Deccan Education Society's

Fergusson College (Autonomous), Pune

Program Specific Outcomes(PSOs) and Course Outcomes (COs) 2019-20

Department of Physics

Programme: M.Sc. Physics

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	**Academic competence:** (i) Associate the universal applications of physics in all disciplines. Articulate fundamental and advance concepts, principles and processes underlying physical phenomena in different branches ranging from classical mechanics to quantum mechanics and extended to electrodynamics, statistical mechanics, atomic, molecular and solid state physics, nanomaterials and electronic science. (ii) Demonstrate mathematical, statistical and computational ability in problem solving. Demonstrate and explain various mathematical techniques, numerical methods, experimental techniques to broaden independent thinking and scientific temper.
PSO2	**Personal and Professional Competence:** (i) Execute experimental and project work independently. (ii) Carry out laboratory oriented numerical calculations and experimental data interpretation. Analyse self-generated data through experiments as well as archival data (iii) Formulation of physics concepts, effective presentation and communication skills through seminars and group discussions. Develop skills of technical report writing along with precise presentation with effective communication. (iv) Apply appropriate concepts and various methods to solve wide range of problems. Incorporate the hands-on training of soldering to connect electronic components for designing circuits for device applications.
PSO3	**Research Competence:** (i) Use of in-house laboratory setup for building instrumentation. Integrate and interprete data. Evaluate the research findings in materials sciences and astrophysics. (ii) Apply experimental skills for interdisciplinary research work. Review of research papers, books for publications in journals. Apply experimental skills for projects / research and need for interdisciplinary research. (iii) Carry out projects in basic, applied and interdisciplinary science to develop conceptual understanding and an orientation towards research. Interpret and analyse the results of the research project. Integrate mathematical / statistical and computational data to analyse and formulate theories. Implement Projects and research paper writing and book reviews.

PSO4	**Entrepreneurial and Social competence:** (i)Enhance analytical skills and research aptitude in specific areas related to physics including materials science, thin film technology, solar energy, radiation dosimetry, astrophysics, atmospheric science, energy generation and storage for academic research and industrial applications. Develop job oriented analytical skills on an advanced level needed in industry, consultancy, education, research or public administration. (ii) Employ and develop skills in specific areas related to physics and engineering for industrial application, production and technology development and transfer. (iii) Develop social awareness through internships and science popularization programs. Execute awareness of ethical issues: emphasis on academic and research ethics, need and value of lifelong learning, international perspective, importance of academic and research ethics, human rights, scientific misconduct, intellectual property rights and issues related to cyber laws and plagiarism.

F.Y. M.Sc. Semester I		
Title of the Course and Course Code	**Classical Mechanics (PHY4101)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe various approaches for finding solutions of equations of motions.	1
CO2	Discuss and give examples of constraints and methods of eliminating them.	2
CO3	Apply different mathematical tools and techniques to find solutions of problems in Mechanics.	3
CO4	Compare and contrast different approaches of solving equations of motion.	4
CO5	Evaluate the generating functions and assess different mathematical transformations.	5
CO6	Develop the techniques to analyze motions in accelerated, frames of references.	6
Title of the Course and Course Code	**Mathematical Methods in Physics (PHY4102)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the concepts of Complex analysis, Fourier and Laplace Transformations.	1
CO2	Discuss basic theory of Linear Algebra, Matrix algebra and special functions.	2
CO3	Apply mathematical tools, special functions on polynomials to solve physical problems and identify mathematical concepts related to physics to generate solutions.	3
CO4	Analyze concepts of vector space, matrix algebra and inner product spaces.	4
CO5	Determine the residues of a complex function and use the residue theorem to compute certain types of integrals.	5
CO6	Construct Fourier series, Fourier and Laplace transforms to solve mathematical problems relevant to the physical sciences.	6
Title of the Course and Course Code	**Quantum Mechanics (PHY4103)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall and outline basic postulates of Quantum Mechanics and Simple stationary state problem.	1
CO2	Explain theory of angular momentum, spin matrices and compute Clebsh-Gordan Coefficient.	2

CO3	Demonstrate and interpret solutions of Schrodinger equation for stationary state problems.	3
CO4	Categorize different applications of approximation methods to solve time dependent and time independent Hamiltonian systems.	4
CO5	Compare different approximation methods in terms of validity.	5
CO6	Specify problems based on concepts of stationary states, angular momentum and approximation method.	6
Title of the Course and Course Code	**Electronics (PHY4104)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List special and general purpose integrated circuit chips.	1
CO2	Explain internal block diagram and working of the ICs.	2
CO3	Illustrate the use of dedicated ICs in different circuits.	3
CO4	Explain working of circuits using operational amplifiers, timers, PLLs and SMPS.	4
CO5	Compare performance parameters of Op-amps and discrete circuits.	5
CO6	Design different circuits for dedicated applications.	6
Title of the Course and Course Code	**Physics Practical Laboratory - I (General Lab) (PHY4105)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Tabulate the appropriate experimental data accurately and keep systematic record of general laboratory experiments.	1
CO2	Discuss the results, findings using the physical scientific framework and learn experimental tools.	2
CO3	Interpret professional quality of textual and graphical presentations of laboratory data and computational results.	3
CO4	Analyze various experimental results by developing analytical abilities to address real applications.	4
CO5	Evaluate possible causes of discrepancy in practical experimental observations and results in comparison to theoretical results.	5
CO6	Develop the skills related to betterment in education and research.	6
	F.Y. M.Sc. Semester II	
Title of the Course and Course Code	**Atoms, Molecules and Solids (PHY4201)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the theories explaining the structure of atoms and the origin of observed spectra.	1
CO2	Explain different types of spectra.	2

CO3	Calculate quantities associated with different types of spectra exhibited by atoms, molecules and solids, heat capacities using different models and structural properties.	3
CO4	Analyze spectra and identify the effect of magnetic and electric fields on it.	4
CO5	Determine the observed dependence of atomic spectral lines on externally applied electric and magnetic fields.	5
CO6	Associate electromagnetic spectrum with the rotational, vibrational and electronic spectra of diatomic molecules, and specify the types of transitions based on selection rules. Compare different structures exhibited by materials	6
Title of the Course and Course Code	**Electrodynamics (PHY4202)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the mathematical description of electromagnetic phenomena based on basic physical quantities.	1
CO2	Apply Maxwell equations in analyzing the nature of electromagnetic field due to time varying charge and current distribution.	3
CO3	Illustrate vector potential and electric field of a localized current distribution using multipole expansion problems.	2
CO4	Analyze the nature of electromagnetic wave and its propagation through different media and interfaces.	4
CO5	Determine charged particle dynamics and radiation from localized time varying electromagnetic sources.	5
CO6	Compose relative problems in electrodynamics and resolve them through the fundamental equations.	6
Title of the Course and Course Code	**Statistical Mechanics (PHY 4203)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define and describe the concepts of probability, macrostates and microstates and phase space.	1
	Compare and distinguish between different types of particles, statistics and distribute bosons, fermions and classical particles among energy levels.	2
CO2	Apply the principles of probability in distribution of particles in different systems and calculate thermodynamic probability.	3
CO3	Analyze the different types of statistical distribution of particles.	4
CO4	Determine and interpret the probability of any type of events.	5
CO6	Formulate and apply the distribution functions to Fermi-Dirac system and Bose-Einstein system.	6

Title of the Course and Course Code	**Basic Material Science (PHY4204)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the mechanisms and factors affecting the solidification process in metals and alloys.	1
CO2	Examine critical awareness of the relevance of phenomenon and laws governing solid solution formation.	3
CO3	Analyze different concepts of metallurgical thermodynamics.	4
CO4	Determine the phase rules, phase diagrams of single and multi-component systems.	5
CO5	Evaluate theory of the atomistic and defect structures, to determine the result in the microstructure and influence the properties of metals and alloys.	5
CO6	Develop learning skills and systematic understanding of the crystal structure/property/ processing relationships of metals and alloys.	6
Title of the Course and Course Code	**Physics Practical Laboratory – II (Electronics Lab) (PHY4205)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define the objectives of a given electronics-based experiments.	1
CO2	Interpret the appropriate tests of measuring equipment for an experiment.	2
CO3	Demonstrate proper use of circuit connections of desired experiment.	3
CO4	Analyze the electrical/ electronic parameters of a given instrument and the obtained results.	4
CO5	Review the observations taken during the experimentation and tabulate the results.	5
CO6	Design and construct the electronic circuit and build-up required instrumentations.	6
	S.Y. M.Sc. Semester III	
Title of the Course and Course Code	**Experimental Techniques in Physics (PHY5301)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define the working principles of the different characterization techniques.	1
CO2	Apply knowledge about the time domain representation and classification of discrete time signals and systems.	3
CO3	Explain the strengths and limitations of each characterization	2

	technique.	
CO4	Analyze the data obtained by the different characterization techniques.	4
CO5	Judge experimental tools for different characterizations of samples.	5
CO6	Generate the breadth of knowledge in the application and design of engineering instruments.	6
Title of the Course and Course Code	**Solid State Physics (PHY5302)**	Number of Credits : 04
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the advances in band theory of solids.	1
CO2	Explain the origin of magnetism and magnetic interactions leading to different types of magnetic materials and associate the interplay between the electrical and magnetic behaviour of superconductors.	2
CO3	Calculate quantities associated with conduction mechanism in materials, magnetic properties and superconductivity.	3
CO4	Analyse the role of electron-lattice interaction in determining the properties of materials.	4
CO5	Review types of materials based on their electrical and magnetic properties.	5
CO6	Specify the types and properties of magnetic materials. Develop an understanding of classification of materials based on band theory.	6
Title of the Course and Course Code	**Physics of Semiconductor Devices (PHY5303)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the band theory of solids and its use in carrier transport process in semiconductors.	1
CO2	Discuss the techniques of fabrication of different semiconductor devices.	2
CO3	Demonstrate I-V and other performance characteristics of different semiconductor devices.	3
CO4	Explain theories related to M-S and MIS devices.	4
CO5	Test the static and dynamic performances of the semiconductor devices.	5
CO6	Design circuits for applications of semiconductor devices.	6

Title of the Course and Course Code	**Materials Synthesis Processing and Applications (PHY5304)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List magnetic, ferroelectric and magnetoelectric materials.	1
CO2	Explain ceramic methods for magnetic and piezoelectric materials synthesis.	2
CO3	Calculate sintering time for diffusion.	3
CO4	Classify between smart materials and other materials.	4
CO5	Compare magnetic and ferroelectric properties of different compounds.	5
CO6	Design ME composites based on properties of magnetic and ferroelectric materials.	6
Title of the Course and Course Code	**Astronomy and Astrophysics - 1 (PHY5305)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the emptiness and vastness of the cosmos and familiarize with the components of the Universe.	1
CO2	Explain different cosmologies, nuclear reactions in stars and synthesis of elements in the universe.	2
CO3	Execute skills in identifying spectra of celestial objects their Doppler shifts and recession velocities, data analysis and familiarity with light curves. Solve problems related to elementary observational Astronomy.	3
CO4	Relate with observational astronomy, constellations and recognize tools used for the purpose.	4
CO5	Compare different stellar spectra, stellar magnitudes and measure stellar distances.	5
CO6	Prepare star charts and make logs for meteor observations.	6
Title of the Course and Course Code	**Vacuum Science and Technology (PHY5306)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the physics principles and relate them to Astrophysics.	1
CO2	Interpret data from archives.	2
CO3	Solve astrophysical equations and problems.	3
CO4	Identify and analyse selective data.	4
CO5	Compare results and estimate errors.	5

CO6	Formulate equations and integrate the results from examples.	6
Title of the Course and Course Code	**Physics Practical Laboratory - III (Materials Science) (PHY5307)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Tabulate the appropriate experimental data accurately and maintain systematic record of day to day laboratory activities.	1
CO2	Discuss the results using the appropriate physical scientific framework and required tools.	2
CO3	Interpret professional quality in textual and graphical presentations of laboratory data and computational results.	3
CO4	Analyze different experimental results by developing analytical abilities to address real world problems.	4
CO5	Determine possible causes of discrepancy in practical experimental observations, results in comparison to theoretical results.	5
CO6	Develop the skills related to betterment in research, education, industry-academia progress.	6
S.Y. M.Sc. Semester IV		
Title of the Course and Course Code	**Nuclear Physics (PHY5401)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the general properties and concepts of nuclei.	1
CO2	Explain types of nuclear interactions, working of different types of nuclear detectors and accelerators.	2
CO3	Illustrate different type of nuclear reactions and understand the working of nuclear reactors.	3
CO4	Differentiate models of nucleus for better understanding of nuclear interaction and review the reaction dynamics.	4
CO5	Determine the type of nuclear reactions and outline the processes of different scattering mechanisms.	5
CO6	Design a table of elementary particles, classify mass spectra, elementary particles and their decay mechanisms.	6

Title of the Course and Course Code	**Astronomy and Astrophysics - II (PHY5402)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Recall the physics principles and relate them to Astrophysics.	1
CO2	Interpret data from archives.	2
CO3	Solve astrophysical equations and problems.	3
CO4	Identify and analyse selective data.	4
CO5	Compare results and estimate errors.	5
CO6	Formulate equations and integrate the results from examples.	6
Title of the Course and Course Code	**Physics of Nanomaterials (PHY5403)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	List different types and forms of Nanomaterials.	1
CO2	Discuss the quantum size effect on the properties of materials.	2
CO3	Examine the different techniques to synthesize the Nanomaterials.	3
CO4	Explain the properties of nanomaterials with the help of theoretical models.	4
CO5	Measure the particle size and determine structure parameters using different characterization techniques.	5
CO6	Write a report on development of the systems and devices for applications of Nanomaterials in different fields.	6
Title of the Course and Course Code	**Thin Film Physics and Technology (PHY5404)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe thin film deposition techniques.	1
CO2	Explain techniques of measurement of thickness of the thin and thick films.	2
CO3	Illustrate different theoretical models to study properties of thin films.	3
CO4	Compare and contrast bulk properties with thin film properties of materials.	4
CO5	Test different properties of thin films.	5
CO6	Write a report on development of thin film sensors and devices.	6

Title of the Course and Course Code	**Atmospheric Science (PHY5405)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Define the moisture parameters.	1
CO2	Represent thermodynamic diagrams and locate, interpret the parameters.	2
CO3	Calculate potential and virtual temperatures.	3
CO4	Explain concepts of atmospheric thermodynamics.	4
CO5	Compare different types of scattering processes in the atmosphere.	5
CO6	Write a report on the different mechanisms of precipitations.	6
Title of the Course and Course Code	**Physics Practical Laboratory - IV (Astrophysics + Atmospheric Science + MATLAB) (PHY5406)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Tabulate the appropriate experimental data accurately and maintain systematic record of performed experiments laboratory	1
CO2	Discuss the results using scientific tools in experiments related to astrophysics.	2
CO3	Interpret professional quality in textual and graphical presentations of experimental data using MATLAB tools.	3
CO4	Analyze theoretical and experimental results and by developing analytical abilities for research.	4
CO5	Determine possible causes of discrepancy in practical experimental observations, results in the subjects of atmospheric sciences and astrophysics.	5
CO6	Develop the skills related to betterment in research, education, industry-academia progress.	6

Title of the Course and Course Code	**Physics Practical Laboratory - V (Project) (PHY5407)**	**Number of Credits : 04**
On completion of the course, the students will be able to:		**Bloom's Cognitive level**
CO1	Describe the necessity, relevance and importance of the project.	1
CO2	Classify the work into small tasks as per the requirements of the aims and objectives of the project.	2
CO3	Examine the experiments as per the appropriate procedure to achieve the goals.	3
CO4	Analyze the data with the help of theory and formulae to validate the hypotheses.	4
CO5	Standardize the procedure to obtain reliable, repeatable results with the published data to justify the observed results.	5
CO6	Develop the skills related for the betterment in research, education, industry-academia collaborations.	6