PROGRAMME OUTCOME, PROGRAMME SPECIFIC OUTCOME AND COURSE OUTCOME

M.Sc Physics	
PROGRAMME OUTCOME	Adequate knowledge in Physics and associated science subjects like Chemistry, Mathematics and Statistics are needed to enrol to the M.Sc Physics. B.Sc with Physics and Mathematics as two of three subjects' combination is a must as qualification for entry to this program. To keep the eminence of the subject Physics, one should be passionate and of inquisitive mind. Hardworking and patience are the best characteristic features of student coming to this program. Due to the recent rapid progress in sciences, students are getting interested for higher studies. In that regard Physics is the subject that is well connected to various disciplines; e.g. education, technology, health-care, space-science, software, air traffic control etc. At the successful completion of this program, students get skilled with logical thinking in steps, formulating model systems and solving problems. With satisfactory number of presentations and group discussions the students become good communicators. Students get the lessons of research and development during their project work, assignments. During project work, group discussion and laboratory class pupils get nurtured to become a team member and to stand beside the others with fellow feeling in need. Their budding creative skills get nourished by inspiring them to manage and organize different events; e.g. Science Day Observation, Lecture Competition, Commemoration of Scientists' birth Day etc. To be honest and ethical in higher education and research, awareness is inculcated amongst the students against plagiarism obeying the intellectual property right. They are instructed to cite references and cross-references in needful.
PROGRAMME SPECIFIC OUTCOME	With successful completion of this program the students become enable to teach secondary, higher secondary levels. They can be absorbed in international schools also. Completing this program one can appear as data analyst, material analyst

	also. They get ample opportunity of pursuing their higher education (e.g. M.Tech, MS, M.Phil, Ph.D). Students coming out with flying colours in M.Sc Physics get professional options in any interdisciplinary area related to Physics.
COURSE OUTCOMES	
PHY101: Mathematical Methods of Physics-I Credit: 3	**Course Objectives:** To make students ready understand the use of mathematical tools in Physics this course is designed. **Course Outcome:** In post graduate courses in Physics, emphasis is given for in depth and quantitative understanding of physical parameters which describe behaviour of the system subjected to various boundary conditions. These physical parameters include mechanical, thermal, optical, electrical, magnetic properties. The system of study is from nano scale structure through micro, mesa and bulk systems. Quantitative understanding of physical processes and parameters require various mathematical methods to solve the given problem subjected to known boundary conditions. The prescribed course runs through various topics which include Vector integration, Gauss and Stoke's theorem, Matrices, Tensors etc. The special functions covered are quite useful in solving transfer of heat in different geometries. Finding solution to differential equations through Laplace transformation method, Green function method, etc strengthens student skill in solving the problems. Integral transformation helps the student in studying the time domain problem in frequency domain. After completing the course, student is expected to solve the problems of physical system and get insight of the solution.
PHY102: Classical Mechanics Credit: 3	**Course Objectives:** This subject provides an in depth knowledge of mechanical systems and an analysis of the constraints present within them.

	Course outcome: By building an understanding of kinetic and potential energies of a system, the Lagrangian and Hamiltonian functions of systems will be set up in order to arrive at the equations of motion. The behaviour of micro and macro molecules under the effect central forces will be analysed by studying rigid body mechanics and Poisson Brackets. Motion in non-inertial frames of references will also be studied in order to understand the effect of forces acting on rotating particles.
PHY103: Classical Electrodynamics Credit: 3	**Course Objective:** A clear concept regarding electrostatics, magnetostatics and electrodynamics is in need to shape the understanding of the students. **Course Outcome:** As the paper deals with mathematical detail, the ability of approaching and solving the problems is also nurtured. As this paper is full of vector, tensor and differential equations, the understanding of mathematical methods can be completed with applications of those topics in electrodynamics. The concept of dielectric and the field in material medium are also grown within the students in this course. Analytical skill and the realization of the regular electromagnetic phenomena are developed studying the electromagnetic waves. Understanding of Maxwell's equations help students for a complete grip over the subject. The perception regarding dipole is shaped in this course and that assists the students to understand Nuclear Physics with clarity. The idea of retarded potential and the point charge makes the thinking ability of the students stronger. The critical thinking ability of the students is developed amongst the students from the topic Special theory of relativity
PHY104: Electronic Circuits and Devices Credit: 3	**Course Objective:** To make students well-equipped with present day knowledge in electronics this course is designed. **Course Outcome:** To give knowledge of some basic electronic components and circuits. To learn the difference between conductor, insulator and semiconductor To study basics of semiconductor and devices and their applications in different areas

	To understand the difference between ordinary pn junction diode and abrupt pn junction. To learn what is thermal equilibrium why it is needed and where it finds its application To study the basics of transistor and its working and implementation To study the various circuits like UJT, SCR and TRIAC To study different biasing techniques to operate transistor, FET, MESFET To know the principle of operation of photoelectronic devices like photodiode, and LED To identify and review the various configuration like common base, common emitter configuration and their V-I characteristics To interpret the difference between the emitter follower and common collector configuration To contemplate with the multistage amplifier To examine CMRR like common mode gain and difference mode gain To describe DC load line and bias point and different biasing circuits. To understand and analyse the IC 741 operational amplifier and its characteristics To deliberate on the solution for the linear and non-linear applications To elucidate and design of phase and frequency response of low pass, high pass and band pass filters To outline summing amplifier, inverting and non-inverting configuration. To summarise various amplifier like summing amplifier and Schmitt trigger To understand the basic logic gates To evaluate and plot Karnaugh maps
PHY105: General Physics Lab Credit: 2	**Course Objective:** Students should carry enough knowledge and expertise in the general experiments so that they can be fit for teaching job as well as to design the experiments in research purpose. **Course Outcome:** In this course the experiments are designed to give glimpse of heat, magnetism, electricity and optics experiments.

	By measuring thermal conductivity of a rod using Forbe's method students realize heat conduction. Determination of elastic constants of a material by Cornu's interference method strengthens the understanding of interference as well as the concept of elastic properties. Concept of black body is clarified from the experiment of verification of Stefan's law by electrical method. Study of coupled oscillators makes analytical thinking of students stronger as they get the same in classical mechanics theory. Measurement of refractive index of a liquid by shift assists the students to understand uses of laser, refractive index and grating. Students get acquainted with nuclear detector and the working principles when they are assigned with study of beta efficiency by GM counter. Performing the experiment with single slit, the pre-requisite knowledge for studying quantum mechanics is developed amongst students. Students get the understanding of
PHY106: Electronics Lab Credit: 2	**Course Objective:** Students should have expertise in the basic experiments of electronics in the present day demand and hence this course is designed. **Course Outcome:** The basic filters will help the student to identify how the frequency depend on resistance and how the signals behave with the frequencies. They can explore how to filter these signals with resistors and capacitors. The students can analyse and compare the effect of frequency to the output voltage. They are exposed to the usage of semi-log graph and how to plot with respect to the given values. The experiments related to operational amplifier makes the students to analyse and working of IC 741 and its characteristics and finding the solution for linear and nonlinear applications using OP-Amp. To appreciate and differentiate the working principles. How the resistor capacitor combination affects the uniformity of waveform and to comprehend the difficulties and to overcome that. The study of basic logic gates will help the student to have thorough understanding of the fundamental concept and the various techniques in digital electronics. To understand the Boolean algebra and the basic properties of Boolean algebra and will be able to simplify the simple Boolean expression using the properties. They should be able to relate Boolean expression to the

	truth table and logic diagrams. They will be able to compute arithmetic operation like addition and subtraction using gates.
PHY108: Techniques in Biophysics Credit: 3	**Course Objective:** Biophysics is one of the modern day subjects. Studying the techniques in biophysics students can become expert in that new field with their understanding of Physical, Chemical processes, different spectra etc. **Course Outcome:** Learning the Physico-Chemical techniques students realize how to handle both physical and chemical conditions in real need. Spectroscopic techniques assist them to understand EM spectra, optical rotatory dispersion, fluorescence, infrared, Raman spectra and apply them.
PHY 201: Mathematical Methods of Physics-II Credit: 3	**Course Objective:** To make students expert in the subjects like Partial Differential Equations (PDE), Green's Functions, Integral Equations, Group Theory and Numerical Techniques and C Programming this course in designed. **Course Outcome:** Mathematical Methods of Physics-II deals with Partial Differential Equations (PDE), Green's Functions, Integral Equations, Group Theory and Numerical Techniques and C Programming. Students learn to set the mathematical scenario of different physical system by writing the PDE's and reveal the underlying sense by solving them. Thus PDE help to develop their analytical skill. Knowledge of Green's function assist students to solve the non-homogeneous differential equations. Learning of methodology and application of the Green's function clarifies the basics of calculus and analytical skill. Integral equations (and its kernels) are needed to understand the modern day Physics. Studying Group theory, the concept of arrangement and representation of real physical properties by mathematics is developed. Learning Numerical techniques and C programming analytical power is grown within the students. As well as the students get practiced to find accurate and precise values.

PHY 202: Quantum Mechanics – I Credit: 3	**Course Objective:** To understand the modern day Physics, present technology in the field of Particle Physics to Nano-materials students require adequate knowledge in Quantum Mechanics. The basics of the subject are designed here to grow the concept amongst the students. **Course Outcome:** This course provides understanding and knowledge to realize the basics of molecular, atomic and sub-atomic physics. Concept of wave function and wave packet is introduced. Students get their critical thinking ability developed by studying uncertainty principle. Study of probability, expectation value and Ehrenfest's theorem assist students to be enriched with mathematical calculation. The concept of Schrodinger equation creates analytical power of students. The knowledge of quantization is clarified by studying energy levels. The study of different potentials nourish them to think about system and its function with the help of mathematical tools. Students get skilled by studying the formalism of quantum mechanics in describing the systems mathematically and this knowledge becomes very useful for their study of particle physics, spectroscopy and research. By learning the symmetry principles, the visualization about the system gets stronger. Concept of linear vector space help them to write the systems in proper way. By studying angular momentum, the conceptual clarity regarding the calculations of the eigen-value and eigen vector. Learning the calculations of CG coefficients students get ready to solve analytical and mathematical problems.
PHY 203: Statistical Mechanics Credit: 3	**Course Objective:** To have in-depth knowledge in thermodynamics and quantum statistics etc. this course is badly needed. **Course Outcome:** In this course the statistical description, quantum statistics of ideal gases, irreversible processes and fluctuations are dealt with. Studying the statistical description students get in-depth knowledge and concept about thermodynamics and its applications. Applications of statistical mechanics clarify the understanding of the students regarding number of breakthroughs in modern

	physics; e.g. Einstein's theory, partition function, theory of equi-partition, specific heat of solids, entropy, Gibb's paradox etc. Identical particles and their statistics are the key of the description of the quantum mechanical particles. Studying the Maxwell-Boltzmann statistics, Fermi-Dirac statistics and Bose-Einstein statistics the analytical and mathematical concept of the students regarding the statistical behaviour of the tiny bodies are developed thoroughly. Finally the introduction of the irreversible processes and fluctuations help students to be groomed for present day statistical physics.
PHY 204: Atomic, Molecular Physics and Modern Optics Credit: 3	**Course Objective:** This course is needed to have clear concept of Atomic, Molecular Physics and Modern Optics amongst students. **Course Outcome:** Chronological study of basic atomic models helps to understand the process of development in this field; thus the logical understanding and comprehensive skill are built. Concepts of atomic spectra are cleared. Study of hydrogen atom with fine structure correction makes the comprehensive knowledge very strong. The concept of fine structure and the hyperfine structure provides the understanding of spectral lines in detail. Study of Zeeman effect, Paschen Beck effect grows the nature of cultivating mathematical and analytical staffs. LS and JJ coupling studies are needed to develop the analytical skill and thinking ability. Study of molecular physics generates the idea of all possible reasons of spectra and thus the thinking ability regarding empirical modelling is nurtured. The problem solving skill is developed by studying the mathematical concept of the rotational spectra. The analytical thinking ability gets feed by studying the Raman spectra. Skill of empirical model developing is created by studying the Born-Oppenheimer approximation. Critical thinking ability is developed by studying the Franck Condon principle. Basics of Laser, 3D mapping of images, Holography, Fibre optics assist students to know and learn present day optics and use them in current technologies.

PHY 205: Optics Lab Credit: 2	**Course Objective:** Optics lab deals with experiments from optics and they are aimed to grow the knowledge of students in that area. **Course Outcome:** Students learn about Constant Deviation Spectrometer (CDS), one of the modern spectroscopy tools when they experiments with CDS. Using optical method the size determination of lycopodium powder teaches the students of application of diffraction as well as the limitation of measuring the length by the direct method. Minute analytical observation power is developed by studying the rotatory dispersion. Performing the experiments with Michelson interferometer students get clarity of happening of interference. This develops their concept on the measurement of wavelength of the used light, measurement of temporal and spatial coherence. Study of interference and diffraction with laser light develops the concept of the mentioned optical phenomena as well as the use of laser. Studying Hartman's constant determination, one gets practised with lamp-scale arrangement and analytical observation of the Hartman's constants. Concept of polarization of light is developed by doing study of elliptically polarized light.
PHY 206: Computational Physics Lab Credit: 2	**Course Objective:** For modern day technology students need to learn the programming and C++ is a very useful one for Physics students. **Course Outcome:** In this laboratory course students get the lessons in computer programming using C++. Students get acquainted with Linux fundamentals. Students get acquainted with Latex fundamentals. Students get practised with Gnu plot of graph plotting. Studying Bisection method, Newton-Raphson method students learn to find the roots of a quadratic equation. Students learn to solve differential equations by learning Euler method. By studying the Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule students learn to do integrations numerically. Students learn matrix multiplication, determination of eigenvalues of matrix, inverse of matrix also in C++.

PHY 207: Experimental Techniques (Soft Core) Credit: 3	**Course Objective:** Students should have the knowledge of this course as basic techniques and different instruments are discussed here in-depth. **Course Outcome:** This is a soft core course. It deals with different experimental techniques in Physics. Studying different temperature and electrical measurements the concept of measurements for regular equipment is grown within the students. Studying the vacuum techniques and the vacuum systems students get their knowledge in that type of systems. Learning magnetic sensors, magneto resistance hall effect sensors students get knowledge about modern day techniques in Physics.
P301: Atomic and Molecular Physics (General) Credit: 4	**Course Objective:** To understand the atomic and molecular structure use the spectra this course is needed. **Course Outcome:** Chronological study of basic atomic models helps to understand the process of development in this field; thus the logical understanding and comprehensive skill are built. Concepts of atomic spectra are cleared. Study of hydrogen atom with fine structure correction makes the comprehensive knowledge very strong. The concept of fine structure and the hyperfine structure provides the understanding of spectral lines in detail. Study of Zeeman effect, Paschen Beck effect grows the nature of cultivating mathematical and analytical staffs. LS and JJ coupling studies are needed to develop the analytical skill and thinking ability. Study of molecular physics generates the idea of all possible reasons of spectra and thus the thinking ability regarding empirical modelling is nurtured. The problem solving skill is developed by studying the mathematical concept of the rotational spectra. The analytical thinking ability gets feed by studying the Raman spectra. Skill of empirical model developing is created by studying the Born-Oppenheimer approximation. Critical thinking ability is developed by studying the Franck Condon principle. Technical knowledge in the subject area is enriched by understanding of instrumentation of IR spectroscopy.

P302: Nuclear and Particle Physics (General) Credit: 4	**Course Objective:** Basic nuclear structure and its representation is understood by studying this course. Students get comprehensive knowledge regarding interaction of charged particles and their behaviour in detail. **Course Outcome:** Interaction gamma rays with particles introduces the clarity to the concepts of Compton scattering, pair production and the photo electric effect. Study of nuclear forces and characteristics assists to develop inclusive knowledge of the students in the nuclear structure. The concept of technical thinking using physical phenomena is cultivated by studying the topics on nuclear detector and the nuclear electronics. Study of liquid drop model provides skill of preparing empirical models. Analytical understanding is developed by studying the shell model. Concept of experimental results and its representation in theory is developed by studying Fermi theory of beta decay, Kurie plot. Students get equipped with understanding of experimental plots. A comprehensive knowledge is gathered after going through the basic particle physics. Particles and their properties are well understood by this topic. Students get skilled by understanding of different symmetry. Thinking ability is nurtured by studying the CP violation. A clear concept of Standard Model of Physics is grown within students after studying this topic.
P303: Condensed Matter Physics (General) Credit: 4	**Course Objective:** This course introduces students to the physical properties of crystalline solids and to explore the electronic properties of various solids around us. **Course Outcome:** The first module of the course gives the fundamental understanding of crystalline solids to students by introducing them to the basics of geometrical crystallography like crystal systems, their classifications, symmetries, concepts of reciprocal lattices and also the physical principle behind X-ray diffraction studies which is a great tool to determine the crystal structures. The second module discusses the free electron theory of metals, where this theory successfully accounts for a wide range of metallic properties like thermal conductivity, specific heat

	capacities, electrical conductivity of metals and their temperature dependence etc. Followed by this module, the course introduces the other classes of solids like semiconductors and superconductors where it discusses their electronic properties and explains their origin. Final module of the course describes the dielectric properties of insulators, internal fields in dielectrics and also various types of magnetic phenomena like diamagnetism, para-magnetism, ferromagnetism, anti-ferromagnetism and ferrimagnetism exhibited by different solids. It also introduces the students to the theories which explains the origin of these magnetic properties in solids. This course aims to establish the fundamental concepts of condensed matter physics to students and also provides the knowledge to apply other concepts of physics which have been previously learned by the students particularly in quantum mechanics, classical mechanics, electromagnetism and statistical mechanics. Research in condensed matter physics has given rise to enormous technological applications which we witness in our daily life. The fundamental knowledge of condensed matter physics is very much essential and plays a major role in other research areas like material science, nanomaterial science, functional materials, spintronics, quantum computing, bio physics, cryogenics, low dimensional semiconductors, etc. This course helps the students to gain essential knowledge required to enhance their basic understanding in these research areas. By the end of this course, students will be able to analyse different types of matter depending on nature of chemical bonds and their electronic properties. They will be able to analyse the crystal structures by applying crystallographic parameters and also to determine the crystal structure by analysis of XRD data. This course enables the students to analyse electron transport and energy related problems by applying quantum mechanical principles. Solving theoretical problems of condensed matter physics in tutorials helps to improve the analytical skills of students. Participating in seminars and interactions, completing the assignments helps the students further to develop their communication skills and understanding of subject respectively. Some of the experiments related to condensed matter physics have been included in the laboratory component. The experimenting activity helps student to analyze and compare the theoretical

	predictions and measured data, to arrive at conclusions and present the results in a comprehensible manner.
P304f: Physics of Nanomaterials Credit: 4	**Course Objective:** Standing at the age of Nano-Technology students must learn nano-materials, nano-particles etc. properly and this course is designed for the same. **Course Outcome:** System of nano materials exhibits certain unique and special properties which have great significances in industrial applications. The course discusses types of nano systems such as quantum wire, quantum well etc and its key differences with respect to its counter part of the bulk system. Different methods for synthesis of nano materials which include Top down and Bottom up approaches are discussed at length. Characterization of nano structures are quite challenging. Methodologies such as Electron Microscopy, Scanning Probe Microscopy, Photo luminescence spectroscopy, IR and Raman spectroscopy, X – Ray diffraction methods etc are studied. The course will enable the student either pursue higher education or apply the acquired knowledge in solving industrial problems.
P306a: Advanced Physics lab I Credit: 2	**Course Objective:** This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Condensed Matter Physics, Nuclear Physics and Optics. It provides an insight to students about experimental techniques, data analysis, error analysis while investigating the physical phenomena. This course provides practical knowledge to students as they perform experiments and correlate it to theory. **Course Outcome:** This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Condensed Matter Physics, Nuclear Physics and Optics. It provides an insight to students about experimental techniques, data analysis, error analysis while investigating the physical phenomena. This course provides practical knowledge to students as they perform experiments and correlate it to theory. The list of experiments in this course are as follows: 1. Rotational Raman spectrum of a molecule.

	This experiment aims at determining the rotational constant and the bond length of nitrogen molecule by analyzing rotational Raman spectrum. 2. ESR spectrometer. Students will use the lab apparatus and measure the Lande-*g* factor of electron for standard ESR sample (DPPH) using portable ESR spectrometer. 3. Analysis of X-ray powder Diffractogram (NaCl, KCl). This experiment demonstrates the concept of x-ray diffraction by crystals. By analysing X-ray powder diffractogram of given compounds (NaCl, Tungsten), students determine the lattice parameter using x-ray intensity peaks. 4. Diffraction of laser light by using grating. This experiment enhances the understanding of diffraction of light concept using grating and also one can determine the wavelength of laser light. 5. Verification of Wiedemann Franz law By measuring the thermal and electrical conductivities of copper, students can verify the Wiedemann Franz law and can determine the Lorentz number At the end of the course, students learn to apply the various procedures and techniques for the experiments. They will be able to perform experiments with different measuring devices and meters and record the data with precision. By applying the mathematical concepts/equations one can arrive at quantitative results. They also develop basic communication skills through working in groups in performing the laboratory experiments. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph and by estimating the errors due to discrepancies in the experimental data and theoretical predictions. It enables them to explain the basic physical principle behind the experiment.

P306b: Advanced Physics lab II Credit: 2	**Course Objective:** This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Condensed Matter Physics, Nuclear Physics and Atmospheric and Space Sciences. It provides an insight to students about experimental techniques, data analysis, error analysis while investigating the physical phenomena. This course provides practical knowledge to students as they perform experiments and correlate it to theory. **Course Outcome:** This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Condensed Matter Physics, Nuclear Physics and Atmospheric and Space Sciences. It provides an insight to students about experimental techniques, data analysis, error analysis while investigating the physical phenomena. This course provides practical knowledge to students as they perform experiments and correlate it to theory. The list of experiments in this course are as follows: 1. Relative humidity of the atmosphere Here student learns to estimate the relative humidity of the atmosphere from the data obtained by dry and wet bulb thermometer for regular interval of time. 2. Study of β – absorption and determination of end point energy Students perform this experiment using Geiger-Muller counter and radioactive beta source thallium to determine the mass attenuation coefficient of β-rays in aluminum absorber and also estimates the end point energy. 3. Band spectrum of PN molecule. This experiment aims at determining the vibrational constants of PN molecule by analyzing its band spectrum using travelling microscope. 4. Thermal relaxation time of serial bulb. By providing the AC and DC currents to thermal relaxation set up, students can estimate the thermal relaxation time of the serial bulb whose emitted light is detected by photodiode.

	5. Indexing the X-ray diffraction pattern From the given X-ray diffractogram, students estimate the lattice parameter and index the x-ray diffraction peaks which helps in identifying the cubic lattice system of the compound. At the end of the course, students learn to apply the various procedures and techniques for the experiments. They will be able to perform experiments with different measuring devices and meters and record the data with precision. By applying the mathematical concepts/equations one can arrive at quantitative results. They also develop basic communication skills through working in groups in performing the laboratory experiments. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph and by estimating the errors due to discrepancies in the experimental data and theoretical predictions. It enables them to explain the basic physical principle behind the experiment.
P401: Computational Physics (General) Credit: 4	**Course Objective:** In this course the probability, statistics, experimental measurements, error, numerical methods and use of computational approach in Physics. **Course Outcome:** In this course the probability, statistics, experimental measurements, error, numerical methods and use of computational approach in Physics. Studying probability and statistics students get acquainted with statistical calculation that can be used in real applications. Understanding of the error, data fitting assist students to get practised with error analysis. The knowledge of numerical methods functions as advantage to the students as they realize the numerical steps of calculus. Finally applications of computational approach in Physics make students ready for the research and development.
P402: Continuum mechanics and special theory of relativity Credit: 4	**Course Objective:** In detail knowledge in tensor and its applications are there in this course. This course deals with Continuum mechanics of solid media, Fluid mechanics, Special Relativity and Relativistic mechanics of a point particle and students need in depth knowledge of them. **Course Outcome:** In this course students get the glimpse of fluid mechanics and of relativistic mechanics. Studying the fluid mechanics students come to know about the viscous nature, linear and rotational movement of the liquid. These

	help the students to work with concept of real life problems related with liquid flow. The continuum mechanics in solid clarifies the knowledge of students regarding the strain tensor, stress tensor and deformations. Study of relativistic mechanics of a point particle makes the analytic strength of the students stronger.
P403c: Lasers and Optics Credit: 4	**Course Objective:** Present day science and technology is well equipped with use of laser. In this course discussions are on lasers and optics. **Course Outcome:** Study of different types of lasers provide in-depth knowledge about the types of laser and their uses, which are badly needed in the current era of technology. The knowledge of basic characterisation, threshold conditions and the Q-switching etc assist students to understand the operation of laser both technical and analytical way. Study of propagation of light in optical media clarifies the knowledge of students regarding the interference, diffraction, polarization and other optical phenomena. Theses train the students to work with different optical media and instruments as well. The study of non-linear optics analytically and mathematically strong about the subject.
P404c: Condensed Matter Physics – II Credit: 2	**Course Objective:** This course deals with the study crystal Physics, Energy bands in solid, Ferroelectrics, Films and surfaces. **Course Outcome:** Studying Crystal Physics students get in-depth concept about crystal and lattice. Studying energy bands in solids, Kroneig Penny model, Brillouin Zone etc. students get thorough knowledge of energy bands. Informative and analytic concept about ferroelectric is clarified with general properties and classification of ferroelectrics. Students get technical and chemical concept after studying about films and surfaces.
P405a: Advanced Physics Lab –III Credit: 4	**Course Objective:** This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Condensed Matter Physics, Nuclear Physics and Atmospheric and Space Sciences. It provides an insight to students about experimental techniques, data analysis, error analysis while investigating the physical phenomena. This course provides practical knowledge to students as they perform experiments and correlate it to theory.

	Course Outcome: The list of experiments in this course are as follows: 1. Estimation of altitudes Here student learns to estimate altitudes from the given pressure data and correlate it with the theoretical values. 2. Studying β efficiency of GM counting system Students perform this experiment using Geiger-Muller counter and radioactive source thallium to determine the efficiency of GM counter in detecting the β particle. 3. Numerical fitting of binding energy curve This experiment aims at identifying the stable isobar for a given mass number using semi-empirical mass formula by fitting the binding energy curve using numerical methods. 4. Determination of Curie temperature for a ferroelectric material By performing experiment using four probe method, students study the temperature variation of dielectric constant of a ferroelectric material BaTiO3 and determine its Curie point. 5. Verification of inverse square law Students perform this experiment using Geiger-Muller counter and radioactive gamma source Cesium and verify the inverse square law. At the end of the course, students learn to apply the various procedures and techniques for the experiments. They will be able to perform experiments with different measuring devices and meters and record the data with precision. By applying the mathematical concepts/equations one can arrive at quantitative results. They also develop basic communication skills through working in groups in performing the laboratory experiments. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph and by estimating the errors due to discrepancies in the experimental data and theoretical predictions. It enables them to explain the basic physical principle behind the experiment.
P405b:	**Course Objective:** This laboratory course focuses on the advanced physics experiments chosen from Atomic and Molecular Physics, Condensed Matter Physics, Nuclear Physics and Atmospheric and

Advanced Physics Lab –IV Credit: 4	Space Sciences. It provides an insight to students about experimental techniques, data analysis, error analysis while investigating the physical phenomena. This course provides practical knowledge to students as they perform experiments and correlate it to theory. **Course Outcome:** The list of experiments in this course are as follows: 1. Magnetic susceptibility by Quincke's method Here student learns to calibrate electromagnet and determine the magnetic susceptibility d of magnetic salts ($MnSO_4$, $MnCl_2$) using Quincke's method 2. Electrical resistivity of semiconducting Ge sample using four probe method. Using four probes set up students learn the variation of resistivity of the Ge sample with temperature and determine the energy gap of the Ge crystal. Students will use computer and analyse the data from CLEA software and perform the following experiment. 3. Estimation of the Hubble's constant using CLEA. 4. Spectral Classification of Stars using CLEA software. 5. Estimation of mass of Jupiter from its moon's periods. At the end of the course, students learn to apply the various procedures and techniques for the experiments. They will be able to perform experiments with different measuring devices and meters, software and record the data with precision. By applying the mathematical concepts/equations one can arrive at quantitative results. They also develop basic communication skills through working in groups in performing the laboratory experiments. Students can learn and understand related physics concepts by performing experiments, applying analytical techniques and interpreting the results with the help of graph and by estimating the errors due to discrepancies in the experimental data and theoretical

	predictions. It enables them to explain the basic physical principle behind the experiment.
P406: Project Work Credit: 4	**Course Objective:** This course provides the primary window of research to each and every student. Students get acquainted with basics of research. Ethics and methodology of research are also taught to students. **Course Outcome:** In a particular subject-area students become very expert during exploring their project related to basic research. The analytical, mathematical and experimental concept of the students in the corresponding topic gets very strong and leads them to choose research or higher education as their career.

Learning Outcome:

For 2018-20batch:

P101-Classical Mechanics:

81% students passed the paper Classical Mechanics.

P102- Electronic Circuits and devices:

85.7% students cleared this paper successfully.

P103-Quantum Mechanics-I:

57% students taste the success in this particular paper.

P104-Mathematical Methods of Physics and C programming:

90.5% students become successful to clear this paper.

P105- Soft core-Atmospheric and Astro-Physics:

90.5% students become successful to clear this paper.

For 2018-20batch:

P201-Statistical Mechanics:

95% students passed the paper Classical Mechanics.

P202- Electrodynamics:

85% students cleared this paper successfully.

P203-Quantum Mechanics-II:

95% students taste the success in this particular paper.

P204-Mathematical Methods of Physics and Numerical Techniques:

90% students become successful to clear this paper.

P205- Soft core-Experimental techniques in Physics

90% students become successful to clear this paper.