COURSE OUTCOME – UNDERGRADUATE PHYSICS HONOURS (CBCS SYSTEM) SEMESTER-1				
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 1 CC1 [Mathematical Physics-I] (FM 40)	Calculus, Vector calculus, Orthogonal curvilinear coordinates, Introduction to probability, Dirac delta functions and its properties.	It allows the students to learn the basics of vector calculus in addition to the conventional calculus analysis. Different co-ordinates system and its uses in physics as well as probabilistic concept in physics is also introduced to the students. They will also learn about the Dirac detla function and its different properties.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	SEMESTER – 1 CC1 [Mathematical Physics-I] PRACTICAL (FM 20)	Mathematical Physics I LAB	Various programming languages (e.g. python , C, C++ etc.) is introduced to the students. They will be habituated with the uses of programming languages to solve any physics related mathematical problems.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 1 CC2 [Mechanics] (FM 40)	Fundamental of Dynamics, Work and energy, Collisions, Rotational Dynamics, Elasticity, Fluid motion, Gravitational and Central Force motion, Oscillations, Non-inertial systems, Special theory of Relativity	Students will get to know about the basic fundamentals of dynamical system. They will be familiar with gravitational field, elasticity of matters. The basics of special theory of relativity is also introduced to the students to make a strong fundaments for research based physics topics.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER – 1 CC2 [Mechanics] PRACTICAL (FM 20)	Mechanics Lab	The students will get hands on training on evaluating gravitational constant, moment of inertia calculation, different measuring techniques, evaluating elastic modulus and viscosity of liquids.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 1 GE1A [Mechanics] (FM 40)	Vectors, Ordinary differential equations, laws of motion, momentum and energy, Rotational motion, Gravitation, Oscillations, Elasticity, Special theory of relativity	Basics of vectors, differential equations is introduced to the students. They will also learn the different aspects of dynamical system, gravitation and relativity.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 2 GE1A [Mechanics] PRACTICAL (FM 20)	Mechanics Lab	Students will learn the different measurement techniques, evaluating gravitational constant, elastic modulus from different physical experiments.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 1 GE1B [Thermal Physics and Statistical Mechanics] (FM 40)	UNIT 1: Law of thermodynamics	In this unit the students will learn about the thermodynamic description of system. They will learn different laws of thermodynamics: Zeroth Law, First Law, second law and third law of thermodynamics. General relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, reversible and irreversible processes, entropy, Carnot's cycle & theorem.

			UNIT 2: Thermodynamical Potentials	In this unit the students will be taught to Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.
			UNIT 3: Kinetic Theory of gases	In this unit students will learn derivation of Maxwell's law of distribution of velocities, mean free path, Transport Phenomena: Viscosity, Conduction and Diffusion, Law of equipartition of energy and its applications.
			UNIT 4: Theory of radiation	A very fundamental part of theory of radiation will be learnt by the students in this section where they will get the taste of Blackbody radiation, Planck's law, Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.
			UNIT 5: Statistical Mechanics	In this unit the students will learn need and elements of statistical mechanics. In statistical mechanics students will be enriched by concept of phase-space, microstate and macrostate. They will also learn the topics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
		COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER – 1 GE1B [Thermal Physics and Statistical Mechanics] PRACTICAL (FM 20)	Thermal Physics and Statistical Mechanics Lab	The students will learn some interesting practical of thermal physics and statistical mechanics like Determination of Mechanical Equivalent of Heat, J, by Callender and Barne's method, Planck's constant using black body radiation, determination of Stefan's Constant, determination of the coefficient of thermal conductivity of Cu by Searle's Apparatus and by Angstrom's Method, determination of the coefficient of thermal conductivity by Lee and Charlton's method, determination of the temperature co-efficient of resistance by Platinum resistance thermometer and study the variation of thermo emf across two junctions of a thermocouple with temperature, record and analyze of temperature using thermocouple, calibration of Resistance Temperature Device (RTD).

COURSE OUTCOME – UNDERGRADUATE PHYSICS HONOURS (CBCS SYSTEM) SEMESTER-2				
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 2 CC3 [Electricity and Magnetism] (FM 40)	Electric Field and Electric potential, Dielectric Properties of Matter, Magnetic Field, Magnetic Properties of Matter, Electromagnetic Induction, Electrical Circuits and Network theorems	The basic concepts of electric field, dielectric medium is introduced to the students. They will also learn about the fundamentals of the magnetostatics and electromagnetic induction. Different analysis of electrical circuits is also introduced here to solve complex electrical problems.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	SEMESTER – 2 CC3 [Electricity and Magnetism] PRACTICAL (FM 20)	Electricity and Magnetism Lab	Hands on training on realizing passive and active components in an electrical circuits is introduced here. The students will also able to learn different techniques to evaluate unknown resistance, inductance, capacitance value.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 2 CC4 [Waves and Optics] (FM 40)	Superposition of collinear harmonic oscillations, superposition of two perpendicular harmonic oscillations, wave motion, velocity of waves, superposition of two harmonic waves, waves optics, interference, interferometer, diffraction and holography	The concepts of waves and superposition of them is introduced here. Students will learn about the wave nature of light via the interference, diffraction phenomena. The concept of interferometer and holography is also introduced in this paper.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER – 2 CC4 [Waves and Optics] PRACTICAL (FM 20)	Waves and Optics lab	Students will be able to realize the different properties of light via the interference, diffraction based experiments.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 2 GE2A [Electricity and Magnetism] (FM 40)	Vector analysis, Electrostatics, Magnetism, Electromagnetic induction, Maxwell's equations and electromagnetic wave propagation	Students will learn about the vectors, electrostatics and magnetostatics. They will also learn about the electromagnetic inductions and wave nature of the electromagnetic fields.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 2 GE2A [Electricity and Magnetism] PRACTICAL (FM 20)	Electricity and Magnetism lab	The students will realize the properties of resistance, capacitor, inductor in an electrical circuit. They will also learn to evaluate the unknown capacitor, inductor, resistance value in an electrical circuit.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 2 GE2B [Waves and Optics] (FM 40)	Unit 1: Superposition of two Collinear Harmonic Oscillations	Students will learn about the Linearity and Superposition Principle of two oscillations having equal frequencies. They will also learn about the linearity and superposiotion of two oscillations of different frequencies and as a result the formation of beats. Students will also be able to solve conceptual and numerical problems on these topics.

			Unit 2: Superposition of two Perpendicular Harmonic Oscillations	In this segment students will get knowledge on graphical and analytical method of superposition of two perpendicular oscillations of same frequencies and also of different frequencies and the formation of Lissajous figures. The students will observe the patterns of Lissajous figures and they will draw them carefully.
			Unit 3: Wave Motion - General	Students will get the idea of formation of Transverse wave , Travelling waves and Standing waves on a string. They will learn different properties of transverse waves, Travelling waves and standing waves on string and solve numerical problems on these topics. The students will be able to express different types of waves mathematically by suitable sinusoidal periodic functions. They will learn about the Normal modes of vibrations of a string. They will gain the knowledge on phase velocity and Group velocity and will be able to establish a mathematical relation between them. The students will also learn about Plane waves and Spherical waves and Wave intensity.
			Unit 4: Sound	In this part the students will learn the Simple harmonic motion, damped vibration , forced vibration and resonance. Students will be able to differentiate between Velocity resonance and Amplitude resonance, to draw the resonance curve, to determine resonant frequencies ,half power frequencies and band width. They will gain knowledge on Sharpness of resonance and quality factor of resonance. Students will study the Fourier's theorem and apply these theorem for analysis of Saw-tooth wave and Square waves. Students will be familiar with the units like decibel and phon, the units of relative intensity and loudness of sound respectively. Students will also get some idea about the musical notes and musical scale. They will also be taught on Acoustics of buildings also. This context students will be taught the topics like Reverberation, Reverberation time , Absorption coefficient. Students will derive the Sabine's formula. They will be able to calculate the reverberation time and to understand the different Acoustic aspects of halls and auditorium. This will help the students in designing the indoor of a hall and auditorium.

			Unit 5: Wave Optics	The students in this section will learn about electromagnetic nature of light as a consequence of Maxwell's equations in Electromagnetism. They will get a very clear idea of wave front and will be able to distinguish between plane wave front, Spherical wave front and Cylindrical wave front. The students will learn the Huygens Principle and will be able to explain the propagation of light wave .
			Unit 6: Interference of light	At first the students will learn about the Young's double slits experiments and the formation of interference fringes. Then they will be able to state the definition of interference. Students will be able to classify the two methods of interference i.e. Division of amplitude and division of wavefront. Students will be familiar with the different techniques for production of interference like Fresnel's bi prism method, Lloyd's single mirror method, Newton's rings formation. The students will find the expression of diameter of Newton's rings. By using this expression students will measure the diameter and they will be able to determine the unknown wave length of monochromatic light and the refractive index of liquid. Students will get idea about the fringes of equal inclination and fringes of equal thickness also. Students will also solve a lot of numerical problems.
			Unit 7:Michelson's Interferometer	In this unit students will get an idea of different forms or shapes of interference fringes produced by Michelson interferometer. Students will learn the construction and working principle of the Michelson interferometer in short. They will learn about the methods of determination of unknown wavelength of monochromatic light, difference of wavelengths of a compound light consisting two wavelengths and refractive index of a thin transparent film and its thickness by using Michelson's interferometer.

			Unit 8: Diffraction of light	At first the students will understand the actual meaning of diffraction of light and the specific conditions to be fulfilled for the occurrence of the diffraction of light. Students will be able to differentiate between the two different categories of diffraction i.e .Fraunhofer diffraction and Fresnel diffraction. In the category of Fraunhofer diffraction, students will get knowledge of diffraction of light through single slit, double slits , Multiple slits and diffraction grating and they will find the expressions of intensities of the diffraction patterns in each case. In the category of Fresnel Diffraction, students will know about the half period zones and zone plates. Students will be able to explain either the bending i.e. diffraction of light or the rectilinear propagation of light with the help of ideas of half period zones.
			Unit 9:Polarization of light	In this unit students will learn about the transverse nature of light waves. Then students will understand the mutual orthogonal directions of Electric field, Magnetic field and Propagation of light wave very well. After this the students will learn about the meaning of plane polarized light and methods of production and analysis of this plane polarized light. At last students will get an elementary idea about the circularly polarized light and the elliptically polarized light too.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 2 GE2B [Waves and Optics] PRACTICAL (FM 20)	Waves and Optics Lab	In the practical course the students will i)Investigate the motion of coupled oscillators and will dertermine the normal modes of vibrations. ii)Determine the frequency of an electrically maintained Tuning fork by Melde's experiment and to verify the wave length ^{2} – Tension law. iii)To study the Lissajous figure by usin the Cathode Ray Oscilloscope and to draw the wave forms of component waves and resultant waves and correlate them with theoretical knowledge on Lissajous figure formation. iv)Determine the value of coefficient of viscosity of water by capillary flow method(Poiseuille's method). v)Measure the intensities of diffraction patterns of single slit and double slits by using optical bench, photo sensor and laser and also determine the wavelength of laser. vi)Determine the unknown wavelength of sodium light by measuring the diameters of Newton's rings by using travelling microscope. vii)Determine the unknown wavelength of monochromatic light by using Fresnel bi prism. viii)Level the spectrometer properly.Then the spectrometer will be set for parallel incident rays and parallel emergent rays by method of Schuster's focusing. Then by using this spectrometer students will determine the refracting angle of prism, refractive indices of the material of the prism for different colours of light of given wavelength, values of Cauchy constants, Dispersive power of the material of prism, Resolving power of prism, unknown wavelengths of lights of different colours by using plane diffraction grating and resolving power of this plane diffraction grating.

COURSE OUTCOME – UNDERGRADUATE PHYSICS HONOURS (CBCS SYSTEM) SEMESTER-3				
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 CC5 [MATHEMATICAL PHYSICS II] (FM 40)	UNIT 1: Fourier Series	In this unit the students will learn about the Fourier series expansion of periodic functions on the basis of Dirichlet conditions leading to the determination of the corresponding Fourier coefficients. This will in turns help the students to find the sum of an infinite series. Differentiation and integration of Fourier Series with its complex representation will also be learnt in this unit. The students will also get to know to about the Fourier expansion of non periodic functions too.
			UNIT 2: Frobenius Method and Special Functions	In this unit the students will be taught to solve 2^{nd} order linear ode's with the introduction to the singular points and hence they will learn about some important 2^{nd} order linear ode's in Physics especially Legendre and Bessel differential equations. Finally the students will get to learn in detail about the various properties of Legendre polynomials and Bessel functions.
			UNIT 3: Some Special Integrals	Some very important functions from application point of view in Physics like Beta, Gamma and Error functions will be introduced in this part and the students will get to know about their different properties and applications.
			UNIT 4: Variational calculus in physics	A very fundamental part of classical physics will be learnt by the students in this section where they will get the taste of Lagrangian and Hamiltonian formulations of classical mechanics based on variational calculus.
			UNIT 5: Partial Differential Equations	In this unit the students will learn how to solve some very important partial differential equations occurred in Physics like Laplace's equation, wave equation, diffusion Equation using separation of variables in different types of coordinate system.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	SEMESTER – 3 CC5 PRACTICAL (FM 20)	Mathematical Physics II Lab	The students will learn some advanced level programming with Python in this course. They will learn to evaluate Gaussian integration, solve numerical solution of first and second order ode's, evaluation of Fourier coefficients of a given periodic signal etc. This course will prepare the students for higher studies and research in theoretical and computational physics.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 CC6 [Thermal Physics] (FM 40)	Introduction to thermodynamics, thermodynamic potentials, Maxwell's thermodynamic relations, Kinetic theory of gases.	Students will learn the basics of thermodynamics. The importance of different thermodynamical potentials will be illustrated among them. They will also learn about the kinematics of the gas molecules.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 CC6 [Thermal Physics] PRACTICAL (FM 20)	Thermal Physics Lab	Different properties of thermal physics is realized via the experiments among the students. They will learn to evaluate temperature, thermal conductivity via the physical experiments.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 CC7 [Digital Systems and Applications] (FM 40)	Integrated circuits, digital circuits, Boolean algebra, data processing circuits, circuits, timers, shift registers, counters, computer organization	The students will learn about the fundamentals of digital electronics. Various counter, timers, data storage components is introduced here for the students. They will also learn about the organization of computer system.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 CC7 [Digital Systems and Applications] PRACTICAL (FM 20)	Digital Systems and Applications lab	Various counter, flip flop storage element, logic gates is introduced among the students via physical experiments.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 SEC1A [Computational Physics] (FM 60)	Unit 1: Introduction	In the introductory part of this skill enhancement course the students will learn the basic concepts of algorithm and flowchart with some basic examples of matrices, series sums etc.
			Unit 2: Scientific Programming	With a brief overview of Linux the students in this part of the curse will be introduced to FORTRAN where they will learn about different attributes of this programming language. The students will also get the knowledge how to write a Fortran program to solve some basic Physics problems.
			Unit 3: Control Statements	In this section the students will learn different looping, control and jumping statements in FORTRAN. They will also get the concepts of function, array, subroutine and file handling. Physical problem solving in this part will also be taught to them.
			Unit 4: Scientific word processing: Introduction to LaTeX	This part of the course will help the students to get the taste of different LaTeX commands for scientific data processing. This wil be very handy to them so far as their future research career in Physics is concerned.
			Unit 5: Visualization	In this section the students will get the knowledge about GUNPLOT for data handling especially for manipulation of graphical data. This will be again very useful for them in their laboratory based works.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER – 3 SEC1B [Electrical Circuits and Networks Skills] (FM 60)	Unit 1: Basic Electricity Principles	In the introductory part of this skill enhancement course the students will learn the basic concepts of Voltage, Current, Resistance, and Power. Ohm's law. Series, parallel, and series-parallel combinations. AC Electricity and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.
			Unit 2: Understanding Electrical Circuits	With a brief overview, students will learn the main electric circuit elements and their combination Single-phase and three-phase alternating current sources. Real, imaginary and complex power components of AC Source, Power factor, Saving energy and money.
			Unit 3: Electrical Drawing and Symbols	In this section the students will learn different drawing symbols, Blueprints, Ladder diagrams, Electrical Schematics, Power circuits, Tracking the connections of elements and identify current flow and voltage drop.
			Unit 4: Generators and Transformers	This part of the course will help the students to get the taste of DC Power sources. AC/DC generators, Operation of transformers.
			Unit 5: Electric Motors	In this section the students will get the knowledge about Single-phase, three-phase & DC motors. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor.
			Unit 6: Solid-State Devices	In this section the students will learn Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.
			Unit 7: Electrical Protection	In this section student will get the knowledge of relays, fuses, disconnect switches, circuit breakers grounding and isolating, surge protection. Interfacing DC or AC sources to control elements.
			Unit 8: Electrical Wiring	In this section student will learn different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors .
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 GE3A [Mechanics] (FM 40)	Vectors, Ordinary differential equations, laws of motion, momentum and energy, Rotational motion, Gravitation, Oscillations, Elasticity, Special theory of relativity	Basics of vectors, differential equations is introduced to the students. They will also learn the different aspects of dynamical system, gravitation and relativity.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 GE3A [Mechanics] PRACTICAL (FM 20)	Mechanics Lab	Students will learn the different measurement techniques, evaluating gravitational constant, elastic modulus from different physical experiments.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 GE3B [Thermal Physics and Statistical Mechanics] (FM 40)	UNIT 1: Law of thermodynamics	In this unit the students will learn about the thermodynamic description of system. They will learn different laws of thermodynamics: Zeroth Law, First Law, second law and third law of thermodynamics. General relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, reversible and irreversible processes, entropy, Carnot's cycle & theorem.
			UNIT 2: Thermodynamical Potentials	In this unit the students will be taught to Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius- Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.
			UNIT 3: Kinetic Theory of gases	In this unit students will learn derivation of Maxwell's law of distribution of velocities, mean free path, Transport Phenomena: Viscosity, Conduction and Diffusion, Law of equipartition of energy and its applications.
			UNIT 4: Theory of radiation	A very fundamental part of theory of radiation will be learnt by the students in this section where they will get the taste of Blackbody radiation, Planck's law, Wien's distribution law, Rayleigh- Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law.
			UNIT 5: Statistical Mechanics	In this unit the students will learn need and elements of statistical mechanics. In statistical mechanics students will be enriched by concept of phase-space, microstate and macrostate. They will also learn the topics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 3 GE3B [Thermal Physics and Statistical Mechanics] PRACTICAL (FM 20)	Thermal Physics and Statistical Mechanics Lab	The students will learn some interesting practical of thermal physics and statistical mechanics like Determination of Mechanical Equivalent of Heat, J, by Callender and Barne's method, Planck's constant using black body radiation, determination of Stefan's Constant, determination of the coefficient of thermal conductivity of Cu by Searle's Apparatus and by Angstrom's Method, determination of the coefficient of thermal conductivity by Lee and Charlton's method, determination of the temperature co-efficient of resistance by Platinum resistance thermometer and study the variation of thermo emf across two junctions of a thermocouple with temperature, record and analyze of temperature using thermocouple, calibration of Resistance Temperature Device (RTD).

COURSE OUTCOME – UNDERGRADUATE PHYSICS HONOURS (CBCS SYSTEM)

SEMESTER-4

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 CC8 [MATHEMATICAL PHYSICS III] (FM 40)	Complex analysis, Integrals transforms, Matrices, Eigen-values and Eigenvectors.	Students will learn detailed complex analysis and its applications in various physical problems. The importance of matrices and eigenvectors is introduced among the students.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	SEMESTER – 4 CC8 PRACTICAL (FM 20)	Mathematical Physics III Lab	Detailed computational programming is introduced among the students to solve complex physical problems. They will learn to use matrices, complex integrations in computational problems.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER – 4 CC9 [ELEMENTS OF MODERN PHYSICS] (FM 40)	UNIT 1: Quantum nature of light: Planck's law, Photoelectric effect, Compton scattering, Matter wave, De Broglie's hypothesis, Davisson –Germer Experiment, Wave description of particles by wave packets, Two-slits experiment with electrons	In this unit the students will learn about the Planck's law and the quantum or particle nature of light.The topics of Photoelectric effect and Compton scattering will help the students in understanding the quantum nature of light in reality. On the other hand , students will also learn about the wave nature of the motion of particle like electrons in the topics Matter waves, De Broglie's hypothesis. Students will learn about different properties of matter waves. The knowledge of Davison-Germer experiment and Two-slits experiment with electrons will help the students in understanding the wave nature of parcicles in motion. Students will also learn to describe the motion of particles with wave-packets and they will also learn the concept of Phase velocity and group velocity. In a nut-shell this unit explains the particle nature of waves and also the wave nature of particle-motion.
			UNIT 2: Position measurement, Gamma ray microscope thought experiment, Heisenberg Uncertainty principle and various applications of this principle. Two slits interference experiments with photons, atoms and particles, linear superposition principle as a consequence, Matter waves and wave amplitude, Schrodinger equation for non-relativistic particles, Momentum and Energy operators, Stationary states, Physical interpretation of Wave function, position probability, normalization of a wave-function and probability current densities in one dimension	In this unit the students will be taught to learn the concept of Heisenberg's uncertainty principles in the simultaneous measurements of two canonical conjugate pairs of variables like position and linear momentum pair, Energy and time pair etc. The study of the Gamma ray microscope and thought experiment will help the students in gaining the idea about measurement of uncertainty in position ans uncertainty in momentum. Students will understand the consequences of linear Superposition principle of waves through study of two slits experiments with photons, atoms and particles . In this unit students will get the knowledge and conceptions about the wave function of quantum mechanics. They will study different properties of wave function. Students will be able to construct Schrodinger equation in one dimension. They will also learn to normalize a wave function , to calculate the position probability and Probability Current densities of a particle in motion.

			UNIT 3: One dimensional infinitely rigid box- energy eigen values and eigen functions, Quantum dot as an example, Quantum mechanical scattering and tunneling in one dimension across a step potential barrier. Size and structure of atomic nucleus and its relation with atomic weight. Impossibility of an electron being in nucleus as a consequence of Heisenberg's uncertainty principle. Nature of nuclear force ,NZ graph, Liquid drop model, Semi-empirical mass formula and binding energy of nucleus, Nuclear shell model and magic numbers.	Students will study about the motion of a quantum-mechanical particle confined in a rigid box. They will be able to find the eigen values of total energy of the particle and the eigen functions of the particle. Students will also be able to express the nature of eigen functions by drawing suitable diagram. Students will also learn the phenomena of Quantum mechanical scattering and tunneling in one dimension across a step potential barrier. They will construct the one dimensional Schrodinger equation, solve the equation and find the eigen functions. Then they will calculate the reflection coefficient and the transmission coefficient and probability of tunneling through the potential barrier. As an example of quantum mechanical tunneling students will also study the alpha decay process in radio activity and they will be able to explain the alpha decay process with the tunneling effect. Students will learn about the size, structure and different properties of nucleus. They will be able to calculate the density of nucleus and the radius of a nucleus. They will be able to explain the non-existence of electrons in the nucleus by Heisenberg's uncertainty principle. They will also learn the properties of nuclear force and they will also get a comparative knowledge among nuclear force and other field forces . Students will also learn the Liquid drop model and Shell model of nucleus. The study on these two nuclear models will help the student in sound understanding of different properties of nucleus. These two models of nucleus are very effective to explain the concept of binding energy and stability of nucleus very well.

			UNIT 4: Radioactive decay laws, Fission and fusion, Lasers .	Students will learn the phenomenon of radioactivity and different radioactive decay laws. They will calculate the Half life , Mean life of radioactive nucleus and apply these decay laws by means of radio carbon dating to calculate the age of very old wooden sample. Students will also learn about the reasons of emission of alpha particles, beta particles and gamma rays and their properties in radioactivity. They will be able to calculate the amount of energy released in alpha decay, beta decay and gamma ray emission and the nature of energy spectra in these three cases. Student will try to apply the principle of conservation of energy and angular momentum in beta decay process and will find that the apparent non-conservation of these two principles in beta decay must require the existence of Pauli's neutrino hypothesis to explain the continuous bêta energy spectrum. Students will learn the nuclear fission and fusion, apply the energy-mass equivalence formula of relativity and calculate the amount of mass deficit and the amount of energy released in these two types of nuclear reactions. They will study the elementary construction of Nuclear reactor and also its working principle. Students will also learn the fusion, thermonuclear reactions driving stellar energy. Students will learn the phenomena of Spontaneous emission, meta stable state formation, population inversion, optical pumping , Stimulated emission, Einstein's A and B coefficients and their relation. Then they will able to understand the origin of LASER . Students will also learn the working principle of three-level laser, four-level laser, Ruby laser and He-Ne lasers and their applications.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 CC9 [ELEMENTS OF MODERN PHYSICS] PRACTICAL (FM 20)	Elements of Modern Physics Lab	Students will learn the Photoelectric effect in details by performing experiments using suitable circuit and they will study the variation of photo current with variation of intensity of incident light and also with the wavelength of light and express these study by drawing suitable graphs. Students will also measure the maximum energy of the photo electrons in terms of stopping potential for different given wavelengths of incident light and then plot the stopping potential versus 1/ wave length graph and will calculate the values of Planck's constant and photoelectric work function from this graph. The students will also determine the value of, i)Planck's constant using blackbody radiation and photo detector. ii) the value of Planck's constant by using LEDs of at least four different colours. They will determine the value of, iii)Thermionic work function of material of filament directly heated vacuum diode. iv)The wave length of H-alpha emission line of hydrogen atom by using Spectrometer and Hydrogen gas filled discharge tube. v)Ionization potential of Mercury by using spectrometer and Mercury filled discharge tube. vi)The wavelength of absorption lines in the rotational spectrum of iodine vapour. vii)the wave length of laser source by studying the diffraction of the laser through single slit, double slits and plane diffraction grating. viii) the value of the specific charge of electron(i.e. e/m value) by magnetic focusing or using bar magnet and also by performing Millikan oil drop experiment. Students will also study the tunnelling effect in tunnel diode by drawing I-V characteristics

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 CC10 [Analog Systems and Applications] (FM 40)	Semiconductor diodes, Two terminal devices and their applications, Bipolar junction transistors, amplifiers	The students will learn about the detailed fundamentals of diodes, transistors. They will also learn about the construction of amplifiers.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 CC10 [Analog Systems and Applications] PRACTICAL (FM 20)	Analog Systems and Applications Lab	Realization of different properties of diodes, transistors, amplifiers is performed via experimental physical problems.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 SEC2A [Basic Instrumentation Skills] (FM 60)	Basic of measurement, Electronic voltmeter, Cathode Ray Oscilloscope, Signal Generators and analysis instruments, impedance bridges & Q-meters, digital instruments, digital multimeter	The students will learn about the basic construction of voltmeter, ammeters. They will also learn to use them. They will also learn about the different errors arising during experiments. The basics of CRO, multimeter is introduced among the students.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEC2B [Renewable Energy and Energy Harvesting] (FM 60)	Unit 1: Fossil fuels and Alternate Sources of energy	In this unit students will learn the topics like fossil fuels and nuclear energy , their uses and limitations. Then they will be able to understand the immediate needs of different renewable and non-conventional energy sources. Then students will learn about an overview of developments in different renewable and non-conventional energy sources like Solar Energy, Offshore Wind Energy, Tidal Energy , Ocean Thermal Energy, Geothermal Energy, Hydroelectricity. Students will also learn about the biomass, bio chemical conversion and biogas generation. After the study of this unit students will be able to promote the uses of renewable and non-conventional energy sources among the people of society for the sustainable development.
			Unit 2: Solar Energy	In this unit student will gain knowledge about solar Energy in details. At first they will learn the importance of solar energy and the mechanism of storage of solar energy. Then students will learn about the various fields of uses of solar energy in Solar pond, solar water heater, solar distillation, solar cooker, solar green house, solar cell ,absorption air conditioning systems and the working principles, merits and demerits of these solar appliances in details. Then students will learn the topics like Photovoltaic systems, Photovoltaic models, Equivalent circuits and also the Sun tracking systems. The students will be able to know the engineering of solar system after studying the Photovoltaic system and the Sun tracking systems. This unit will help the students to promote the uses of solar energy system in our daily life for the economic as well as environmental benefits of our society .
			Unit 3: Wind Energy Harvesting	In this section the students will learn fundamentals of wind energy, advantages and disadvantages of wind energy. Then they will learn about the construction and working principles of different electrical machinery parts of wind turbines. After studying this unit students will be able to identify the practical fields of applications of wind energy in a tropical country like India subject to the vast geometrical and atmospheric diversity in Our country.

			Unit 4: Ocean Energy Harvesting	This part of the course will help the students to get the knowledge of potential of Ocean Energy against Wind and Solar energy. Students will learn about the wave characteristics and statistics. They will also get ideas about the construction and working principles of different wave energy devices. taste of different LaTeX commands for scientific data processing. This wil be very handy to them so far as their future research career in Physics is concerned.
			Unit 5: Geothermal Energy	In this section the students will get the knowledge of Geothermal Energy Resources and the practical scopes of availability of these resources. They will also learn about the different technologies used for harvesting of geothermal energy.
			Unit 6:Hydro Energy	In this part students will learn about the Hydropower resources and the technologies used for generation of hydroelectric power. Students will also get knowledge about the environmental impacts of infrastructure required for hydroelectric power plant and hence the students will gain awareness about environmental issues.
			Unit 7: Piezoelectric Energy Harvesting	In introduction of this unit students will learn about the Physics behind the piezoelectric effect , the characteristics of piezoelectric effect , properties of different piezoelectric materials and mathematical descriptions of piezoelectricity. They will get some idea about the modeling of piezoelectric generators on the basis of different piezoelectric parameters. Finally the students will learn about the processes of piezoelectric energy harvesting and various applications of piezoelectric effects in different appliances for our daily uses.
			Unit 8:Electromagnetic Energy Harvesting	In this unit students will learn about the different aspects of Electromagnetic Energy Harvesting. They will study about the physics of linear generators, mathematical models of linear generators and different applications of them. Students will learn about the Carbon capture technologies, cells, batteries and power consumptions also. Students will get some idea about the different burning environmental issues and the needs of renewable energy sources for sustainable development. The aim of this unit is to help every student to become an eco friendly aware citizen of our country.

			Unit 9: Demonstration and Experiments	The aim of this unit is to give some practical exposures to the students on some renewable energy sources. The students will be given demonstrations of training modules on solar energy, wind energy, conversion of vibration into voltage by using piezoelectric materials and conversion of thermal energy into voltage using thermoelectric modules.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 GE4A [Electricity and Magnetism] (FM 40)	Vector analysis, Electrostatics, Magnetism, Electromagnetic induction, Maxwell's equations and electromagnetic wave propagation	Students will learn about the vectors, electrostatics and magnetostatics. They will also learn about the electromagnetic inductions and wave nature of the electromagnetic fields.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 GE4A [Electricity and Magnetism] PRACTICAL (FM 20)	Electricity and Magnetism lab	The students will realize the properties of resistance, capacitor, inductor in an electrical circuit. They will also learn to evaluate the unknown capacitor, inductor, resistance value in an electrical circuit.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 4 GE4B [Waves and Optics] (FM 40)	Unit 1: Superposition of two Collinear Harmonic Oscillations	Students will learn about the Linearity and Superposition Principle of two oscillations having equal frequencies. They will also learn about the linearity and superposiotion of two oscillations of different frequencies and as a result the formation of beats. Students will also be able to solve conceptual and numerical problems on these topics.

			Unit 2: Superposition of two Perpendicular Harmonic Oscillations	In this segment students will get knowledge on graphical and analytical method of superposition of two perpendicular oscillations of same frequencies and also of different frequencies and the formation of Lissajous figures. The students will observe the patterns of Lissajous figures and they will draw them carefully.
			Unit 3: Wave Motion - General	Students will get the idea of formation of Transverse wave , Travelling waves and Standing waves on a string. They will learn different properties of transverse waves, Travelling waves and standing waves on string and solve numerical problems on these topics. The students will be able to express different types of waves mathematically by suitable sinusoidal periodic functions. They will learn about the Normal modes of vibrations of a string. They will gain the knowledge on phase velocity and Group velocity and will be able to establish a mathematical relation between them. The students will also learn about Plane waves and Spherical waves and Wave intensity.
			Unit 4: Sound	In this part the students will learn the Simple harmonic motion, damped vibration , forced vibration and resonance. Students will be able to differentiate between Velocity resonance and Amplitude resonance, to draw the resonance curve, to determine resonant frequencies ,half power frequencies and band width. They will gain knowledge on Sharpness of resonance and quality factor of resonance. Students will study the Fourier's theorem and apply these theorem for analysis of Saw-tooth wave and Square waves. Students will be familiar with the units like decibel and phon, the units of relative intensity and loudness of sound respectively. Students will also get some idea about the musical notes and musical scale. They will also be taught on Acoustics of buildings also. This context students will be taught the topics like Reverberation, Reverberation time , Absorption coefficient. Students will derive the Sabine's formula. They will be able to calculate the reverberation time and to understand the different Acoustic aspects of halls and auditorium. This will help the students in designing the indoor of a hall and auditorium.

			Unit 5: Wave Optics	The students in this section will learn about electromagnetic nature of light as a consequence of Maxwell's equations in Electromagnetism. They will get a very clear idea of wave front and will be able to distinguish between plane wave front, Spherical wave front and Cylindrical wave front. The students will learn the Huygens Principle and will be able to explain the propagation of light wave .
			Unit 6: Interference of light	At first the students will learn about the Young's double slits experiments and the formation of interference fringes. Then they will be able to state the definition of interference. Students will be able to classify the two methods of interference i.e. Division of amplitude and division of wavefront. Students will be familiar with the different techniques for production of interference like Fresnel's bi prism method, Lloyd's single mirror method, Newton's rings formation. The students will find the expression of diameter of Newton's rings. By using this expression students will measure the diameter and they will be able to determine the unknown wave length of monochromatic light and the refractive index of liquid. Students will get idea about the fringes of equal inclination and fringes of equal thickness also. Students will also solve a lot of numerical problems.
			Unit 7:Michelson's Interferometer	In this unit students will get an idea of different forms or shapes of interference fringes produced by Michelson interferometer. Students will learn the construction and working principle of the Michelson interferometer in short. They will learn about the methods of determination of unknown wavelength of monochromatic light, difference of wavelengths of a compound light consisting two wavelengths and refractive index of a thin transparent film and its thickness by using Michelson's interferometer.

			Unit 8: Diffraction of light	At first the students will understand the actual meaning of diffraction of light and the specific conditions to be fulfilled for the occurrence of the diffraction of light. Students will be able to differentiate between the two different categories of diffraction i.e .Fraunhofer diffraction and Fresnel diffraction. In the category of Fraunhofer diffraction, students will get knowledge of diffraction of light through single slit, double slits , Multiple slits and diffraction grating and they will find the expressions of intensities of the diffraction patterns in each case. In the category of Fresnel Diffraction, students will know about the half period zones and zone plates. Students will be able to explain either the bending i.e. diffraction of light or the rectilinear propagation of light with the help of ideas of half period zones.
			Unit 9:Polarization of light	In this unit students will learn about the transverse nature of light waves. Then students will understand the mutual orthogonal directions of Electric field, Magnetic field and Propagation of light wave very well. After this the students will learn about the meaning of plane polarized light and methods of production and analysis of this plane polarized light. At last students will get an elementary idea about the circularly polarized light and the elliptically polarized light too.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER – 4 GE4B [Waves and Optics] PRACTICAL (FM 20)	Waves and Optics Lab	In the practical course the students will i)Investigate the motion of coupled oscillators and will dertermine the normal modes of vibrations. ii)Determine the frequency of an electrically maintained Tuning fork by Melde's experiment and to verify the wave length ^{2} – Tension law. iii)To study the Lissajous figure by usin the Cathode Ray Oscilloscope and to draw the wave forms of component waves and resultant waves and correlate them with theoretical knowledge on Lissajous figure formation. iv)Determine the value of coefficient of viscosity of water by capillary flow method(Poiseuille's method). v)Measure the intensities of diffraction patterns of single slit and double slits by using optical bench, photo sensor and laser and also determine the wavelength of laser. vi)Determine the unknown wavelength of sodium light by measuring the diameters of Newton's rings by using travelling microscope. vii)Determine the unknown wavelength of monochromatic light by using Fresnel bi prism. viii)Level the spectrometer properly.Then the spectrometer will be set for parallel incident rays and parallel emergent rays by method of Schuster's focusing. Then by using this spectrometer students will determine the refracting angle of prism, refractive indices of the material of the prism for different colours of light of given wavelength, values of Cauchy constants, Dispersive power of the material of prism, Resolving power of prism, unknown wavelengths of lights of different colours by using plane diffraction grating and resolving power of this plane diffraction grating.

COURSE OUTCOME – UNDERGRADUATE PHYSICS HONOURS (CBCS SYSTEM) SEMESTER-5				
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 5 CC11 [Quantum Mechanics and Applications] (FM 40)	Schrodinger equation, General discussion of bound states in an arbitrary potential, Quantum theory of hydrogen like atoms, atoms in electric & Magnetic fields, atoms in external magnetic fields, many electron atoms.	The students will learn about the basics of quantum mechanics and its importance. Different physical problem is solved via quantum mechanical approach and majorly for hydrogen like atoms. The influence of magnetic field in an atom is also introduced. They will also learn about the many electron systems.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	SEMESTER - 5 CC11 [Quantum Mechanics and Applications] PRACTICAL (FM 20)	Quantum Mechanics and Applications Lab	Students will learn to use highly sophisticated programming to solve complex quantum mechanical problems.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER – 5 CC12[Solid State Physics] (FM 40)	Unit 1: Crystal Structure	In this 1st unit the students will learn about the nature of solid materials. They will learn the geometry of crystal structure of solid materials. They will be familiar with the terms Lattice , Basis, Lattice Translation vectors, Central and Non-central elements, unit cells, Miller indices, Reciprocal lattices, Brillouin zones and different types of crystal lattices. Then the students will be able to differentiate between crystalline and amorphous solid materials. Students will learn about the process of X-ray diffraction through crystal and Bragg's law and then they will be able to get an idea of determination of the values of different parameters of crystal structure very much required for complete determination of crystal structure. The students will be able to calculate Co-ordination numbers, packing fraction, volume of primitive unit cell, atomic factors and geometrical factors for simple cubic, body centered cubic, face centered cubic crystals.
			Unit 2: Elementary Lattice Dynamics	In this section students will learn about Lattice vibrations and Phonons. Student will study the lattice vibrations in linear monatomic and diatomic lattice chains. They will be able to calculate the frequencies of these lattice vibrations in terms of lattice parameters and then they will be able to differentiate between Acoustical and Optical modes of vibration on the basis of two different sets of values of frequency. On the basis of lattice vibrations students will learn different theories for determination of specific heat of solids like Dulong Petit's law of specific heat, Eienstein's theory of specific heat and Debye's theory of specific heat. The study on these theories will helpvector the students to know the actual nature of lattice vibration very well.

			Unit 3: Magnetic Properties of Matter	In this part of syllabus students will learn different magnetic parameters like Intensity of magnetic field, Magnetic induction field, Magnetization vector, Magnetic dipole moment, Magnetic Susceptibility and Magnetic permeability. Then the students will be able to differentiate all magnetic materials into three categories Diamagnetic, Paramagnetic and Ferromagnetic on the basis of these parameters. After this the students will learn the classical Langevin theories of diamagnetism and para magnetism and will be able to find the expression of magnetic susceptibility and correlate these expressions with the values of these parameters determined by experiments . Students will also study the quantum mechanical approach on para magnetism and they can correlate the results with those obtained in classical approach. Then the students will study the concepts of ferromagnetic domains, spontaneous magnetization, Weiss's theory of ferromagnetism. Then the students will learn the discussions on B-H loop, Magnetic Hysteresis and Energy loss. Students will be familiar with the terms Residual magnetism, Magnetic saturation, Coercive force and they can choose the most suitable magnetic material for a definite purpose on the basis of required values of different parameters.
			Unit 4: Dielectric Properties of materials	Students will gain the knowledge on dielectric properties of materials in details in this unit. They will learn about electric dipole, electric dipole moment, dielectric polarization , polarization vector, polarizability, electric displacement vector, electric susceptibility, electric permeability and dielectric constant. Students will get the concept of local field and will be able to derive the Clausius Mossotti equation. They will also learn the classical theory of electric polarization and will derive the Langevin- Debye equation involving the polarizability of the dielectric material. Students will also study the phenomena of Normal and Anomalous Dispersion and will derive the Cauchy Sellmeir relations and find the expression of complex dielectric constant of dielectric materials. Students will also learn the Plasma oscillations, Plasma frequency and Plasmons.

			Unit 5: Ferroelectric Properties of Materials	In this very important theory part the students will get the knowledge of ferroelectric properties of materials. At first students will learn the structural phase transition of some materials which is the origin of ferroelectricity, piezoelectricity and pyroelectricity in materials. Students will learn about the ferroelectric domains, Curie-Weiss law and Ferroelectric domains. Students will be able to learn the various applications of ferroelectric, piezoelectric and pyroelectric materials
			Unit 6: Elementary Band Theory	In this section the students will learn about the nature of periodic potential energy and its different aspects in crystals by using the Kronig Penny model of periodic potential. After learning this, the students will be able to understand the phenomenon of energy band formation in crystalline solids. Then the students will learn to classify the crystalline solid materials into three broad categories insulators, semi conductors. Then the students will learn about intrinsic and extrinsic semiconductors, process of doping and properties of P-type and N-type semiconductors, electric mobility of charge carriers in semiconductors some properties of semiconductors. The students will learn about the Hall effect , Procedure of measurement of Hall coefficient by four probe method.
			Unit 7: Superconductivity	In this part, at first, the students will get familiar with the experimental results in the field of superconductivity. Then the students will be able to understand the concepts of critical temperature, critical magnetic field ,Meissner effect in correlation with the experimental results. Students will be able to classify the superconductors into two categories type I and type II superconductors. In order to find the origin of Meissner effect, students will form the London's equation and solve the equations. After these they will calculate the penetration depth magnetic field inside the superconductors. At last students will learn the isotope effect and get the elementary idea about BCS theory of super conductivity.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 5 CC12 [Solid State Physics] PRACTICAL (FM 20)	Solid State Physics Lab	The students will be able to , i)Energize an electromagnet , measure the magnetizing current and measure the magnetic induction field inside the two poles of the electromagnet by magnetic flux meter. ii)Determine the value of magnetic susceptibility of a paramagnetic solution by Quick's method. iii)Determine the value of magnetic susceptibility of a solid paramagnetic materials by Guoy's method. iv)Determine the coupling coefficient of a piezoelectric crystal. v)Determine the value of dielectric constant of a dielectric material with frequency vi)Determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon Resonance(SPR) vii)Determine the refractive index of a dielectric layer using Surface Plasmon Resonance(SPR). vii)Draw the P-E hysteresis loop of a ferroelectric material and study the different parameters of the loop. viii)Draw the B-H hysteresis loop of a ferromagnetic material and study the different parameters of the loop. ix)Measure the resistivity of a semiconductor(Germanium)with temperature by four probe method (from room temperature to 10 degree C) and determine the energy band gap of the semiconductor. x)Determine the value of Hall ccoefficient and value of number density of charge carriers by performing the experiment of Hall effect.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 5 DSE 1A [Advanced Mathematical Physics I]	Unit 1: Laplace Transform	The students in this unit will learn about another integral transform apart from the Fourier transform. In this Laplace transform part they will get to know the various properties and applications of it.

		(FM 40)	Unit 2: Linear Vector Spaces	In this very important theory part the students will get the taste of abstract algebra with the concepts of fields, groups and linear vector spaces. They will get the knowledge of mappings and matrix representations of linear vector space along with the idea of basis, inner product and orthogonalization. This unit will help them to visualize Quantum Mechanics on a different note.
			Unit 3: Cartesian Tensors	In this section the students will learn about algebraic tricks to play with Tensors and they will also learn to apply this tensor algebra in vector calculus and solid geometry which will suppose to be very fruitful their research career especially in the domain of general theory of relativity. Concepts of different physical tensors will also be provided to them.
			Unit 4: General Tensors	In this last part of the course the students will get familiar with the tensor algebra in addition to the knowledge about some important tensors like metric tensor, permutation tensor etc.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 5 DSE 1A PRACTICAL (FM 20)	Advanced Mathematical Physics I Lab	The students will learn some simulations using SCILAB along with Python in this course. They will learn to simulate matrix diagonalization, basic quantum mechanical commutation relations verification, Euclidean geodesic study, ground state eigen value problem solving for simple quantum mechanical systems, Lagrangian formulations for constrained classical systems etc. This course will enhance the knowledge of the in theoretical and computational physics to a great extent.

NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 5 DSE1B [Nano-materials and Applications] (FM 40)	Nanoscale Systems, Synthesis of Nano structured Materials, Characterization, Optical Properties, Electron Transport and Applications.	In this course students will have preliminary concepts of nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods). They will be able to synthesize nano materials by Top down or Bottom Up different techniques and characterize by XRD, SEM and TEM techniques. Quantitative treatment of quasi-particles & excitons with Carrier transport in nanostructures will be studied. They will be able to understand the application of nanomaterial in different Micro Electromechanical Systems (MEMS) and Nano Electromechanical Systems (NEMS).
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 5 DSE1B PRACTICAL (FM 20)	Nano-materials and Applications	In this course students will be able to have hands on training on synthesis of metal nano particles by chemical route, synthesis of semiconductor nanoparticles, study XRD pattern of nanomaterials, study the effect of size on color of nanomaterials, Fabricate a thin film of nanoparticles by spin coating, Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency and Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2022	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 5 DSE2A	Unit 1: Recapitulation of classical mechanics	The students in this unit will learn about Newton's laws of motion, phase portraits, small amplitude oscillation, equilibrium and stability, Hamilton's equation of motions.

		[Applied Dynamics] (FM 40)	Unit 2: Introduction to Dynamical system	In this very important theory in which students will learn general ideal of dynamical system, phase space, flows on the line, fixed points, flows on the circle, discrete dynamical system .
			Unit 3: Introduction to chaos and fractals	In this section the students will learn about chaos, different route of chaos, nonlinear time series analysis and chaos characterization. They will also study self similarity and fractal geometry and fractal dimensions etc.
			Unit 4: Introduction to fluid dynamics	In this last part of the course the students will get familiar with different characteristics of fluid, kinematics of moving fluids, equation of continuity, Bernoulli's theorem, Navier-Stokes' equation.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 5 DSE2A [Applied Dynamics] PRACTICAL (FM 20)	Applied dynamics Lab	The students will learn some computation and visualization of different problems of applied dynamics using Python/Scilab/C/Fortan etc. The will study dynamics of couple oscillators, dynamics of various continuous nonlinear system, predator-prey dynamics, dynamics of map, visualization of Sierpinski gasket, visualization of fractal fern.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 5 DSE 2B [Atmospheric Physics] (FM 40)	Unit 1: General Features of Earth's atmosphere	Students as an introctory part of this course will learn the basic theromodyanamical aspects of Earth's atmosphere including clouds, winds, fogs etc and they will get the idea about different meteorological architectures to characterize these aspects especially cyclones, thunderstorms etc.

			Unit 2: Atmospheric Dynamics	In this segment students will get handy concepts regarding the basic mechanical laws and equations of motion governing the dynamics of Earth's atmosphere leading to the application especially in different types of circulation.
			Unit 3: Atmospheric Waves	Students will get the idea of different kinds of atmospheric wave like rosby wave, buyouncy wave, atmospheric gravity wave etc especially the dispersion, absorption and flow of these waves.
			Unit 4: Atmospheric Radar and Lidar	In this instrumental part of the course the students will acquire the idea to to study different atmospheric phenomena using Radar and Lidar.
			Unit 5: Atmospheric Aerosols	The students in this section will learn about atmospheric aerosols in detail and they also learn optical phenomena of atmosphere especially about the aspects of solar radiation.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 5 DSE 2B PRACTICAL (FM 20)	Atmospheric Physics Lab	In the practical course the students will go through some simulations using SCILAB. They will learn to simulate atmospheric waves in terms of the corresponding dispersion relations. The students will also be taught how to handle Radar, Lidar, satellite and Radiosonde data. They will also analyse time series data of temperature profile of an area or place. This lab course will certainly a good prospect for the students for their future career both in job and research purpose.

COURSE OUTCOME – UNDERGRADUATE PHYSICS HONOURS (CBCS SYSTEM) SEMESTER-6				
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 6 CC 13 [Electromagnetic Theory] (FM 40)	Unit 1 Maxwell Equations	In this introductory part of one of the fundamental components of classical physics, the students will get the important concept of displacement current and thereby the establishment of Maxwell's equations. They will theoretically investigate the propagation of EM waves mainly in vacuum. The students also get the important concepts of field potentials and energy density along with Poynting vector.
			Unit 2: EM Wave Propagation in Unbounded Media	In tis section the students will get to to learn the outcomes propagation of em waves in conductors, dielectrics and plasma leading to know about some very important parameters like skin depth, dielectric constant, plasma frequency etc.
			Unit 3: EM Wave in Bounded Media	The students in this segment will study the reflection and refraction of em waves at the interface between two dielectrics and hence they will get to know some crucial laws of em theory like Fresnel's law, Brewster's law etc.
			Unit 4: Polarization of Electromagnetic Waves	In this part the students will learn about the polarization of em waves which includes double refraction, Nicol prism, compensators, wave plates etc. They will also learn the rotator polarization of em waves in deep detail.
			Unit 5: Wave guides	The students in this part will mainly learn about the concept of planar wave guides and the propagation of em waves through them. This section will help the students to gather knowledge on transmission of em waves in coaxial transmission line which will beneficial in their future research and even job oriented career.

			Unit 6: Optical Fibres	In this last part of this course the students will again get a research based knowledge regarding the characterization of optical fibers in a simple but effective way.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	SEMESTER – 6 CC 13 PRACTICAL (FM 20)	Electromagnetic Theory Lab	The students will get hands on training on the topics covered in CC 13 (theory). Theoretical predictions on polarization of electromagnetic waves and verification through the experiments will be taught to them. The students will get hand on knowledge on polarimeters, compensators and antenna. Reflection, refraction and radiation properties of electromagnetic waves will also be studied in this laboratory course.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 6 CC14 [Statistical Mechanics] (FM 40)	Classical Statistical Mechanics, Classical Theory of Radiation, Quantum Theory of Radiation, Bose-Einstein Statistics and Fermi-Dirac Statistics.	It allows the students to learn the basics of Ensemble, partition function and thermodynamic functions. Student will also learn the theory of radiation from classical to quantum i.e. from Wien's Displacement law. Wien's Distribution Law. Saha's Ionization Formula. Rayleigh-Jean's Law to Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation. The course also covers two types of distribution: Bose-Einstein and Fermi-Dirac distribution law.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME

		SEMESTER - 6 CC14 PRACTICAL (FM 20)	Statistical Mechanics Lab	The students will get hands on training on computationally solving course (CC 14 theory) related problems. Students will be able to computationally analyse the behaviour of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, the partition function, Planck's law for Black Body radiation and Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 6 DSE3A [Nuclear and Particle Physics] (FM 60)	Unit 1: General properties of Nuclei	In the 1st unit students will learn about the constituents of nucleus, the intrinsic properties of these constituents, quantitative facts about the mass, radii, charge density, matter density, angular momentum parity, magnetic moment, electric moment and nuclear excited states. The students will learn about the binding energy, average binding energy and its variation with mass number and main features of this average binding energy versus mass number curve.
			Unit 2: Nuclear models	In this section the students will get the idea about three nuclear models. First the students will identify the similarities between a liquid drop and a nucleus. Then they will learn the assumptions of this models and derive the expression of nuclear binding energy containing five different energy terms and correlate the bindint energy curve obtained from this relation with the experimental curves. They will learn the merits and demerits of the liquid drop model. Then students will learn the Fermi gas model of nucleus. At last they will study the shell model of nucleus in details.

			Unit 3: Radioactivity decay	In this segment,the students will study the basics of alpha-decay process. They will learn the discrete nature of alpha disintegration energy spectrum. Then the students will learn to explain the origin of alpha decay by studying the quantum mechanical tunneling effect and Gamow's theory of alpha decay. Students will study the Geiger Nuttall law as a consequence of Gamow's theory. Students will also learn the kinematics of different types of beta decay. They will study the continuous beta disintegration energy spectrum and will try to correlate the continuous beta disintegration enrgy spectrum with the principle of conservation of energy and angular momentum and they will apparently find thatthese conservation principles are likely to be violated here . Pauli's neutrino hypothesis will be able to explain the continuous nature of beta energy spectrum along with the validity of energy and angular momentum conservation principles. Students will also learn the origin of Gamma ray emission, kinematics of Gamma ray emission and the origin of emission of internal conversion electrons.
			Unit 4: Nuclear reactions	In this part the students will learn about different types of nuclear reactions, Conservation laws to be obeyed in these reactions and kinematics of these reactions. Students will be able to calculate the Q-value, Reaction rate and reaction cross sections and solve the related numerical problems. Students will also get knowledge of Compound and direct reactions, resonance reactions and and Coulomb scattering or Rutherford scattering. The ideas on Coulomb scattering will help the students to get information about the radius of a nucleus.

			Unit 5: Interaction of Nuclear radiations with matter	In this part the students will mainly learn about the interaction of emitted nuclear radiations (i.e. alpha particle, beta particles and gamma rays) with matter. They will know about the process of ionization of the atoms of the medium when the moving alpha particles interact with them. They will also know about the process of energy radiation by the electrons(i.e. beta particles)by means of Cerenkov radiation. At last students will learn about the interaction of gamma rays with the matter. The gamma ray photons interact with the matter in many ways like photoelectric effects, electron-positron pair formation, Compton scattering etc. So students will also get knowledge about Photoelectric effect, Compton scattering and the pair production mechanism also .
			Unit 6: Detectors for Nuclear radiations	In this part of this course the students will learn about the various types of detectors of nuclear radiations and their working principles. At first students will know about the construction and working principle of gas detectors like Ionization chamber and Geige-Muller counter and applications of them. Then they will learn the basic principle of Scintillation Detectors along with the construction and working principle of Photo Multiplier Tube. Students will get knowledge on semiconductor detectors made of Silicon and Germanium used for detection of charges particles and photons. At last the students will also learn about the process of neutron detection also.
			Unit 7: Particle Accelerators	In this part of this paper at first the students will know about the functions of a particle accelerator. Then they will be familiar with the accelerator facility available in India. At last the students will learn about the construction, working principle, applications, advantages and disadvantages of different particle accelerators like Van-de Graff generator, Linear accelerator, Cyclotron and Synchrotrons .

			Unit 8: Particle Physics	In this last unit of this paper the students will learn about the basic features, types and families of elementary particles. They will get knowledge on different type of interactions and conservation laws of energy, linear momentum, angular momentum, parity, Baryon number, Lepton number, Isospin , strangeness and charm in these interactions. At last the students will know about the Quark model, colour quantum number and gluons also.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 6 DSE3B [Advanced Mathematical Physics II] (FM 60)	Calculus of Variation, Group Theory, Advanced probability Theory.	In this course students will learn about calculus of variations: Euler-Lagrange's equation, canonical transformation along with Legendre transformation. The basics of group theory and some special groups with operator are also part of tis course. Students will also learn binomial, multinomial expansions and probability distributions of advanced probability theory.
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER – 6 DSE 4A [Astronomy and Astrophysics] (FM 60)	Unit 1: Astronomical Scales	Students as an introductory part of this course will learn about astronomical scales, basic concepts of positional astronomy: Celestial Sphere, Astronomical Coordinate Systems, Geographical Coordinate Systems. Basic Parameters of Stars: Determination of Distance by Parallax Method, Luminosity: Apparent and Absolute magnitude scale, Distance Modulus, Determination of Temperature and Radius of a star; Stellar Spectral Classification, Hertzsprung-Russell Diagram.
			Unit 2:Astronomical technique	In this segment students will get handy concepts regarding the basic optical definitions for Astronomy, optical telescopes, telescope mountings, Space telescopes, detectors and their Use.
			Unit 3: Physical principles	Students will get the idea of gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.

			Unit 4: The sun and the solar family	In this section students will study about the sun, the solar family, origin of the Solar system: the nebular model, tidal forces and planetary rings, extra-solar planets. They also learn stellar spectra and classification structure like their temperature dependence, black body approximation, H R diagram, luminosity classification.
			Unit 5: The milky way	The students in this section will learn about basic structure and properties of the milky way, nature of rotation of the milky way, stars and star clusters of the milky way, properties around the galactic nucleus.
			Unit 6: Galaxies	In this unit students will learn galaxy morphology, Hubble's classification of galaxies, elliptical, spiral and lenticular galaxies, the milky way galaxy, gas and dust in the galaxy, spiral arms.
			Unit 7: Large scale structure and the expanding universe	Cosmic Distance Ladder, Hubble's Law (Distance- Velocity Relation), Clusters of Galaxies (Virial theorem and dark matter).
NAME OF THE PROGRAMME	YEAR OF INTRODUCTION	COURSE OUTCOME		
BSC	2018	COURSE	COURSE NAME	COURSE OUTCOME
		SEMESTER - 6 DSE4B [Classical Dynamics] (FM 60)	Unit 1: Classical Mechanics of Point Particles	In this part students will review of Newtonian mechanics; Application to the motion of a charge particle in external electric and magnetic fields. They will also study generalized coordinates and velocities, recap of Lagrangian and Hamiltonian mechanics. Properties of simple harmonic oscillator, central force field, effective potential and the Laplace-Runge-Lenz vector will also be discussed.
			Unit 2: Small Amplitude Oscillations	In this section the students will get to learn the outcomes of minima of potential energy and points of stable equilibrium, expansion of the potential energy around a minimum, small amplitude oscillations about the minimum, normal modes of oscillations.
			Unit 3: Special Theory of Relativity	In this section student will study special theory of relativity which include postulates of special theory of relativity, Lorentz transformations, Minkowski space, space-time diagrams, time-dilation, length contraction and twin paradox, four-velocity and acceleration, Doppler effect from a four-vector perspective, conservation of four-momentum, relativistic kinematics.
			Unit 4: Fluid Dynamics	In this part the students will learn about the density and pressure in a fluid, an element of fluid and its velocity, continuity equation and mass conservation, Poiseuille's equation for flow, Navier-Stokes equation, qualitative description of turbulence, Reynolds number.