B.Sc. (H) Physics

Choice Base Credit System (CBCS)

ACADEMIC SESSION

(w.e.f. 2017-18)

DEPARTMENT OF PHYSICS

FACULTY OF SCIENCES

MATHABHANGA COLLEGE

COOCHBEHAR, WEST BENGAL, INDIA

VISION

A department that can effectively harness its multidisciplinary strengths to create an academically stimulating atmosphere; evolving into a well-integrated system that synergies the efforts of its competent faculty towards imparting intellectual confidence that aids comprehension and complements the spirit of inquiry.

MISSION

- To create well-rounded individuals ready to comprehend scientific and technical challenges offered in the area of specialization.
- To counsel the students so that the road map becomes clearer to them and they have the zest to turn the blueprint of their careers into a material reality.
- To encourage critical thinking and develop their research acumen by aiding the nascent spirit for scientific exploration.
- Help them take economic, social, legal and political considerations when visualizing the role of technology in improving quality of life.
- To infuse intellectual audacity that makes them take bold initiatives to venture into alternative methods and modes to achieve technological breakthroughs.

B.Sc. (Hons.) Physics

Physics is the most fundamental of the sciences. New concepts, such as Quantum Mechanics and Relativity, are introduced at the degree level in order to understand nature at the deepest level.

These theories have profound philosophical implications because they challenge our view of the everyday world. At the same time, they have a huge impact on society since they underpin the technological revolution. While studying one of the most intellectually satisfying disciplines, one can acquire transferable skills including numeracy, problem-solving, an ability to reason clearly and communicate well. Core physics topics include Newtonian Dynamics, Wave Phenomena, The Material Universe, Working with Physics, Practical Physics and Maths for Physics, Electromagnetism, Condensed Matter, Quantum and Atomic Physics and Nuclear and Particle Physics.

Aims of the Undergraduate degree programme in Physics with honours

The overall aims of the Undergraduate honors degree programme in physics are to:

- Producing graduates who are well-grounded in the fundamentals of Physics and acquisition of the necessary skills, in order to use their knowledge in Physics in a wide range of practical applications.
- Developing creative thinking and the power of imagination to enable the graduates to work in research in academia and industry for broader application.
- Accommodating their relevant fields in allied disciplines and allowing the graduates of Physics to fit into the interdisciplinary environment.
- Relating the training of Physics graduates to the employment opportunities within the country.

It also promotes research and creative activities of students by providing exposure to the realm of physical science and technical expertise. The B.Sc. (Hons.) programme in physics is designed to provide a thorough basic knowledge in physics at the undergraduate level. Apart from the

general topics in physics, many of the new topics included in the syllabus keep the students abreast with the latest developments taking place in the field. Also, the experiments chosen for each practical course are such that they bring out the concept of application of the theory in a practical situation. It also helps in creative thinking and self-learning.

PROGRAM OUTCOMES OF UG PROGRAM OF FACULTY OF SCIENCES

PO1	Disciplinary knowledge	Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.
PO2	Communication Skills	Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one"s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information clearly and concisely to different groups.
PO4	Problem solving	Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one"s learning to real-life situations.
PO5	Analytical reasoning	Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and address opposing viewpoints.
PO6	Research-related skills	A sense of inquiry and capability for asking relevant/appropriate questions, problematizing, synthesizing, and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation.

PO7	Technical knowledge/digital literacy	Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. Capability to analyse and synthesize the basic data
PO8	Leadership readiness/qualities	Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

Program Specific Outcomes (PSOs)

The program specific outcomes (PSO"s) are the statement of competencies/abilities that describes the knowledge and capabilities of the post-graduate will have by the end of program studies.

After successful completion of B. Sc. (H) Physics program, the students will be able to

PSO1	Demonstrates (i) a fundamental/systematic or coherent understanding of the academic field of Physics, its different learning areas and applications, and its linkages with related disciplinary areas/subjects; (ii) Demonstrate procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service; (iii) Demonstrate skills in areas related to one"s specialisation area within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.
PSO2	Demonstrates the ability to use Physics skills such as formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.

PSO3	Plan and execute physics-related experiments or investigations, analyse and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.

CO, PSO and PO for Physics Honours for the CBCS program

CC1 Mathematical Physics 1
• CO1 : To acquire knowledge of calculus which are integral part of any branch of Physics • CO2: Understand divergence, gradient and curl and their physical interpretation which are very important for theories of electricity and magnetism to be taught later. • CO3: Solving the first order and second order differential equations • CO4: To develop the problem solving capability
CC 2 Mechanics
• CO1: Students learn accurately how to describe • CO2: Know how to apply the conservation principle and symmetry of a system. • CO3: Understand laws of motion, reference frames, and its applications i.e. projectile motion, simple harmonic oscillator, Rocket motion, elastic and inelastic collisions. • CO4: Understand the idea of conservation of angular momentum, central forces effective potential. • CO5: Understand the application of central force to the stability of circular orbits, Kepler's laws of planetary motion. • CO6: Understand the dynamics of rotating objects i.e. rigid bodies, angular velocity, the moment of inertia and related examples involving the centrifugal force and coriolis force. • CO7: Understand the basics of material properties like, elasticity, elastic constants and their relation, torsion of a cylinder, • CO8 Know the basics of motion of fluid which includes streamlined and turbulent flows, critical velocity, flow of a liquid through a capillary tube. • CO9: To understand special theory of relativity, length contraction, time dilation, mass-energy relation etc. This is one of the corner stone of modern physics.
CC3

Electricity and Magnetism
• CO1: To learn about basic concepts of electrical charges and currents and their properties • CO2: Enhance problem solving capability based on various realistic situation • CO3: Understand the concept of conductors, dielectrics, inductance and capacitance. • CO4: Gather knowledge on the nature of magnetic materials. • CO5: Understand the concept of static and time varying fields. • CO6: Gain knowledge on electromagnetic induction and Faraday's law and its applications • CO7: Learn about EM waves and its propagation • CO8: Learn to use and solve Maxwell's equations
CC4 Waves and Optics
• CO1: Student learn about various types of waves and their propagation. • CO2:To provide a basic understanding of physical optics • CO3:To provide a knowledge of various optical phenomena, for example interference, diffraction, polarization etc.
CC5 Mathematical Physics II
• CO1: Understand how to expand a function in a Fourier series. • CO2: Solving differential equation using power law expansion (so called Frobenius method). Learn about various special functions i.e. Legendre, Bessel functions, generating functions and their properties. • CO3: Fourier integral and its properties and application to signal analysis and also in quantum mechanics • CO4: Application of probability and various distribution functions in Physics. • CO5: Learn to solve Integrations using Beta and Gamma functions which are very important in all branches of physics.
CC6 Thermal Physics

• CO1:To understand the principle of calorimetry • CO2: Understand the basic principle and laws of Thermodynamics • CO3: Understand the concepts of Entropy, various thermodynamic potentials and their applications in various systems • CO4: To understand the basic concepts of Maxwell-Botlzmann's velocity distribution functions • CO5: Gain knowledge about microscopic behavior of systems in explaining pressure, transport properties, viscosity, diffusion etc.
CC7 Digital systems and applications
• CO1: To learn integrated circuits(IC), number system and Boolean description, introduction to logic systems, various Gates • CO2: To understand product and sum in logical expression, conversion between truth table and logical expression, Karnaugh map • CO3: To learn how to Implement different circuits: adder, subtractor, idea of multiplexer, demultiplexers, encoder, decoder • CO4: To know registers and counters, computer organization, data conversion.
CC8 Mathematical Physics III
• CO1: To study complex analysis, Cauchy Riemann conditions, Analyticity, Cauchy Integral formula, Laurent and Taylor series expansion and definite integrals using contour integration. • CO2: To learn Fourier Integral and Laplace integrals which very useful mathematical tool.
CC9 Elements of Modern Physics
• CO1: To know about Radiation and its nature, old quantum theory, concept of wave-particle duality and de Broglie hypothesis. • CO2: To learn about Schrodinger equation as first principle, probabilistic interpretation of quantum mechanics,

commutation relation ,various operators and their meaning. These are very crucial as students learn Quantum Mechanics for the first time and these are basic building block of modern physics. • CO3: Students learn about Nuclear structure and various models. Interaction within and with nucleus. Gamma,Beta decay. Nuclear Fission and Fusion
CC10 Analog Systems and Applications
• CO1: To motivate the students to apply the principles of electronics in their day-to-day life. • CO2: Learn various network theorems, diodes and their application • CO3: Study various theory and working principles of transistors, regulated power supply, amplifiers, concept of feedback, OPAMP, Multivibrators and Oscillators
CC11 Quantum Mechanics and Applications
• CO1: One of the most important subject in undergraduate course. Students solve various quantum mechanical features • Bysolving various optentials: example, Finite and infinite well, Harmonic Oscillator. • CO2:Learn Quantum theory of Hydrogen atoms, solution of Schrodinger equation under central force, Orbital angular momentum and spin angular moemnta • CO3: To know generalized angular momenta, Electron's magnetic moment, Energy of a magnetic dipole, Stern-Garlach experiment • CO4: To study Fine structure of hydrogen atoms, atoms in presence of electric and magnetic fields-- application of Quantum mechanics for atomic systems • CO5: To learn Many electron atoms, identical particles, Pauli principle.
CC12 Solid State Physics

• CO1: To learn crystal structure, lattice dynamics • CO2: To understand quantum properties of matter like magnetic property, dielectric property • CO3: To understand elementary band theory • CO4: Superconductivity – one of major breakthrough in modern science
CC13 Electromagnetic Theory
• CO1: Learn Maxwell's equations, gauge transformations, Pyonting vector, Electromagnetic field energy density, momentum density etc. • CO2: Propagation of electromagnetic wave through medium • CO3: Polarization
CC14 Statistical Mechanics
• CO1: To understand statistical properties of matter, connections with thermodynamics • CO2: To use these theory in practical systems (ideal gas, Bose and Fermi systems), Identical particles • CO3: To learn Bose-Einstein statistics, and its application, Fermi-Dirac statistics and its application

Discipline Specific Elective Subjects (DSE)
DSE 1 Communication Electronics
• CO1: To introduce students to basics of electronic communication • CO2:To learn analog modulations and to modulate analog pulse • CO3: To learn how to modulate digital pulse • CO4: Students are introduced to communication and navigation system, which has many modern day applications.
DSE 2 Classical Dynamics
• CO1: To understand calculus of variation • CO2: To learn about small oscillations • CO3: To understand about rigid body motion • CO4: To know about non-linear dynamics
DSE3 Dissertation
• CO1: To test the independent understanding skill of the students which they have acquired during their time in college • CO2: To guide the students the basic knowledge of research • CO3:To provide a clear road map for doing research in their future.
DSE4 Nulcear and Particle Physics

- CO1: To learn general properties of nuclei, various nuclear models, radioactivity
- CO2: To understand nuclear reactions and interaction of nuclear radiation with matter
- CO3: To know about the detectors for nuclear radiations and particle accelerators
- CO4: To learn and understand fundamentals of particle physics.

Skill Enhancement Courses (SEC)
SEC 1 Electrical Circuits and Network Skills
CO1: Students know about various electrical instruments (generators, transformers, AC motor etc). CO2: To familiarize the basic laws, source transformations, theorems and methods of analyzing electrical circuits CO3: To explain the use of network theorems and concept of resonance.
SEC-2 Renewable energy and Energy Harvesting
CO1: Students learn about fossil fuels and its hazards and need for alternative energy sources, CO2: Students gain knowledge about how to harvest energy from various non-conventional energy sources

Practical Topics
Practicals of Mechanics Lab, Thermal Lab, Electricity and Magnetism Lab, Waves and Optics Lab, Modern Physics Lab

CO1:Various theories which students learn in theory lesson are verified in practical classes. CO2: Students learn various practical situation, how to handle tools and instruments, measurement techniques, graph plotting, statistical/error estimations etc. CO3: Physics is essentially a practical based subject, knowledge of proving/disproving a certain theory is important. Practicals bridge between theoretical knowledge and real life situation
Practicals based on Computation and Programming (Python language)
CO1: Understand how to write an algorithm, iteration techniques CO2: Various numerical methods to solve many problems numerically. e.g. finding solution of a equation, integration and differentiation etc. CO3: Plotting different kinds of graphs, how to label them etc.

DEPARTMENT OF PHYSICS

CO-PO MAPPING
For Physics Honours

Name of the Faculty: .....

Semester	Paper	CO	CO-PO Correlation Matrix									
			PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	PSO-3
Semester-I	CC-1	CO-1										
		CO-2										
		CO-3										
		CO-4										
	CC-2	CO-1										
		CO-2										
		CO-3										
		CO-4										
		CO-5										
		CO-6										
		CO-7										
		CO-8										
		CO-9										
Semester-II	CC-3	CO-1										
		CO-2										
		CO-3										
		CO4										
		CO5										
		CO6										
		C07										
		CO8										
	CC-4	CO-1										
		CO-2										
		CO-3										
Semester-III	CC-5	CO-1										
		CO-2										
		CO-3										
		CO-4										
		CO5										
	CC-6	CO-1										
		CO-2										
		CO-3										
		CO-4										
		CO-5										
	CC-7	CO-1										
		CO-2										
		CO-3										
		CO-4										
	SEC(H)-1	CO-1										
		CO-2										
		CO-3										

Semester-IV	CC-8	CO-1											
		CO-2											
	CC-9	CO-1											
		CO-2											
		CO-3											
	CC-10	CO-1											
		CO-2											
		CO-3											
	SEC(H)-2	CO-1											
		CO-2											
		CO-3											
Semester-V	CC-11	CO-1											
		CO-2											
		CO-3											
		CO-4											
		CO-5											
	CC-12	CO-1											
		CO-2											
		CO-3											
		CO-4											
	DSE(H)-1	CO-1											
		CO-2											
		CO-3											
		CO-4											
	DSE(H)-2	CO-1											
		CO-2											
		CO-3											
		CO-4											
Semester-VI	CC-13	CO-1											
		CO-2											
		CO-3											
	CC-14	CO-1											
		CO-2											
		CO-3											
	DSE(H)-3	CO-1											
		CO-2											
		CO-3											
	DSE(H)-4	CO-1											
		CO-2											
		CO-3											
		CO4											

**Mapping Scale: 1 to 3 (3: Strong correlation; 2: medium correlation; 1: weak correlation)

Co Mapping with PO and PSO

Paper	CC13
Semester	6

3	stands for HIGH correlation
2	stands for MEDIUM correlation
1	stands for LOW correlation

Paper	CO	CO-PO Correlation Matrix									
		PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	PSO-3
CC-13	CO-1	3		3	2	1	1		3	1	1
	CO-2	3		3	2	2	1		3	2	2
	CO-3	3	1	2	1	1	1	1	3	1	1
Average		3	0.33	2.67	1.67	1.33	1	0.33	3	1.33	1.33

CO ATTAINMENT CALCULATION				
	DIRECT ASSESSMENT			
	DIRECT ASSESSMENT1 (CIA)		DIRECT ASSESSMENT 2 (ESE)	INDIRECT ASSESSMENT STUDENTS/FACULTY/EMPLOYER
	INTERNAL		EXTERNAL	COURSE EXIT SURVEY
Number of students who have scored more than Target (P)	9	10	14	14
Percentage of students who have scored more than Target (P/N)*100	64.3	71.4	100	100
Attainment Level (3 for >80%, 2 for >70%, 1 for >60%	1	2	3	3
Attainment based on internal assessment (CIA)			CIA=1.5	
Direct CO Attainment Level (DA)=40%CIA +60% ESE			DA=2.4	
Indirect CO Attainment Level (IA) (Based on Exit Survey)			IA=3	
80% of DA			1.92	
20% of IA			0.6	
CO Attainment Level (COA)=80%DA+20%IA			2.52	

Target is 60% as the target remains same for direct and indirect assessments.

PO attainment Calculation										
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	PSO3
Average Mapping (M)	3	0.33	2.67	1.67	1.33	1	0.33	3	1.33	1.33
PO/PSO Attainment Level (=COA*M/3)	2.52	0.28	2.24	1.4	1.12	0.84	0.28	2.52	1.12	1.22