Department of Physics

Bankura Zilla Saradamani Mahila Mahavidyapith

4 Years Honours Degree with PHYSICS MAJOR

PROGRAMME OUTCOMES

- The Physics Undergraduate (UG) Programme consists of **major**, **minor** and **interdisciplinary** subjects
- The curriculum is derived from the National Education Policy (**NEP-2020**) and encompasses a comprehensive range of topics in the discipline of Physics.
- Upon completing the course, the students will acquire a substantial amount of information.
- The entire course is suitable for the competitive test for advanced studies and research.
- This program offers a wide range of interdisciplinary courses. The students will get a wide range of talents from many fields, which will be quite valuable to them.
- Employ critical thinking and scientific knowledge to design, carry out, record, and analyze the results of Physics experiments.
- Create an awareness of the impact of Physics on society and development outside the scientific community.
- To inculcate the scientific temperament in the students and outside the scientific community.
- Exhibit disciplined work habits as an individual.

PROGRAMME SPECIFIC OUTCOMES

- Gain knowledge of Physics through theory and practice.
- Understand good laboratory practices and safety.
- Gain the capability of oral and written scientific communication and will prove that they can think critically and work independently.
- Make aware and handle the sophisticated instruments/equipment.

COURSE OUTCOMES	
Semester – I	
Course Name	**Outcomes**
MJC-1 (Th.) **[DSC Major Paper]** **Core T-1: Mechanics and General Properties of Matter (3 Credits)**	❖ Develop the concepts of classical mechanics, vector, vector differentiation, and integration. ❖ Acquire knowledge about the elasticity of the material and the streamline and turbulent motion. Understand the relationship between elastic constants. ❖ Understand how major concepts developed and changed over time. ❖ Capable of analyzing and solving problems using oral and written reasoning skills based on the concepts of classical mechanics. ❖ Ability to prepare and organize a presentation on the application of fundamental dynamics
MJC-1 (Pr.) **[DSC Major Paper]** **Core P-1: Mechanics and General Properties of Matter Lab. (1 Credit)**	❖ Students will learn to use the screw gauge, slide callipers, microscope, telescope, stopwatch, etc. ❖ They will know how to measure the Young's modulus of a material experimentally. ❖ They will be able to determine experimentally the acceleration due to gravity. ❖ Students will know how to determine the coefficient of viscosity of liquid. ❖ They will know how to measure the spring constant experimentally.
MN-1 (Th.) **[Minor Paper]** **Core T-1: Mechanics and General Properties of Matter (3 Credits)**	❖ Develop the concepts of classical mechanics, vector, vector differentiation, and integration. ❖ Acquire knowledge about the elasticity of the material and the streamline and turbulent motion. Understand the relationship between elastic constants. ❖ Understand how major concepts developed and changed over time.

	❖ Capable of analyzing and solving problems using oral and written reasoning skills based on the concepts of classical mechanics.
MN-1 (Pr.) **[Minor Paper]** **Core P-1: Mechanics and General Properties of Matter Lab.** **(1 Credit)**	❖ Students will learn to use the screw gauge, slide callipers, microscope, telescope, stopwatch, etc. ❖ They will know how to measure the Young's modulus of a material experimentally. ❖ They will be able to determine experimentally the acceleration due to gravity. ❖ Students will know how to determine the coefficient of viscosity of liquid. ❖ They will know how to measure the spring constant experimentally.
MD-1 **[Multidisciplinary Paper]** **Fundamental of Physics-I** **(3 Credits)**	❖ Students will learn and develop the concepts of vector and basic knowledge of the vector differential operator Del and understand the operation on the scalar and vector field. ❖ Students will Learn and realize about vector theorems like Divergence and Green theorem etc. ❖ Students will develop the concepts on classical mechanics and enhance the basic knowledge of the non-inertial and inertial frame of reference, variable mass, rocket motion, special theory of relativity. ❖ They will acquire knowledge about the elasticity of the material and the streamline and turbulent motion, application of fundamental dynamics ❖ They can understand the relation between electrical charge, electrical field, electrical potential, superposition of SHM collinearly and perpendicularly and can study the Beat ant Lissajous figures.
SEC-1 (Th.) **[Skill Enhancement Course]** **Basics of Computer and Python Programming** **(2 Credits)**	❖ Students will know about the computer architecture. ❖ They will gain the knowledge on hight level language. ❖ There is a scope to study the Python programming language. ❖ They will know the Grammer, syntax, I/O statements, loops and all other things of the Python language. ❖ Students will know how can solve any physical problem in Python. ❖ There is a scope to learn the graph plotting.

SEC-1 (Pr.) **[Skill Enhancement Course]** **Basics of Computer and Python Programming Lab.** **(1 Credit)**	❖ Students will know to install the python, the interface of Python software. ❖ They will be able to do program how to calculate the multiplication and sum of two numbers, add the even/odd numbers from 1-100, sort the number in ascending/descending order. ❖ They will be able to plot the graph of a sine, cos, and tan curves, the graph of f(x) vs x or x^2 or x^3, the graph of e^x, e^{-x}, and log(x), the graph of $ax + b/x^2$ (where a and b are positive constants). ❖ Students will learn how to plot data file. ❖ There is a scope to learn about the least square fitting.
Semester – II	
MJC-2 (Th.) **[DSC Major Paper]** **Core T-2: Electricity and Magnetism** **(3 Credits)**	❖ The course will help the students to understand the basic concepts of electrostatics including electric field, potential, electrostatic energy, electric dipole etc. ❖ They should be able to understand Laplace's equation, Poisson's equation, method of images and their application to simple electrostatic problems. ❖ The students will also acquire knowledge about dielectric properties of matter and application of laws of electrostatics for dielectric materials. ❖ This course will provide the students with basic knowledge of magnetostatics, i.e. the magnetic effect of current and related laws of physics. ❖ On completion of the course students will learn about electromagnetic induction, magnetic properties of matter, operation of different electrical circuits, network theorem, etc.
MJC-2 (Pr.) **[DSC Major Paper]** **Core P-2: Electricity and Magnetism Lab.** **(1 Credit)**	❖ On performing the laboratory experiments students should have a rudimentary grasp on how experimental equipment related to electricity and magnetism can be used. ❖ They will have a better insight by experimentally verifying some of the laws/theorems of electricity and magnetism. ❖ They will be able to proof the Thevenin, Norton and Maximum power transfer theorems.

	❖ Students will perform the response curve of a Series LCR circuit. ❖ They will know how to construct one Ohm coil.
MN-2 (Th.) **[Minor Paper]** **Core T-2: Electricity and Magnetism** **(3 Credits)**	❖ The course will help the students to understand the basic concepts of electrostatics including electric field, potential, electrostatic energy, electric dipole etc. ❖ They should be able to understand Laplace's equation, Poisson's equation, method of images and their application to simple electrostatic problems. ❖ The students will also acquire knowledge about dielectric properties of matter and application of laws of electrostatics for dielectric materials. ❖ This course will provide the students with basic knowledge of magnetostatics, i.e. the magnetic effect of current and related laws of physics. ❖ On completion of the course students will learn about electromagnetic induction, magnetic properties of matter, operation of different electrical circuits, network theorem, etc.
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MD-2 **[Multidisciplinary Paper]** **Fundamental of Physics-II** **(3 Credits)**	❖ After completion of the course the students should understand the basic concepts about magnetic effect of current, basic concepts about different types of magnetic materials and electromagnetic induction. ❖ This course further enables the students to acquire knowledge about basic concepts of kinetic theory of gases. ❖ They will also gain knowledge about the laws of thermodynamics and their application to different thermodynamic processes. ❖ This course will further help the students to acquire knowledge on basic

	modern physics such as structure of matter, atomic model, production of x-rays, theory of photo electric effect, Compton scattering, pair production and black body radiation.
SEC-2 (Th.) **[Skill Enhancement Course]** **Basics Instrumentation Skill** **(2 Credits)**	❖ Through this course, the students will develop ideas about the basics of measurements. ❖ They learn the uses of various instruments like electronic voltmeter, cathode ray oscilloscope (CRO), Signal Generators and Analysis Instruments, Impedance Bridges & Q-Meters and some digital instruments.
SEC-2 (Pr.) **[Skill Enhancement Course]** **Basics Instrumentation Skill Lab.** **(1 Credit)**	❖ They will observe experimentally the loading effect of a multi-meter while measuring voltage across a low resistance and high resistance. ❖ Students will be able to find the limitations of a multi-meter for measuring low/high frequency voltage and currents. ❖ They will be able to determine the low resistance using a Carry-Foster bridge ❖ Students can find the voltage, frequency, time period and phase angle using CRO. ❖ Measurement of a current through low resistance using a potentiometer. ❖ They can measure the rise, fall and delay times using a CRO. ❖ Students can convert the range of a given measuring instrument (voltmeter, ammeter).
Semester – III	
MJC-3 (Th.) **[DSC Major Paper]** **Mathematical Physics-I** **(3 Credits)**	❖ Students will develop the concepts of First Order and Second Order Differential equations. ❖ They will acquire knowledge on Particular Integral, Partial derivatives, and Integrating factor. ❖ They will learn about vector integration and related theorems like Divergence and Green theorem etc.

	❖ Students can acquire Knowledge about the orthogonal curvilinear coordinate systems and their transformation relation with special emphasis on spherical polar system. ❖ They can be able to think about the mathematical formulation of Fourier series, half range series, Fourier transformation etc. ❖ They will get knowledge about ODE learn to solve series solution of 2nd order ODE, Bessel's differential equation, Legendre's differential equation, Partial differential equations, Solution of Laplace's equation in different coordinate systems by the method of separation of variables.
MJC-3 (Pr.) **[DSC Major Paper]** **Mathematical Physics-I Lab.** **(1 Credit)**	The students will be able to ❖ Understand and visualize different coordinate systems. ❖ Implement basic vector operations in Python. ❖ Solve first- and second-order differential equations using Python. ❖ Implement numerical solutions for ordinary and partial differential equations. ❖ Compute Fourier series for different functions. ❖ Understand and visualize the impact of harmonics in periodic functions. ❖ Explore special functions like Legendre and Bessel functions using Python.
MJC-4 (Th.) **[DSC Major Paper]** **Waves and Oscillation** **(3 Credits)**	❖ The course will provide the students with knowledge of various aspects of simple harmonic oscillation including damped and forced oscillations, resonance, superposition under different conditions, Lissajous figures etc. ❖ The students will acquire knowledge about wave motion, superposition of waves and formation of waves on strings and pipes. ❖ Students also recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems, point out the limitations, and be able to refer to very different solutions of identical oscillator equations due to different initial and boundary conditions.
MJC-4 (Pr.) **[DSC Major Paper]** **Waves and Oscillation Lab.** **(1 Credit)**	The course will help the students to ❖ Know how to determine the acceleration due to gravity at a place using Compound pendulum and Simple pendulum.

	❖ Notice the difference between flat resonance and sharp resonance in case of volume resonator and sonometer experiments respectively. ❖ Verify the laws of transverse vibrations in a stretched string using sonometer and comment on the relation between frequency, length and tension of a stretched string under vibration. ❖ Demonstrate the formation of stationary waves on a string in Melde's string experiment. ❖ Observe the motion of coupled oscillators and normal modes. ❖ Examine phenomena of simple harmonic motion and the distinction between undamped, damped and forced oscillations and the concepts of resonance and quality factor with reference to damped harmonic oscillator.
MN-3 (Th.) **[Minor Paper]** **Waves and Oscillation** **(3 Credits)**	❖ The course will provide the students with knowledge of various aspects of simple harmonic oscillation including damped and forced oscillations, resonance, superposition under different conditions, Lissajous figures etc. ❖ The students will acquire knowledge about wave motion, superposition of waves and formation of waves on strings and pipes. ❖ Students also recognize and use a mathematical oscillator equation and wave equation, and derive these equations for certain systems, point out the limitations, and be able to refer to very different solutions of identical oscillator equations due to different initial and boundary conditions.
MN-3 (Pr.) **[Minor Paper]** **Waves and Oscillation Lab.** **(1 Credit)**	The course will help the students to ❖ Know how to determine the acceleration due to gravity at a place using Compound pendulum and Simple pendulum. ❖ Notice the difference between flat resonance and sharp resonance in case of volume resonator and sonometer experiments respectively. ❖ Verify the laws of transverse vibrations in a stretched string using sonometer and comment on the relation between frequency, length and tension of a stretched string under vibration. ❖ Demonstrate the formation of stationary waves on a string in Melde's string experiment.

	❖ Observe the motion of coupled oscillators and normal modes. ❖ Examine phenomena of simple harmonic motion and the distinction between undamped, damped and forced oscillations and the concepts of resonance and quality factor with reference to damped harmonic oscillator.
MD-3 **[Multidisciplinary Paper]** **Renewable Energy and Energy harvesting** **(3 Credits)**	❖ The students will have sufficient knowledge about the non-conventional and conventional energy sources. ❖ They will learn about the need of renewable energy sources in modern times. ❖ They should acquire the knowledge about the importance of solar energy and methods of utilization of solar energy. ❖ They will develop the basic idea about tidal energy, wind energy, geothermal energy, bio- mass energy, hydropower and applications of these energy sources. ❖ They will also understand how to utilize the piezoelectric effect as a source of non-conventional energy. ❖ The students will gain basic knowledge of electromagnetic energy harvesting.
SEC-3 (Th.) **[Skill Enhancement Course]** **Introduction to LASER and Fibre Optics** **(2 Credits)**	❖ Students will be familiar with the properties and types of LASERs and optical fibers. ❖ They will know about the applications of LASERS and optical fibers.
SEC-3 (Pr.) **[Skill Enhancement Course]** **Introduction to LASER and Fibre Optics Lab.** **(1 Credit)**	A student should be able to demonstrate understanding of and be able to solve problems on ❖ Absorption and spontaneous and stimulated emission in two level, three level, four level systems, and the conditions for laser amplification. ❖ The four-level laser system, the simple homogeneous laser and its output behavior and optimal operating conditions.

	❖ Spectral properties of a single longitudinal mode, mode locked laser operation, schemes for active and passive mode locking in real laser system. ❖ Operations and basic properties of the most common laser types- He-Ne, ruby
Semester – IV	
MJC-5 (Th.) **[DSC Major Paper]** **Mathematical Physics-II** **(3 Credits)**	Students will ❖ Develop the concept about Argand diagram and know the algebraic operation on complex number. ❖ Know about different types of singularity and able to know simplest way of integration over a closed contour. ❖ Able to solve simultaneous equations using matrix method and learn the properties of matrix. ❖ Develop the idea about probability, probability distribution and central limit theorem. ❖ Gain knowledge about Dirac-delta function and Kronecker delta functions.
MJC-5 (Pr.) **[DSC Major Paper]** **Mathematical Physics-II Lab.** **(1 Credit)**	❖ Students will be familiar with Scilab language and be able to install and/or use the programming language. ❖ They will be able to write the program to determine the roots of complex number and unity. ❖ Students will gain sufficient knowledge to plot 2D/3D graph and able to plot data and functions. ❖ Students will be able to solve differential equations and can determine the value of a definite integral. ❖ They gain knowledge about least square fitting and may be apply these concepts to plot best graph in their laboratory work.
MJC-6 (Th.) **[DSC Major Paper]** **Heat and Thermodynamics** **(3 Credits)**	A student will ❖ Know about the kinetic of gases, the zeroth law of thermodynamics, 1st and 2nd law of 1. thermodynamics.

	❖ Gather knowledge about isothermal and adiabatic processes and learn how to solve thermodynamic problems. ❖ Able to understand the working principle of Heat engines – Carnot's engine and its applications. ❖ Learn about entropy and how the entropy of the universe is changing. ❖ Understand the interrelationship between thermodynamic functions and the ability to use such relationships to solve practical problems. ❖ Understand how statistics of the microscopic world can be used to explain the thermal features of the macroscopic world. ❖ Be able to use thermal and statistical principles in a wide range of applications.
MJC-6 (Pr.) **[DSC Major Paper]** **Heat and Thermodynamics Lab.** **(1 Credit)**	A student will be ❖ Able to learn how to experimentally measure the thermal conductivity in different methods. ❖ Also learn about the platinum resistance thermometer, thermocouple, etc.
MJC-7 (Th.) **[DSC Major Paper]** **Classical Mechanics** **(3 Credits)**	Upon successful completion of this course, it is intended that a student will ❖ Know how to impose constraints on a system in order to simplify the methods in solving physics problems. They will also understand the important of concepts such as generalized coordinates and constrained motion. ❖ Learn about Lagrangian and Hamiltonian formulation of classical mechanics and get familiar with their applications to solve simple physics problems. ❖ Distinguish between inertial and non-inertial frames. ❖ They will also get acquainted to the various aspects of Theory and application in the field of special theory of relativity
MJC-7 (Pr.) **[DSC Major Paper]** **Classical Mechanics Lab.** **(1 Credit)**	Upon successful completion of this course, it is intended that a student will be able to ❖ Determine moment of inertia and elastic constants of different materials.

	❖ Estimate the value of acceleration due to gravity and get familiar with the digital timing technique.
MJC-8 (Th.) **[DSC Major Paper]** **Analog Electronics systems and Applications** **(3 Credits)**	❖ This course will help the students to get familiar with different topics of semiconductor physics, three terminal devices, voltage-controlled devices and current controlled devices. ❖ They will able to know about different amplifier circuits. Gain Understand how major concepts developed and changed over time. ❖ The students will come to know about the operational amplifier and its uses in different aspects. ❖ Overall, they will gain sufficient knowledge on the theories of electronic circuits.
MJC-8 (Pr.) **[DSC Major Paper]** **Analog Electronics systems and Applications Lab.** **(1 Credit)**	❖ This course will help the students to get familiar electronic circuits, uses of bread board and discrete components. ❖ Students will learn experimentally the I-V characteristics of PN diode, LED and BJT. ❖ They will be able to design an amplifier using transistor. ❖ They will be able to investigate the uses of Op. Amp. as inverting, non-inverting, adder and subtractor. ❖ The students will be able to design Wien bridge oscillator, integrator, and differentiator by employing Op. Amp.
MN-4 (Th.) **[Minor Paper]** **Heat and Thermodynamics** **(3 Credits)**	A student will ❖ Know about the kinetic of gases, the zeroth law of thermodynamics, 1st and 2nd laws of thermodynamics. ❖ Gather knowledge about isothermal and adiabatic processes and learn how to solve thermodynamic problems. ❖ Able to understand the working principle of Heat engines – Carnot's engine and its applications. ❖ Learn about entropy and how the entropy of the universe is changing. ❖ Understand the interrelationship between thermodynamic functions and the ability to use such relationships to solve practical problems.

	❖ Understand how statistics of the microscopic world can be used to explain the thermal features of the macroscopic world. ❖ Be able to use thermal and statistical principles in a wide range of applications.
MN-4 (Pr.) **[Minor Paper]** **Heat and Thermodynamics Lab.** **(1 Credit)**	❖ Students will be able to learn how to experimentally measure the thermal conductivity in different methods. ❖ They will learn about the platinum resistance thermometer, thermocouple, etc.