St. Xavier's College (Autonomous), Mumbai
Department of Physics

Programme: M.Sc. Physics

Programme Specific Outcomes (PSOs) for M.Sc. Physics

Sr. No.	On completing M.Sc. Physics, the student will be able to:
PSO 1	Demonstrate competence and apply sound domain knowledge in physics, astronomy and astrophysics in teaching, industry and research.
PSO 2	Use appropriate advanced computer applications, develop algorithms and domain-specific digital tools in the multi-faceted world of IT.
PSO 3	Practice effective academic and creative written and oral communication and presentation skills in physics.
PSO 4	Demonstrate professionalism, organizational skills and employability skills; make decisions, put into practice self-, time- and change-management and solve problems at micro and macro levels.
PSO 5	Enter new research areas within a specific field of physics, astronomy or astrophysics that require analytical and innovative approaches to help ease problems faced by society and to understand the mysteries of the universe.
PSO 6	Understand, investigate and evaluate concepts from diverse disciplines such as physical, biological and social sciences, and relate the course content with environmental problems.

Course Outcomes (COs): M.Sc. Physics

Semester I

Course Title: Mathematical Physics
Course Code: SPHY0701

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the concepts of tensors, differential equations with varying coefficients, integral transforms and series and complex variables.	1, 4	U, R
CO 2	Master the fundamentals of numerical methods, computer algorithms and programming languages.	1, 2, 4	U, R
CO 3	Develop skills to solve physics problems by analytical methods.	1, 3, 4	U, R, Ap
CO 4	Develop skills to solve problems in physics using computational methods.	1, 2, 3, 4	Ap, An
CO 5	Use online resources for selecting innovative applied or interdisciplinary problems.	1, 2, 3, 4, 5	Ap, An, E
CO 6	Solve the selected problems by both analytical and computational methods and compare the results obtained.	1, 2, 3, 4, 5, 6	Ap, An, E, C

Course Title: Classical Mechanics
Course Code: SPHY0702

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand fundamental concepts of Newtonian mechanics and its applications to various physical systems, natural and man made.	1, 3, 4, 6	U, R
CO 2	Use advanced concepts of mechanics theory, such as the Lagrange's and the Hamilton's Formulations to understand complex mechanical systems.	1, 3, 4, 5, 6	U, Ap, An
CO 3	Understand the foundations of chaotic motion and distinguish different chaos phenomena.	1, 2, 3, 4, 5	U, AP, An
CO 4	Apply the acquired knowledge and skills to solve problems in modern physics.	1, 3, 4, 5	Ap, An, E
CO 5	Use critical thinking skills to formulate and solve quantitative problems in applied physics.	1, 2, 3, 4, 5, 6	Ap, An, E, C
CO 6	Use computational methods to study deterministic and nondeterministic chaotic systems.	1, 2, 3, 4, 5, 6	Ap, An, E, C

Course Title: Quantum Mechanics
Course Code: SPHY0703

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand general formalism and Dirac notation in quantum mechanics.	1, 2, 3	R, U, An
CO 2	Master the applications of quantum mechanics in one-dimensional and three-dimensional physics problems.	1, 2, 3, 4	R, U, An, Ap
CO 3	Know the details of perturbation theory, approximation and variation methods.	1, 2, 3, 4, 6	R, U, An, Ap, E, C
CO 4	Understand the quantum mechanical scattering theory, and the fundamentals of relativistic quantum mechanics.	1, 2, 3, 4, 6	R, U, An Ap, E, C
CO 5	Use online resources for selecting innovative applied or interdisciplinary problems related to any of the methods specified.	1, 2, 3, 4, 5, 6	R, U, An, Ap, E, C
CO 6	Use computational or analytical methods to solve the selected problems.	1, 2, 3, 4, 5, 6	R, U, An, Ap, E, C

Course Title: Astronomy and Astrophysics: An Overview
Course Code: SPHY0704

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Have knowledge of the expanse of the universe, and the nature of the planets, stars and galaxies.	1, 3	U, R
CO 2	Understand how the astronomical observations are carried out for the celestial objects.	1, 2, 3, 4	U, Ap
CO 3	Apply mathematical tools and physics laws to understand the nature of planets, stars and galaxies.	2, 4, 5	U, Ap, An, E
CO 4	Use online resources to analyse data obtained from various astronomical observations.	1, 2, 4, 5	Ap, An, E,
CO 5	Evaluate the results of this analysis and interpret the nature of the solar system, and variety of stars and galaxies.	1, 2, 3, 4, 5, 6	Ap, An, E, C
CO 6	Create new observational programs or data analyses and interpretation projects in astronomy.	2, 4, 5, 6	Ap, An, E, C

Course Title: Practicals – I
Course Code: SPHY07PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Execute fundamental experimental/ computational techniques; identify suitable problems to carry out laboratory projects in mathematical physics, classical mechanics, quantum mechanics and introductory astrophysics.	1, 2, 5, 6
CO 2	Design an approach to solve the project problem undertaken, and perform the necessary data collection, analysis or simulations; communicate the work done through a project report and oral presentation.	1, 2, 3, 4, 5, 6

Semester II

Course Title: Statistical Mechanics
Course Code: SPHY0801

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the concept of phase space and arguments leading to ensemble theories.	1, 3	R, U
CO 2	Master and apply the statistical basis of classical and quantum thermodynamics, to gain understanding of different physical systems.	3, 5, 6	U, Ap
CO 3	Analyse, evaluate and make inferences using specific type of theories in specific problem sets and experimental situations.	2, 4, 5	An, E, C
CO 4	Understand phase transitions and fluid models.	1, 3	R, U, An
CO 5	Creatively apply the fluid models to various practical situations in the physical systems - created by humans as well as the planets, stars etc.	2, 3, 5, 6	U, Ap, An, E
CO 6	Understand, apply and analyse physical systems using the basic principles of non-equilibrium statistical mechanics.	2, 3, 4, 5, 6	U, Ap, An, E

Course Title: Electrodyamics and Solid State Physics
Course Code: SPHY0802

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand and analyze dispersive properties of and propagation of electromagnetic waves in materials - conductors, dielectrics and plasmas.	1, 2, 3, 5	U, R, Ap, An
CO 2	Analyse the behaviour of electromagnetic fields in waveguides.	1, 2, 3, 5	U, An, E, C
CO 3	Understnnd radiating systems and analyse multipole radiation in atoms and nuclei.	1, 2, 3, 5	U, Ap, An
CO 4	Understand the lattice vibrations and thermal properties of solids, phonons and their dispersive and thermal properties.	2, 3, 4, 5, 6	U, Ap, An
CO 5	Understand optical properties of materials and various models of magnetism.	1, 2, 3, 4, 5, 6	U, Ap, E, C
CO 6	Apply knowledge of solid state physics in the society, for example, to synthesise and characterize novel materials which can be used in devices.	1, 2, 3, 4, 5, 6	Ap, An, E, C

Course Title: Atomic, Molecular and Nuclear Physics
Course Code: SPHY0803

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand and analyse the simple atomic structure described by quantum physics, and interaction of atoms with electromagnetic fields.	1, 2, 3, 4	R, U, An, Ap
CO 2	Apply simple atomic model to analyse problems in physical and biological sciences.	1, 2, 3, 4, 6	R, U, An, Ap, C, E
CO 3	Understand complex atomic models and their consequences.	1, 2, 3, 4, 5, 6	R, U, An, Ap, C, E
CO 4	Use various spectroscopy techniques to understand theory of the atomic models.	1, 2, 3, 4, 5, 6	R, U, An, Ap, C, E
CO 5	Understand nuclear models and reactions, and how nuclear reactors and detectors are built for energy production and detection.	1, 2, 3, 4, 5, 6	R, U, An, Ap, C, E
CO 6	Master the design of particle accelerators to produce elementary particles, and learn the physics of elementary particles.	1, 2, 3, 4, 5, 6	R, U, An, Ap, C, E

Course Title: Electronics and Digital Image Processing
Course Code: SPHY0804

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand electronic communication systems, and analyse various techniques to overcome electronic error in data encryption/decryption.	1, 2, 3, 4, 6	R, U, An, Ap, C, E
CO 2	Understand and develop controller-based electronic systems for data acquisition in various physics experiments.	1, 2, 3, 4, 6	R, U, An, Ap, C, E
CO 3	Review the fundamental concepts of digital image processing.	1, 2, 3, 4, 6	R, U, An, Ap, E
CO 4	Describe the fundamentals of color imaging and its applications.	1, 2, 3, 4, 6	R, U, An, Ap, C, E
CO 5	Analyse images in spatial and frequency domain using various transforms.	1, 2, 3, 4, 5, 6	R, U, An, Ap, C, E
CO 6	Evaluate the techniques for image enhancement and interpret image segmentation techniques.	1, 2, 3, 4, 5, 6	R, U, An, Ap, C, E

Course Title: Practicals – II
Course Code: SPHY08PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Execute fundamental experimental/ computational techniques; identify suitable problems to carry out laboratory projects in statistical mechanics, electrodynamics, solid state physics, atomic, molecular and nuclear physics, electronics, and digital image processing.	1, 2, 5, 6
CO 2	Design an approach to solve the project problem undertaken, and perform the necessary data collection, analysis or simulations; communicate the work done through a project report and oral presentation.	1, 2, 3, 4, 5, 6

Semester III

Course Title: Physics of Radiation and Matter
Course Code: SPHY0901

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Possess knowledge of the radiative processes in the presence of matter.	1	U, R
CO 2	Understand how the radiation and matter interact in different physical states of matter.	1, 3	U, R, Ap
CO 3	Apply mathematical tools and physics laws to understand the nature of radiation in stars and the interstellar medium.	1, 2, 4	Ap, An, E
CO 4	Use online resources to analyse the data obtained from various astronomical observations to understand electromagnetic radiation.	2, 3, 4, 5	Ap, An, E
CO 5	Evaluate the results of this analysis and interpret the nature of the solar system, variety of stars and galaxies.	3, 4, 5	Ap, An, E, C
CO 6	Create new observational programs or data analyses and interpretation projects to further the knowledge of radiative processes in astrophysics.	1, 2, 3, 4, 5, 6	Ap, An, E, C

Course Title: Stellar Structure and Evolution
Course Code: SPHY0902

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand a star's life cycle from formation to death, and the processes that change the vast universe slowly but continuously.	1, 3, 6	U, R
CO 2	Understand through detailed physics application how the energy is generated in the interior of the sun and how this store of energy is received by planets such as the earth.	1, 3, 6	U, Ap
CO 3	Apply mathematical tools and physics laws to understand the structure of stellar interior and its atmosphere.	1, 2, 4, 5	Ap, An
CO 4	Analyse the data obtained from various astronomical observations to develop stellar models.	2, 3, 4, 5	Ap, An, E
CO 5	Evaluate the results of this analysis and understand the nature of the sun and other stars of different types.	2, 3, 4, 5	U, Ap, An, E
CO 6	Create new observational programs or data analyses and interpretation projects to understand the different stages of stellar evolution.	1, 2, 3, 4, 5, 6	Ap, An, E, C

Course Title: Galaxies: Formation, Structure and Dynamics
Course Code: SPHY0903

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Have knowledge of the different types of galaxies and their clustering and evolution in the expanse of the universe.	1, 3	R, U
CO 2	Understand the technology used for cosmological observations done for these celestial objects.	1, 3	R, U
CO 3	Apply mathematical tools and physics laws to understand the nature of galaxies and their clustering.	1, 6	U, Ap
CO 4	Analyse data obtained from various astronomical observations using the online resources.	2, 4	Ap, An
CO 5	Evaluate the results of these analyses and interpret the nature of the galaxies and the black holes.	4, 6	An, E
CO 6	Create new observational programs or data analyses and interpretation projects in galactic astronomy and cosmology.	2, 5, 6	An, E, C

Course Title: General Relativity and Cosmology
Course Code: SPHY0904

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Have knowledge of special and general theory of relativity.	1, 3, 6	U, R
CO 2	Understand the relation of gravity to the curvature of space-time.	1, 3, 5	U, Ap
CO 3	Apply mathematical tools and physics laws to understand the nature of massive objects such as neutron stars, black holes and centers of galaxies.	2, 4, 5	U, Ap, An
CO 4	Understand the theory of the expanding universe, and classical cosmology.	1, 2, 3, 4, 5, 6	U, Ap, An
CO 5	Critically analyse and interpret results of modern cosmological observations and data.	1, 2, 3, 4, 5, 6	Ap, An, E
CO 6	Apply the knowledge of general theory of relativity and develop new projects in galactic astronomy and cosmology.	1, 2, 3, 4, 5, 6	Ap, An, E, C

Course Title: Practicals – III
Course Code: SPHY09PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Execute fundamental experimental/ computational techniques; identify suitable problems related to the physics of radiation and matter, stellar structure and evolution, structure, formation and dynamics of galaxies, general relativity and cosmology.	1, 2, 5, 6
CO 2	Design an approach to solve the project problem undertaken, and perform the necessary data collection, analysis or simulations; communicate the work done through a project report and oral presentation.	1, 2, 3, 4, 5, 6

Semester IV

Course Title: M.Sc. Dissertation
Course Code: SPHY10PROJ

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Identify an area for carrying out research where the knowledge base can be potentially augmented.	1, 4, 5, 6	U, Ap, An
CO 2	Understand the shortcoming/lacunae in the state of existing knowledge through literature review.	3, 4, 5	Ap, An, E
CO 3	Propose/ design a possible solution to the problem at hand through a synopsis.	2, 3, 4, 5	Ap, An, E, C
CO 4	Collaborate with other researchers and laboratories around in the pursuit of the proposed solution through collection and/or data analysis and numerical simulations.	4, 5	Ap, An, E, C
CO 5	Present the work in the form of a bound thesis.	3, 4, 5, 6	U, Ap, An, C, E
CO 6	Defend the work through a presentation and a viva exam to a panel of evaluators.	1, 2, 3, 4, 5, 6	U, Ap, An, E, C