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CO, PSO and PO for Physics Honours for the new CBCS program Physics Dept., Gour Mahavidyalaya

Core Courses	Course Outcomes
DC1 Mathematical Physics 1	 To acquire knowledge of calculus which are integral part of any branch of Physics Understand divergence, gradient and curl and their physical interpretation which are very important for theories of electricity and magnetism to be taught later. Understand basics of matrices and determinants i.e. inverses, adjoint, linear vector spaces, basis, basis transformations, how to calculate eigenvalues, eigenvectors. Solve simple problems with physics oriented application. To develop the problem solving capability

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DC 2 Mechanics	 Students learn accurately how to describe motion of objects, planetary motions, gravitation etc. Understand the motion of objects in different frame of references. Know how to apply the conservation principle and symmetry of a system. Understand laws of motion, reference frames, and its applications i.e. projectile motion, simple harmonic oscillator, Rocket motion, elastic and inelastic collisions. Understand the idea of conservation of angular momentum, central forces effective potential. Understand the application of central force to the stability of circular orbits, Kepler's laws of planetary motion. 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.
	of planetary motion.
	6) Understand the dynamics of rotating objects
	of inertia and related examples involving the
	centrifugal force and coriolis force.
	7) Learn that different kinds of matter have
	various properties. For example, pressure, surface
	stress. Modulus are important properties of solid
	objects.
	8) Understand the basics of material properties
	like, elasticity, elastic constants and their relation, torsion of a cylinder, bending of a beam,
	cantilever, beam supported at its ends

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	and loaded in the middle. 9) Know the basics of motion of fluid which includes streamlined and turbulent flows, equation of continuity, critical velocity, flow of a liquid through a capillary tube.
DC3 Electricity and Magnetism	 To learn about basic concepts of electrical charges and currents and their properties Enhance problem solving capability based on various realistic situation Understand the concept of conductors, dielectrics, inductance and capacitance. Gather knowledge on the nature of magnetic materials. Understand the concept of static and time varying fields. Gain knowledge on electromagnetic induction and Faraday's law and its applications Learn to use and solve Maxwell's equations
DC4 Waves and Optics	 Student learn about various types of waves and their propagation. To provide a basic understanding of physical and geometrical optics To provide a knowledge of various optical phenomena, for example interference, diffraction, polarization etc.

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DC5 Mathematical Physics II	 Understand how to expand a function in a Fourier series. 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. Fourier integral and its properties and application to signal analysis and also in quantum mechanics Application of probability and various distribution functions in Physics. Learn to solve partial differential equation which is very important in all branches of physics.
DC6 Thermal Physics	 To understand the principle of calorimetry Understand the basic principle and laws of Thermodynamics Understand the concepts of Entropy, various thermodynamic potentials and their applications in various systems

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	4) Gain knowledge about microscopic behavior of systems in explaining pressure, transport properties, viscosity, diffusion etc.
DC7 Digital systems and applications	 To learn integrated circuits(IC), number system and Boolean description, introduction to logic systems, various Gates To understand product and sum in logical expression, conversion between truth table and logical expression, Karnaugh map To learn how to Implement different circuits: adder, subtractor, idea of multiplexer, demultiplexers, encoder, decoder To know registers and counters, computer organization, data conversion.
DC8 Mathematical Physics III	 To study complex analysis, Cauchy Riemann conditions, Analyticity, Cauchy Integral formula, Laurent and Taylor series expansion and definite integrals using contour integration. To learn variational calculus. Lagrangian and Hamiltonian formulation, Euler-Lagrange equation, Use of symmetry and conservation laws. To understand special theory of relativity, length contraction, time dilation, mass-energy relation etc. This is one of the corner stone of modern physics.

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DC9 Modern Physics	 To know about Radiation and its nature, old quantum theory, concept of wave-particle duality and de Broglie hypethesis. To learn about Schrodinger equation as first principle, probabilistic interpretation of quantum mechanics, commutation relation 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. Students learn about Nuclear structure and various models. Interaction within and with nucleus. Gamma,Beta decay. Nuclear Fission and Fusion
DC10 Analog Electronics	 To know basic boolean principle and how various electronic instruments work based on this To motivate the students to apply the principles of electronics in their day-to-day life. Learn various network theorems, diodes and their application Study various theory and working principles of transistors, regulated power supply, amplifiers, concept of feedback, OPAMP, Multivibrators and Oscillators
DC11 Quantum Mechanics	 One of the most important subject in undergraduate course. Students solve various various quantum mechanical features by solving various potentials: example, Finite and infinite well, Harmonic oscillator Learn Quantum theory of Hydrogen atoms, solution of Schrodinger equation under central force, Orbital angular momentum and spin angular momentum To know generalized angular momenta, Electron's magnetic moment, Energy of a magnetic dipole, Stern-Garlach experiment To study Fine structure of hydrogen atoms, atoms in presence of electric and magnetic fields application of Quantum mechanics for atomic systems

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	To learn Many electron atoms, identical particles, Pauli principle.
DC12 Solid State Physics	 To learn crystal structure, lattice dynamics To understand quantum properties of matter like magnetic property, dielectric property To understand elementary band theory Superconductivity – one of major breakthrough in modern science

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DC13 Statistical Mechanics	 To understand statistical properties of matter, connections with thermodynamics To use these theory in practical systems (ideal gas, Bose and Fermi systems), Identical particles To learn Bose-Einstein statistics, and its application, Fermi-Dirac statistics and its application
DC14 Digital systems and applications	To learn integrated circuits(IC), number system and Boolean description, introduction to logic systems, various Gates 2) To understand product and sum in logical expression, conversion between truth table and logical expression, Karnaugh map 3) To learn how to Implement different circuits: adder, subtractor, idea of multiplexer, demultiplexers, encoder, decoder 4) To know registers and counters, computer organization, data conversion.

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Departmental Specific Elective Subjects (DSE)	Course outcomes
DSE1(a) Advanced Mathematical Methods	 To learn Linear Algebra and vector space To understand tensors and tensor algebra To know group theory and its application
DSE1(b) Nuclear and Particle Physics	 To learn general properties of nuclei, various nuclear models, radioactivity To understand nuclear reactions and interaction of nuclear radiation with matter To know about the detectors for nuclear radiations and particle accelerators To learn and understand fundamentals of particle physics.
DSE2(a) Advanced Classical Dynamics	 To understand calculus of variation To learn about small oscillations To understand about rigid body motion To know about non-linear dynamics
DSE2(b) Communication Electronics	 To introduce students to basics of electronic communication To learn analog modulations and to modulate analog pulse To learn how to modulate digital pulse Students are introduced to communication and navigation system, which has many modern day applications.

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DSEB1 (a) Astronomy and Astrophysics	 Gain knowledge on various tools of astronomy, basic introduction of starts, galaxies, interstellar medium, mass and length scales of astronomy To learn observational tools of astronomy To understand star and other stellar systems, formation and evolution of stars To know about the galaxies and its components To learn basics of cosmology, redshift, field equations and accelerating universe
DSEB1 (b) Nulcear and Particle Physics	 To learn general properties of nuclei, various nuclear models, radioactivity 2) To understand nuclear reactions and interaction of nuclear radiation with matter 3) To know about the detectors for nuclear radiations and particle accelerators 4) To learn and understand fundamentals of particle physics.
DSEA2 (a) Nano Materials and applications	 To learn about nanoscale systems, their band structures, application of Schrodinger equation for such nano structures To know how to synthesis nano materials and how to characterize them To know various properties of nano materials, e.g. optical and electrical (transport) properties
DSEA2(b) Advanced Classical Dynamics	 To understand calculus of variation To learn about small oscillations To understand about rigid body motion To know about non-linear dynamics
DSEB2(a) Communication Electronics	To introduce students to basics of electronic communication 2) To learn analog modulations and to modulate analog pulse 3) To learn how to modulate digital pulse 4) Students are introduced to communication and navigation system, which has many modern day applications.
DSE3(a) Advanced Mathematical Methods - II	 Linear Vector Spaces Matrices

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	3) Cartesian Tensors
	4) General Tensors
DSE3(b) Classical Dynamics	1) Classical mechanics of point particles.
	2) Lagrangian and Hamiltonians of simple
	systems and derivations of equation of motion.
	3) Small amplitude oscillations
	4) Special theory of relativity
	5) Relativistic kinematics of one and two particle
	system.
	6) Basics of fluid dynamics

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Skill Enhancement Courses (SEC)	Course outcomes
SEC 1-A Electrical Circuits and Network Skills	Students know about various electrical instruments (generators, transformers, AC motor etc).
SEC 1-B Computer Algebra System & Figure Drawing Skill	
SEC 2-A Renewable energy and Energy Harvesting	Students learn about fossil fuels and its hazards and need for alternative energy sources, how to harvest energy from various non-conventional energy sources
SEC 2-B Basics of Programming and Scientific Word Processing	Students learn Arduino, which is basically an open-source electronics proto-type which itself can be used as a circuit

Practical Topics	Course outcomes
Practicals of Mechanics, Thermodynamics, Electricity and Magnetism, Waves, Optics, Modern Physics	 Various theories which students learn in theory lesson are verified in practical classes. Students learn various practical situation, how to handle tools and instruments, measurement techniques, graph plotting, statistical/error estimations etc. 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)	 Understand how to write an algorithm, iteration techniques Various numerical methods to solve many problems numerically. e.g. finding solution of a equation, integration and differentiation etc. Plotting different kinds of graphs, how to label them etc.

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Program Specific Outcome (PSO)	 Physics deals with a wide variety of systems, from microscopic level (atoms, nucleus) to Astronomical level (Sun, galaxy). Basic principles are more-or-less same used by physicists at every level. Each of these theories are experimentally verified in a number of ways and found to be an sufficiently appropriate description of nature. Students get oriented along this line of thinking and earn enough proficiency to use Physical Principles/concepts to explain various phenomena. Physics uses mathematics as a medium to organize and formulate experimental results. Students gather handsome knowledge on mathematics required for formulating and solving problems. Students learn to perform various types of numerical calculations. Students have learned laboratory skills, enabling them to take measurements in a physics laboratory and analyze the measurements to draw valid conclusions. Students will develop good oral and written scientific communication skill. Students learn to think critically and work independently.
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Program Outcome (PO)	 The course structure has been prepared in such a way so as the students learn and understand how the various physical phenomena take place based on their already acquired knowledge. Solving problems based on realistic situation make them understand how various physical systems in everyday life works. Therefore, the course not only introduce some abstract knowledge, but instill basic need-based knowledge as well. The main cognitive outcome of the program is that the student should be able to explain an otherwise unknown situation/problem on their own based on what they have learnt. Another important part of the program is its mathematical rigour. Students learn how to solve problems and prove various theorems. This has an enormous effect in their behavioral outcome. The students learn to analyze situation in a more logical and coherent way. This also instills the quality of accepting a particular
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knowledge/information based on facts available.
4) The mathematical skill and theoretical principles learnt during the three-year program, help them motivate and contribute to the society by actively participating in innovative research, teaching. Also, they can induce rational thinking to the society which is, otherwise, very important in today's scenario.
5) Students are well prepared for cutting edge research activity for example, Nano Sacience, Astrophysics, Nuclear and Particle Physics, Condensed Matter Physics etc.



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Core Course for B.Sc (Hons.)

S.		DC-	DC-2	DC-3	DC-4	DC-5	DC-6	DC-7	DC-8	DC-9	DC-	DC-	DC-	DC-13	DC-
No.		1									10	11	12		14
1	Fundamental understanding of the field	X	X	X	X	Х	Х	Х	Х	X	Х	X	Х	Х	Х
2	Application of basic Physics concepts	X	X	X	X	Х	Х	Х	X	X	Х	X	X	Х	Х
3	Linkages with related disciplines	X	X	X	X	Х	Х	Х	X	X	Х	X	X	Х	Х
4	Procedural knowledge for professional subjects	X	X	X	X	X	Х	X	X	X	X	X	Х	Х	Х
5	Skills in related field of specialization	X	X	X	X	Х	Х	Х	Х	X	Х	X	X	Х	Х
6	Ability to use in Physics problem	X	X	X	X	Х	Х	Х	X	X	Х	X	X	Х	Х
7	Skills in Mathematical modeling	X	X	X	X	Х	_	_	X	_	_	X	X	Х	Х
8	Skills in performing analysis and interpretation of data	X	X	X	X	X	Х	X	X	X	Х	X	X	Х	X
9	Develop investigative Skills	X	X	X	X	X	X	X	X	-	Х	X	X	Х	Х
10	Skills in problem solving in Physics and related discipline	X	X	X	X	Х	Х	Х	Х	X	Х	X	X	Х	Х
11	Develop Technical Communication skills	X	X	X	X	-	-	Х	Х	X	Х	X	X	Х	Х
12	Developing analytical skills and popular communication	X	X	X	X	-	-	-	-	X	_	-	X	X	X
13	Developing ICT skills	X	X	X	X	X	X	X	X	-	X	X	X	X	X

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14	Demonstrate	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х	Х
	Professional														
	behaviour with respect														
	to attribute like														
	objectivity, ethical														
	values, self reading,														
	etc														





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Discipline Specific Electives (DSE) forB.Sc. (Hons.)

S.		DSE							
No		-1-A	-1-B	-2-A	-2-B	-3-A	-3-B	-4-A	-4-B
1	Fundamental understanding of the field	X	X	Х	Х	X	X	Х	Х
2	Application of basic Physics concepts	Х	Х	Х	Х	Х	Х	Х	Х
3	Linkages with related disciplines	Х	Х	Х	Х	Х	Х	Х	Х
4	Procedural knowledge for professional subjects	Х	Х	Х	Х	Х	Х	Х	Х
5	Skills in related field of specialization	X	Х	Х	Х	Х	X	Х	Х
6	Ability to use in Physics problem	X	Х	Х	Х	X	X	Х	Х
7	Skills in Mathematical modeling	-	-	-	Х	Х	Х	Х	-
8	Skills in performing analysis and interpretation of data	Х	X	Х	Х	Х	-	-	-
9	Develop investigative Skills	X	-	-	Х	Х	Х	Х	-
10	Skills in problem solving in Physics and related discipline	X	-	-	Х	Х	X	Х	-
11	Develop Technical Communication skills	-	-	Х	Х	-	-	-	_
12	Developing analytical skills and popular communication	-	-	Х	-	-	-	-	-
13	Developing ICT skills	-	X	-	Х	-	Х	Х	Х
14	Demonstrate Professional behaviour with respect to attribute like objectivity, ethical values, self reading, etc	X	X	X	X	X	X	X	X

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Skill Enhancement Course (SEC) for B.Sc. (Hons.) and B.Sc. Regular

S.		SEC	SEC	SEC	SEC
No.		-1-A	-1-B	-2-A	-2-B
1	Fundamental understanding of the field	X	Х	Х	Х
2	Application of basic Physics concepts	Х	Х	Х	Х
3	Linkages with related disciplines	Х	Х	Х	Х
4	Procedural knowledge for professional subjects	-	Х	Х	Х
5	Skills in related field of specialization	-	-	-	Х
6	Ability to use in Physics problem	-	Х	Х	-
7	Skills in Mathematical modeling	-	Х	-	-
8	Skills in performing analysis and interpretation of data	X	Х	Х	Х
9	Develop investigative Skills	Х	-	-	-
10	Skills in problem solving in Physics and related discipline	-	Х	-	Х
11	Develop Technical Communication skills	-	Х	Х	Х
12	Developing analytical skills and popular communication	-	Х	Х	-
13	Developing ICT skills	-	X	-	-
14	Demonstrate Professional behaviour with respect to attribute like objectivity, ethical values, self reading, etc	X	X	X	X