagnetic induction and electrical circuits which are extremely essential for higher studies in physics and also important for various engineering applications. This course builds the basis for studying more advanced topics in electromagnetic theory.   |
|    |        |                         | Practical | The students will strengthen their skill of experimental work in this course. They will be familiar with various electrical components, power supply, multimeter and various other measuring instruments. They will be able to perform experiments on various topics of electricity and magnetism in this course. They will learn about precautions to be taken during performing an experiment and will be able to identify different sources of error. They will also learn how to analyze experimental data.   |
|    | CC-III | Wave & Optics           | Theory    | The students will gain basic knowledge about vibration, wave motion and wave theory of light. Study of classical harmonic oscillator and wave propagation in vacuum and material media, and phenomena of interference and diffraction of light are important for further progress to more advanced topics of Physics.   |

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|     |       |                               | Practical | In this laboratory course the students will be acquainted with spectrometer, a very important optical instrument and some other optical instruments like Fresnel's biprism and Newton's ring experiment. They will learn how to level a spectrometer and how to take readings from it. They will also be familiar with various light sources used in physics laboratory. They will be able to determine some well known physical quantities like refractive index etc. by performing laboratory work.  |
| III | CC-IV | Mathematical Physics-II       | Theory    | In this course the students will learn more advanced topics of mathematical physics like Fourier series, some special functions, special integrals, integral transforms, partial differential equations and probability. All these topics are very important for studying theoretical aspects of various branches of physics.  |
|     |       |                               | Practical | In this course the students will learn more advanced computational techniques using different packages of SciLab/Python/Fortran. They will learn various numerical analysis techniques like use of array, numerical solution of problems of matrix algebra, numerical integration, interpolation, solution of differential equation and curve fitting. This course will immensely benefit the students for higher studies and research career in Physics.  |
|     | CC-V  | Thermal Physics               | Theory    | Thermodynamics is introduced in this course and this covers fundamental laws of nature. Problems related to conversion of heat into work or the vice versa give rise to thermodynamics. Students will learn the principle of operation of engines and refrigerators in this course.<br>The students learn the basic distribution laws which are obeyed by the molecules in the Thermal Physics part and the application to explain the basic laws of ideal gas. The limitation to explain different observed phenomena with ideal gas prescription leads the study of real gas and also conduction of heat in this course. |
|     |       |                               | Practical | In this course the student will perform different experiments on heat and thermodynamics. This laboratory course will further enrich their experimental skill learned so far.  |
|     | CC-VI | Digital System & Applications | Theory    | This topic intends to make the students familiar with the digital world. Starting from the introductory ideas of ICs, fundamental Gates and different number systems, the topic in steps is extended to  |

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|    |        |                                      | Practical | <p>implementation of different logic circuits. The students will be familiar with the basics of hardware; learn Counters, Registers, Flip-Flops, Data Processing Circuits and Computer Organization.</p> <p>This course will give the students hand on training of fabrication of the basic electronic components like different Gates, Flip-Flops, Shift Registers, Multiplexers using standard ICs.</p>   |
|    | SEC-1  | Renewable Energy & Energy Harvesting | Theory    | In this course students will learn about alternative energy sources like solar energy, wind power etc. and energy conservation and applications.  |
| IV | CC-VII | Mathematical Physics- III            | Theory    | The students will learn the mathematical tools required for study of some advanced topics of theoretical physics. They will learn complex analysis, variational calculus. This is one of the fundamental concepts of physics which every student of physics should learn.   |
|    |        |                                      | Practical | The students will learn some advanced level programming with SciLab/Python in this course. They will learn to handle Gaussian integration, delta function, numerical solution of first and second order differential equation, some special functions, solution of some basic partial differential equations and evaluation of Fourier coefficients. This course will prepare the students for higher studies and research in theoretical and computational physics.  |
|    | CC-IX  | Elements of Modern Physics           | Theory    | The students will be introduced to the fascinating world of quantum physics in this course. One cannot have any other tool except this branch to probe the physics in the micro world. The students will become familiar with the mathematical tools and their physical implications and have a good practice in solving problems using those tools. The students will learn basics of nuclear structure, radioactivity, nuclear fission & fusion. They will also learn fundamental principle of Laser and its applications in this course. This course is extremely important from theoretical as well as application point of view. |
|    |        |                                      | Practical | This laboratory course will introduce the students to some advanced level experiments. The students will learn to determine value of Planck's constant, study of photoelectric effect, verification of Stefan's law of radiation, determination of e/m of electron and behaviour of tunnel diode  |
|    | CC-X   | Analog Systems & Applications        | Theory    | This course forms the basis of electronics which is undoubtedly at the heart of most of the technological advances of the present era. The students will understand the basic concepts of semiconductor   |

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|   |        |                                      | Practical | <p>physics and its application. They will learn about the operation, characteristics and various applications of different type of diodes, transistors, field effect transistors, OPAMP and oscillators. They will also have an idea about working of amplifier and regulated power supply.</p> <p>This laboratory course will provide the student with adequate exposure to some essential laboratory equipments like CRO, function generator, regulated power supply etc. The students will design, fabricate and perform experiments with zener diode, transistor, OPAMP and Wein Bridge oscillator. The students will acquire basic skill required for higher studies or research in experimental Physics.</p> |
|   | SEC-2  | Electrical Circuits & Network Skills | Theory    | The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode   |
| V | CC-XI  | Quantum Mechanics & Applications     | Theory    | The already introduced Quantum Mechanics finds application in this course and hence this is the appropriate course to introduce Atomic Physics so that the students get continuity in their progress. Student will also learn the behavior of atoms in magnetic and electric field. This course is essential for progress to higher studies and research career in physics.  |
|   |        |                                      | Practical | The student will learn some advanced computational techniques and applying them to solve various problems related to quantum mechanics using SciLab/C++/Python in this course.   |
|   | CC-XII | Solid State Physics                  | Theory    | The study of the solid state encompasses the understanding of the organizational, mechanical, magnetic and electrical properties of the substance as well as the forces that bind the units into the solid state. By far the most important subfield of solid state physics in the 20th century is the study of semiconductors and solid state electronics. The syllabus also covers Superconductivity, the ability of certain materials to conduct electric current with practically zero resistance. Superconductors have been employed in, or proposed for use in, an enormous variety of applications.   |
|   |        |                                      | Practical | All the Experiments of this course are related to investigation of fundamental and electrical and magnetic properties of solids. The determinations of BH loop area of ferromagnetic substance, dielectric constant of a material, study and verification of temperature dependence of resistance of semiconductor etc by experiments will boost up the  |



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|    |           |                               |           | interest of the students.  |
|    | DSE-1 (1) | Advanced Mathematical Physics | Theory    | The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of Linear Vector Space, Matrices: Eigen Value & Eigen Vector Problems, Cartesian Tensors, General Tensors , Symmetric – Asymmetric Tensors etc.  |
|    |           |                               | Practical | The student will learn some advanced computational techniques & simulation based techniques using SciLab/C++   |
|    | DSE-2 (5) | Classical Dynamics            | Theory    | This course is aimed for solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen in the areas of advanced mechanics. Students will learn to apply the Hamiltonian, Lagrangian theory in various real life mechanical systems including systems with small oscillations. Here students will also learn about the Special theory of Relativity.  |
| VI | CC-XIII   | Electromagnetic Theory        | Theory    | The students will go through a very important training in Electromagnetic Theory which is one of the fundamental components of classical physics. The important set of relations of Electrostatics, Magnetostatics, Electro-magnetic Induction, taught in earlier Semesters find application in this topic. The electromagnetic wave is generated naturally from the Maxwell's relations and the students will get the explanation of polarization and related optical and other aspects from this theory. |
|    |           |                               | Practical | The behavior of electromagnetic wave after refraction as established through well known laws can be verified in the laboratory. Also the theoretical predictions on polarization of electromagnetic waves find verification through the experiments referred in this course.   |
|    | CC-XIV    | Statistical Mechanics         | Theory    | In Statistical Mechanics, the students will get an entry into the world of mechanics comprising of a collection of particles and will understand how to study the gross behavior of a system. This approach also establishes the laws of thermodynamics which are the fundamental rules of nature. The Quantum Statistical Mechanics gives the approaches to treat identical elementary particles which are frequently involved in theoretical and experimental research .                                 |
|    |           |                               | Practical | The students will use C/C++/SciLab/Python programming to study aspects of statistics like Random numbers and Time scale, application of Random numbers etc. The approach is extended also to the study of different distributions in statistical mechanics.  |

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|  | DSE-3 (6) | Nuclear and Particle Physics | Theory | The students of UG level will get the first lesson of Nuclear Physics in this topic. The contents are very important from the viewpoints of both theory and applications. Since it is very difficult to set up Nuclear Physics Laboratory at the UG level, the students are taught very carefully so that they may get the necessary inputs to carry on the study in Masters and in the Research level. |
|  | DSE-4 (8) | Astronomy & Astrophysics     | Theory | In this course students will study various aspects of astrophysics, e.g. The Sun, Milky Way, Galaxies, Large Scale Structures & Expanding Universe. Those are the basic foundations of Astronomy & Astrophysics and will help the students to pursue advanced study in this field.  |

