BANKURA ZILLA SARADAMANI MAHILA MAHAVIDYAPITH
Nutanchati, Opposite Axis Bank, Bankura,
West Bengal, Pin-722101

ACADEMIC AUDIT REPORT
For the Academic year 2017 - 2018

Academic Audit of Department : PHYSICS										
Period of Audit: 2017-2018										
I - COLLEGE PROFILE (To be filled in by the IQAC Co-ordinator)										
1	Name of the Department, Website, email and Ph. No.		Department: Physics, http://bzsmcollege.org/, E-mail id: sarada_6@yahoo.co.in ; Ph. No.: 03242-251194							
2	Name of the HOD, email & Mob. No.		Goutam Mandal ,E-mail: phy.gmandal@gmail.com; Mobile No: 9474806931							
3	Name of the IQAC Coordinator, email & Mob. No.		Dr.Nityananda Patra, nityananda.patra1967@gmail.com Mobile No.: 9474144885							
4	Year of Establishment/ Year of Affiliation		1973/1975							
5	NAAC Grade with Cycle, Accredited Year (if not Accredited Status of Preparations)		Grade A (3.04) Cycle 2 2015							
6	UGC Recognition (2F & 12 B)		YES							
7	Departmental Working Hours (if shift system mention details of both shifts & give reasons for shift system)		10.10 a.m-5.00 p.m (Monday to Saturday)							
8	No. of Posts Sanctioned: Teaching - Non Teaching- Supportive Staff - Other if any -							Teaching	Non Teaching	
			Govt. approved :					1	1	
			Management approved :					-	-	
			Govt. approved Contractual :					-	-	
			Management approved Contractual :					-	-	
			Guest Working:					4	1	
9	Course wise & Year wise Students strength particulars		**No of Students**	**Sem-I**	**Sem-II**	**Sem-III**	**Sem-IV**	**Part-I**	**Part-II**	**Part-III**
				BankuraUniversty				**Burdwan University**		
			Honours	21	21	-	-		05	-
			General	-	-	-	-	-	51	05

II - CURRICULAR ASPECTS		**Statement**	**Impression/Recommendation/ Remark by Academic Advisors**	**Status**	**Grade**
1	Departmental Annual Curricular Plans	Distribution of syllabus in modules and unitization of syllabus were prepared well before the commencement of classes and executed in a planned and systematic manner. PO, CO & PSO is also formulated **(Annexure-I).**	Practical experience on theoretical knowledge be given importance through the introduction of Internship, if possible.	Good	A
2	Departmental Activities and Records of students' and Teachers' participation for the Academic Year 2018 to 2019	Every activity is recorded such as Departmental meetings, Departmental Seminar, Student-Seminar, Class Tests, Meetings of committees related to Parent-Student -Teacher formed by the department etc.	Database on the pass out students for making alumni association more dynamic and productive be made an integral part of the departmental activities every year.	Good	A
3	Add-on Courses completed during Academic Year 2018 to 2019	NIL	At least introduction of some vocational training courses be made compulsory every year to impart practical knowledge.	Poor	C
4	Plan for introduction of new Add-on Courses in Academic Year 2018 to 2019	NIL	Efforts be made for the introduction of some vocational training courses or at least hands on training be made compulsory every year to impart practical knowledge.	Poor	C
5	Coverage of Syllabus (Average Percentage)	More than 90% syllabus is covered for all courses of UG program. Records are kept in the individual Teacher's Diary.	100% coverage of the syllabus should be made mandatory because it will help the advanced students immensely.	Good	A
6	Maintenance of Student Attendance Registers	Day to day attendance is recorded in the Student Attendance Registers.	Poor attendance (i.e. less than 50%) of the students be compulsorily intimated to the parents.	Good	A

7	Feedback forms on Curriculum from students	Feedback is taken and analyzed. **(Annexure –II)** Attempts are being made to submit the Feedback online by the students from the current session. Suggestions and Proposals from students have been carefully analyzed. Some of the demands have been fulfilled by the department in the interest of the students.	Online feedback procedure should be made compulsory.	Satisfactory	B

** Grade A (Good) / B (Satisfactory) / C (Poor)

III - TEACHING, LEARNING & EVALUATION		**Statement**	**Impression/Recommendation/Remark by Academic Advisors**	**Status**	**Grade**
1	Teaching Diaries & Plans in the Prescribed Formats	The teaching diaries and plans are maintained by all the teachers of the department and those are verified and signed by the Principal.	Well maintained.	Good	A
2	Co-Curricular Activities (Departmental Level)	Students of each year/ semester organized Teachers' Day celebration program every year in the department. They used to participate in the "Physics Quiz" Contest, "Concept Test In Physics" conducted by the Department.	Arrangement of Exhibition at least once a year is recommended.	Good	A
3	Degrees offered	UG programs run by the department.	Job-oriented programmes be introduced, if possible.	Good	A
4	Conduct of Internal Examinations-continuous assessment & Mid-Term Test	Continuous assessment is carried out by the department in the form of Class Test, Mid-term test, Concept Test, Surprise Test, Practical Test and Internal Assessment.	Well maintained and documented.	Good	A
5	Remedial Classes	Remedial classes are conducted for each semester as and when required subject to the availability of time and convenience of student and teachers. Sometimes in the remedial classes, evaluated and assessed answer scripts are shown to the students for their self-assessment and better understanding of the subject.	Assessed answer scripts reflecting the academic improvement of the students be given to the students to show their parents.	Good	A
6	Record of Mentoring of students by teachers	Record of mentoring of students by teachers is maintained by the department. However, mentoring is also provided outside the class .	Performances of the students in all respects be intimated to the parents periodically, if possible.	Good	A
7	Result Analysis for the years 2017 & 2018	Result analysis is done according to result sheet provided by the University **(Annexure-III).** After critical analysis of the results, the students are advised about how to improve both the theoretical and practical marks.	Final result sheet should be well-circulated through college prospectus, website etc.	Good	A

** Grade A (Good) / B (Satisfactory) / C(Poor)

IV - RESEARCH AND CONSULTANCY		**Statement**	**Impression/Recommendation/Remark by Academic Advisors**	**Status**	**Grade**
1	No. of Research Guides in the Department	Nil	All Departmental teachers be encouraged to complete their Ph.D.	Poor	C
2	No. of Faculty registered for Ph. D (attach details)	Nil	All Departmental teachers be encouraged to complete their Ph.D.	Poor	C
3	Number of Major/Minor/Other Research Projects (attach details)	Major: Nil Minor: Nil Others: Nil	Other funding agencies may be explored.	Poor	C
4	Number of Research Papers Published in Academic year (Internationals/Nationals Journals) (attach details)	National : 1 International: 2 **(Annexure-IV)**	Inadequate.	Satisfactory	B
5	Number of Papers Presented in Academic year 2018 to 2019 (International/National/State Level Conference) (attach details)	International: Nil National : 1 **(Annexure-IV)** State Level Conference: Nil	Inadequate.	Satisfactory	B
6	Number of Books Published in Academic year 2018 to 2019 (Single Author/Co Author) (attach details)	As a Single Author – Nil As a Co-Author – 1 **(Annexure-IV)**	Inadequate.	Satisfactory	B
7	Number of Seminars / Workshops / Training Program Conducted in the Academic year (International / National / State) (attach details)	Nil	Efforts to be made to conduct National/International Seminars	Satisfactory	B
8	Student Seminars/ Workshop/ Exhibition/ Project in the Academic Year (other than University)	03	Arrangement of Exhibition at least once a year is recommended.	Satisfactory	B
9	Record of Consultancy in Academic year 2017 to 2018 (attach details)	Nil	Initiative should be taken by the college to invite various companies for placement, if possible.	Poor	C
10	Record of MOUs in Academic year 2017 to 2018 (attach details)		Initiative should be taken by the college, if possible.	Poor	C

** Grade A (Good) / B (Satisfactory) / C (Poor)

V - EXTENSION ACTIVITIES		**Statement**	**Impression/Recommendation/ Remark by Academic Advisors**	**Status**	**Grade**
1	Record of Subject/Department Related Extension Activities (attach details)	Student Project **(Annexure-V)**	Adequate	Good	A
2	Field Visit (attach records)	NIL	Initiative may be taken by the Department.	Poor	C
3	Industry Visit (attach records)	NIL	Initiative may be taken by the Department.	Poor	C
4	Any Other Club (attach records)	NIL	Initiative may be taken by the Department.	Poor	C
5	Any other social service activity undertaken by the students and teachers/students/teachers of the department (attach records)	Public awareness camp **(Annexure-VI)**	Adequate	Good	A

** Grade A (Good) / B (Satisfactory) / C (Poor)

Recommendation/Suggestions by Academic Advisors

	Suggestions for improvement/progress of the department	Sheet attached		
			Signatures of Academic Advisor with designation	Seal
	Declaration by the Department	1	(Inspector of Colleges)	Inspector of Colleges (Addl. Charge) Bankura University
		2		
		3		
	Signature of the HOD with date			
	Signature of the Principal with date			

Declaration by the Principal

On behalf of the College Governing Body and as Institutional Head, I will forward the observations by the Academic Advisors to IQAC and also to the Governing Body of the Institution for further necessary action regarding Academic development of the department.

Date:

Signature of Principal
Principal
Bankura Zilla Saradamani Mahila Mahavidyapith

P O , C O, P S O

Department of Physics

ACADEMIC YEAR :2016-17

B. Sc. PHYSICS HONOURS

Department of Physics	After successful completion of three year degree Honours course in physics a student should be able to:
Programme Outcomes	PO-1. Get a brief idea about the various fields of physics. PO-2. Solve the problem and also think methodically, independently and draw a logical conclusion. PO-3. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Physics experiments. PO-4. Create an awareness of the impact of Physics on the society, and development outside the scientific community. PO-5. PO-6. To inculcate the scientific temperament in the students and outside the scientific community. PO-5. Exhibit disciplined work habits as an individual.
Programme Specific Outcomes	PSO-1. Gain the knowledge of Physics through theory and practical. PSO-2. Understand good laboratory practices and safety. PSO-3. Gain capability of oral and written scientific communication, and will prove that they can think critically and work independently. PSO-4. Make aware and handle the sophisticated instruments/equipments.

Course Outcomes B. Sc Physics Part-I	
Course	**Outcomes** After completion of these courses students should be able to:
Paper-I	**CO-1.** Know about vector algebra, gradient, divergence, curl of a vector field, conservative fields. **CO-2**. Know about vector integration and related theorems like Divergence theorem, Greens theorem etc. **CO-3.** Learn about the orthogonal curvilinear coordinate systems their transformation relations with special emphasis on spherical polar system. **CO-4.** Know about gamma function, beta function , relation between them , Dirichlet's integral . **CO-5.** know about Ordinary differential equations, Wronskian, Series solution of 2^{nd} order ODE, Bessel's differential equation , Legendre's differential equation, Partial differential equations, Solution of Laplace's equation in different coordinate system by the method of separation of variables. **CO-6.** Think about the mathematical formulation of Fourier series, half range series, Fourier transformation etc. **CO-7.** Know about Superposition of two harmonic oscillations, Lissajous figures, Beat phenomenon, Normal modes and normal vibrations. **CO-8.** Study of Damped harmonic oscillator, Forced oscillations, resonance, Waves in a continuous medium, Dispersion, Phase and group velocity. Energy transport by a traveling wave, Kundt's tube.
Paper-II	**CO-1.** Know about system of variable mass, Rocket motion, Work-energy theorem, Angular momentum and torque, system of particles, Collisions. **CO-2**. Know about moment of inertia , Radius of gyration , Product of inertia, Ellipsoid of inertia, Compound pendulum, Rotating coordinate systems, Fictitious forces.

	CO-3. Learn about the gravitational potential and intensity due to spherical and other symmetrical bodies**,** Central forces, Reduced mass, motion under central force, Differential equation of the orbit, Motion of artificial satellites. **CO-4.** Know about motion of ideal fluids, Euler's equation for an incompressible fluid, Bernoulli's theorem, Venturimeter. **CO-5.** Think on elastic moduli and their interrelationship, loaded Beams, Stresses induced by bending, cantilever, flat spiral spring. **CO-6.** Know about the surface tension and its molecular origin, excess pressure on a curved liquid surface, capillary rise, vapour pressure over a curved surface **CO-7.** Take detail study of viscous flow through a capillary tube, Poiseuille's formula, Stokes' law, rotating cylinder method for the determination of the coefficient of viscosity of a liquid, production and the measurement of high vacuum.
Paper-III	**CO-1.** Know about temperature in kinetic theory, Maxwellian distribution function of molecular speeds, Boltzmann's extension of Maxwell's distribution law, Specific heat of gases, molecular collisions, transport phenomena in gases, coefficient of viscosity of gases, thermal conductivity of gases. **CO-2**. Know about real gases, virial expansion and virial coefficients , Vander Waal's equation of state, critical constants, conductivity and diffusivity, one-dimensional heat flow equation, heat flow in three dimensions with spherical and cylindrical geometry, Ingen-Hausz experiment , Wiedemann-Franz law. **CO-3.** Think about the Gauss's theorem in integral and differential forms, applications of Gauss's theorem, Laplace's equation, solution of Laplace's equation for simple geometries, Poisson's equation, multipole expansion of the electrostatic scalar potential, the linear quadrupole, Earnshaw's theorem. **CO-4.** Know about redistribution of charges on the surface of a conductor, method of images, capacitance and their types, Dielectric, Polarization, electric displacement vector **D,** field and potential due to a dielectric sphere etc. **CO-5.** Learn on wave picture of light, Fermat's principle and its

	application loaded , Paraxial theory, Matrix method in paraxial optics. **CO-6.** Think about the aberrations, Abbe's sine condition , chromatic aberration , Ramsden and Huyghens eye pieces , simple and compound microscopes , Elements of fiber optics , step-index and graded-index fibers , single and multimode fibers , intermodal dispersion.
Paper-IV[Practical]	**CO-1.** Experimentally determine Young's modulus of a material in the form of a wire by Searle's method. **CO-2**. Experimentally determine rigidity modulus of a material in the form of a wire by dynamical method. **CO-3.** Experimentally determine coefficient of linear expansion of the material of a rod using Pullinger's apparatus. **CO-4.** Experimentally determine the pressure coefficient of air. **CO-5.** Experimentally determine focal length of a concave lens by the combination method. **CO-6.** Experimentally determine refractive index of a liquid by using a travelling microscope. **CO-7.** Experimentally determine the acceleration due to gravity with the help of Kater's pendulum. **CO-8.** Experimentally determine Young's modulus of a material in the form of a bar by the method of flexure. **CO-9.** Experimentally determine the coefficient of viscosity of water by Poiseuille's method. **CO-10.** Experimentally determine the coefficient of viscosity of highly viscous liquid by Stoke's method. **CO-11.** Experimentally determine surface tension of liquid at different temperatures by Jaeger's method. **CO-12.** Experimentally determine the surface tension of water by capillary – rise method. **CO-13.** Experimentally determine thermal conductivity of a bad conductor by Lees and Chorlton method.

Course Outcomes B. Sc Physics Part-II	
Course	**Outcomes** After completion of these courses students should be able to:
Paper-V	**CO-1.** Know about complex numbers, polar form, Argand diagram, complex variable, analytic functions, Cauchy-Riemann equations, complex line integrals, Cauchy's integral theorem, Cauchy's integral formula, singular points, Poles, Essential singularity, residue at a pole of order *m*, Cauchy's residue theorem. **CO-2**. Know about Linear vector spaces, virial expansion and virial coefficients , linearly independent set of vectors, orthogonality of vectors, linear transformation. linear operators. **CO-3.** Learn about Matrix algebra , Hermitian, orthogonal and unitary solution of a system of linear equations by matrix method, eigenvalues and eigenvectors of a matrix , properties of eigenvectors and eigenvalues of Hermitian and unitary matrices , similarity transformation. **CO-4.** Know about constraints and their classification generalized coordinates, configuration space, principle of virtual work, D'Alembert's principle, calculus of variations, Hamilton's variational principle, Langrangian formalism, cyclic or ignorable coordinates. **CO-5.** Think on Legendre's dual transformation to the Lagrangian of a system, Hamilton's function and Hamilton's equations of motion, application of Hamiltonian formalism to simple systems.
Paper-VI	**CO-1.** Know about equation of continuity, Resistance networks, Kirchoff's laws, Wheatstone bridge, Ampere's law, magnetic induction **B,** Biot-Savart law, integral form of Ampere's law, magnetic dipole, magnetic dipole-dipole interaction, Lorentz force, motion of charged particles in a uniform magnetic field, measurement of the charge *e* and the (*e*/*m*) ratio of electrons. **CO-2.** Learn on Faraday's law of electromagnetic induction, motional emf, self and mutual inductance, electromagnetic damping, Fluxmeter, magnetic field in material media, magnetic moment. Magnetization **M,** Permeability and magnetic susceptibility, Dia-, para-, and ferromagnetism, Hysterisis. B-H curve.

	CO-3. Know about growth and decay of currents in circuits with L and R, charging and discharging of capacitors in CR and LCR circuits, alternating current , use of complex numbers, currents in LR, CR, and LCR circuits with sinusoidal emf , Power factor, AC and DC motors and generators, Transformer, Wattmeters, **CO-4.** Think on generalization of Ampere's law, Displacement current. Maxwell's equations, Maxwell's equations in material media , Coulomb and Lorentz gauges , Poynting's theorem, Poynting vector, electromagnetic waves in isotropic dielectric media, Plane waves in conducting media, Skin effect, Reflection at a conducting surface, Polarization of electromagnetic waves, Fresnel's relations, Polarization by reflection. Brewster angle. **CO-5.** Know about Scattering of radiation by a free charge, Thomson scattering cross-section, Scattering by a bound charge , Rayleigh scattering cross-section. blue of the sky, elementary treatment of normal and anomalous dispersion, Cauchy's formula.
Paper-VII	**CO-1.** Think about Electromagnetic spectrum, wave equation, Plane, cylindrical, and spherical waves, Wavefront. Huygens' principle, reflection and refraction phenomena, Interference. Spatial and temporal coherence, Holography , Two-beam interference. Interference by division of wavefront and division of amplitude. Young's double slit experiment. Fresnel's biprism, Lloyd's mirror, Michelson's interferometer, visibility of fringes, interference in thin films. Newton's rings. Fabry-Perot interferometer, Resolving power of a Fabry-Perot interferometer. **CO-2.** Learn on Fresnel diffraction, Zone plate. Rectilinear propagation. Fraunhofer diffraction. Diffraction due to a single double slits, grating. Rayleigh's criterion for the resolution , Resolving powers of telescope, microscope, and prism. Resolving and dispersive power of a plane diffraction grating. **CO-3.** Know about anisotropic crystals, Fresnel equation, Optic axis. Uniaxial and biaxial crystals, birefringence, Ordinary and extraordinary rays. Huygens' construction, Half-wave and quarter-wave plates, Nicol prism, Babinet's compensator. Optical activity, Faraday effect, Kerr effect, Pockels effect.

	CO-4. Think on stimulated and spontaneous emission, Ordinary and laser light, characteristics of laser light, Population inversion. Pumping. Optical resonator, Ruby laser. He- Ne laser. **CO-5.** Know about thermodynamic systems, thermal equilibrium, Zeroth law of thermodynamics, thermodynamic processes, work and its path dependence, work in quasi-static processes, work and heat, Adiabatic work, First law of thermodynamics, applications of the first law, adiabatic and isothermal elastic moduli. **CO-6.** Learn about Heat engines, efficiency of Carnot cycle. Second law of thermodynamics, Refrigerator, reversible and irreversible processes, Carnot's theorem, entropy, TS diagram, Entropy change in reversible and irreversible processes. Principle of the increase of entropy, Entropy and disorder. Entropy and information. **CO-7.** Think on Maxwell's thermodynamic relations, Clausius-Clapeyron equation, Enthalpy. Porous-plug experiment. Joule-Thomson effect. Helmholtz and Gibbs functions, Chemical potential. Gibbs' phase rule , Triple point. **CO-8.** Concept on Seebeck, Peltier and Thomson effects. Thermoelectric power, Cooling by adiabatic demagnetization. Nernst heat theorem, Unattainability of absolute zero of temperature. Third law of thermodynamics.
Paper-VIII[Practical]	**CO-1.** Experimentally determine the horizontal component of the earth's magnetic field using deflection and vibration magnetometers. **CO-2.** Experimentally determine the potential difference and the current through a resistance with the help of a potentiometer. **CO-3.** Experimentally determine the resistance of a suspended coil dead beat galvanometer by the half deflection method. **CO-4.** Experimentally verify Thevenin's theorem and the maximum power transfer theorem. **CO-5.** Experimentally determine temperature co-efficient of resistance of a material in the form of a coil. **CO-6.** Experimentally determine the melting point of a suitable solid by using a thermocouple.

	CO-7. Experimentally determine the ECE of copper. **CO-8.** Experimentally determine the boiling point of a suitable liquid using a platinum resistance thermometer. **CO-9.** Experimentally determine the constant of a ballistic galvanometer using a suitable standard solenoid by drawing R-λ curve. **CO-10.** Experimentally determine the self-inductances of two coils and their equivalent inductance in cases of series and parallel connections by using Anderson's method. **CO-11.** Experimentally determine the resonance curve and the determination of the Q-factor of a series LCR circuit. **CO-12.** Experimentally construct one ohm coil and comparison with standard one-ohm coil.
Course Outcomes B. Sc Physics **Part-III**	
Course	**Outcomes** After completion of these courses students should be able to:
Paper-IX	**CO-1.** Know about Galilean and Newtonian relativity, The ether concept, Michelson-Morley experiment, Relativity of simultaneity. Lorentz transformation equations, Length contraction. Time dilation. Decay time of muons. Law of addition of velocities along the same direction. Doppler effect, Head light effect, invariance of the principle of conservation of linear momentum, variation of mass with velocity. Covariant formulation of Newton's laws of motion, idea of mass-energy equivalence. The longitudinal and transverse mass, The transformation properties of momentum, energy, mass and force. **CO-2.** Learn on Four vector, Transformation of 4 vectors, four velocity, four momentum, Poincare & Minkowski 4-D representation. Geometrical interpretation of Lorentz transformation equation, space like and space like intervals, light cone, past, present and future, proper length, proper time interval, length contraction and time dilation from Minkowski 4-D representation, the intererdependence of electric and magnetic fields. Transformation equations for **E** and **B**. Invariance of Maxwell's equations under a Lorentz transformation. **CO-3.** Know about Probality Theory, Probability of occurrence of event.,

	theorem and total probability and compound probability. Binomial, Poission and Guassian distribution, mean value, variance and standard deviation. **CO-4.** Think on Phase space, μ-space and Γ-space, Ensembles, Principle of equal a priori probability, Microstates and macrostates. Statistical equilibrium. Microcanonical ensemble. Statistical definition of entropy. Entropy of a perfect gas, Sackur-Tetrode formula, Gibbs paradox, Law of equipartition of energy, Rotational specific heat of hydrogen. Ortho and para hydrogen, vibrational specific heat of diatomic molecules. **CO-5.** Learn about MB, BE, and FD statistics, Derivation of distribution functions for the three statistics, Conditions under which BE and FD distributions reduce to MB distribution. Thermodynamic behaviour of an ideal Bose gas. BE condensation. Einstein and Debye's theories of the specific heat of solids. **CO-6.** Know about classical theory of black body radiation. Kirchhoff's law, Stefan's law, Wien's displacement law, Rayleigh- Jeans formula, cavity radiation as a photon gas, Density of states of photons. Derivation of Planck's law by applying BE statistics. Energy density as functions of wavelength and frequency, Stefan's constant. Entropy of a photon gas. Radiation pressure. **CO-7.** Learn on FD distribution function, Fermi gas, Free electron gas in metals, Specific heat of electron gas in metals, Thermionic emission. Richardson-Dushman equation, Brownian motion, Langevin and Einstein's theories. Brownian motion of small spherical particles suspended in a viscous liquid. **CO-8.** Understand on crystalline and amorphous solids, Lattice and basis, Primitive cell, Unit cell. The characteristics of the three cubic lattices sc, bcc, and fcc, Miller indices, Reciprocal lattice, The volume of a primitive cell of reciprocal lattice, The reciprocal lattices of sc and square lattices. Determination of crystal structure by x-ray diffraction. Laue and Bragg equations, Ewald construction, The powder method. **CO-9.** Think about different types of interatomic binding in solids, Ionic crystals, Dielectric materials. Polarization. Lorentz local field. Clausius-Mosotti relation. Induced and orientational polarization.

	Dipolar polarizability. Langevan's theory of orientational polarizability, Sommerfeld's free electron theory, Fermi energy, temperature, velocity and momentum. Electrical and thermal conductivity in free electron model. Wiedemann-Franz law and its range of validity, Hall effect, Hall coefficient for one and two types of carriers, Origin of energy bands in solids, Band picture of metals, insulators and semiconductors. **CO-10.** Know about Langevin's formula for molar diamagnetic susceptibility, Elementary quantum theory of paramagnetism. Curie's law. Curie constant, Effective number of Bohr magnetons. Gouy method for the measurement of susceptibility. Ferromagnetism. Spontaneous magnetization, Curie-Weiss law, Weiss molecular field. Weiss's phenomenological theory of ferromagnetism, Ferromagnetic domains, Boundary displacement. Rotation of domains, Hysterisis.
Paper-X	**CO-1.** Learn about Millikan's oil drop method, Thomson method, Photoelectric effect, Einstein's quantum theory of the photoelectric effect, Stopping potential , The concept of photon. Interaction of photons with free and bound electrons, Compton effect. **CO-2.** Know about Singly ionized helium, positronium, and muonic atom, Wilson-Sommerfeld quantization rule and its application to linear harmonic oscillator, particle in a one-dimensional box, The correspondence principle. Failures of old quantum theory, Franck-Hertz experiment, Excitation and Ionisation potentials, metastable states; Bremstrahlung. X –ray spectra, Moseley's law. **CO-3.** Know about One electron system, Bohr magneton, Orbital g-factor. Stern –Gerlach experiment, Electron spin, Spin angular momentum, The quantum numbers S and M_s. Spin magnetic moment and spin g-factor, Toatal angular momentum $\mathbf{J} = \mathbf{L} + \mathbf{S}$, Vector atom model. Fine structure. Elementary theory of spin-orbit coupling and the spin-orbit interaction energy. Spectra of atoms of alkali metals. Doublet structure. Quantum defect and its dependence on *l*. Principal, sharp, diffuse and fundamental series. Doublet structure. Atomic transitions and selection rules , atom in a magnetic field. Lande's g-factor. Weak-field Zeeman effect, Normal and anomalous Zeeman effects, Paschen back effect. **CO-4.** Lean on many –electron atoms, Pauli exclusion principle, LS & JJ coupling schemes, Hund's rules. Ground states of atoms, The covalent

	bond. Hydrogen molecule. Molecular spectra. Rotational, vibrational, and electronic spectra. Rotational and vibrational energy levels of diatomic molecules, Raman effect and its uses. **CO-5.** Know about de Broglie's postulate, wave-particle duality, Davisson-Germer experiment, Uncertainty principle and its implications, Heisenberg's thought experiment with gamma ray microscope. Young's double slit experiment with electrons/photons. **CO-6.** Take concept of measurement in quantum theory, Postulates of quantum theory regarding the results of measurement of an observable, Expansion postulate , Orthogonality and completeness, Schroedinger's equation in one dimension, generalization of the one dimensional Schroedinger's equation to three dimensions, Schroedinger equation as an operator equation. Statistical interpretation of wavefunction, Probability density. Normalization. Expectation values. Schroedinger's time-independent equation. Equation of continuity, Probability current density. **CO-7.** Know about free particle or particle in a constant 1D potential, The step potential. Boundary conditions on the wavefunction and its derivative at a point where the potential function has a finite discontinuity, Reflection and transmission coefficients. Finite potential barrier, Barrier penetration. Tunnelling, The infinite square well potential or particle in a box, The simple harmonic oscillator, Particle in a rectangular box. **CO-8.** Learn about particle in a spherically symmetric potential, Radial and angular parts of the wavefunction, Space quantization. Hydrogen atom problem. **CO-9.** Think about Rutherford's scattering formula. Estimation of nuclear radius. Determination of atomic masses by Bainbridge type mass spectrograph. Unified mass unit (u), Mass defect, Packing fraction. Nuclear binding energy. Average binding energy per nucleon. Binding energy curve. Neutron and alpha separation energy. Nuclear radius. Nuclear density. Magnetic moment of nuclei. Nuclear magneton. Electric quadrupole moment of nuclei. Electric quadrupole moment and nuclear shape. **CO-10.** Learn about Liquid drop model, Binding energy on the basis of

	liquid drop model, Shell model, Magic numbers. Spin-orbit interaction, Bethe-Weizsacker semi-empirical formula. Volume, surface, Coulomb, asymmetry, pairing and shell terms, Mass parabola. Most stable nuclei. Stability of nuclei. Discovery of the neutron. Detection of neutrons. Neutron Magnetic moment. Nuclear forces. **CO-11.** Know about Natural, and artificial radioactivity, half life, and mean life. Activity and its units. Radioactive dating, Simplified account of Gamow's theory of alpha decay. Geiger-Nuttall law, Beta decay. β^-, β^+ decays, Pauli's Neutrino hypothesis, Outline of Fermi theory of beta decay, Gamma decay. Pair creation and annihilation. Energetics. Interaction of gamma rays with matter. Photoelectric, Compton and pair production processes. **CO-12.** Understand about ionization chamber, Proportional counter, Geiger-Muller counter, Self-quenching. Dead time and recovery time, Linear accelerator. Cyclotron, Betatron. VEC. **CO-13.** Learn about Nuclear Fission, Energy release, Emission of neutrons. Theory of spontaneous fission. Self-sustaining chain reaction. Nuclear Reactor, Nuclear reactions. Cross-section of a nuclear reaction. Laboratory and centre of mass systems. Conservation principles governing nuclear reactions. Threshold energy of an endo-ergic reaction. Compound nucleus. Experimental verification of the compound nucleus hypothesis. Mention of Ghoshal experiment. Q-value of a nuclear reaction. Nonrelativistic Q-equation.
Paper-XI	**CO-1.** Know about Richardson's equation, Fermi level and work function of solids. Vacuum diodes and triodes-- their volt ampere characteristics, Triode parameters (μ , r_p, g_m), Functional structure and operation of a Cathode Ray Oscilloscope. **CO-2.** Take concepts on study on Eenergy band concept. Band diagram, Concept of hole, Intrinsic and extrinsic semiconductors, Elemental and compound semiconductors, Majority and minority carrier densities. Effective mass. Mobility of holes and electrons. Direct and indirect band gap semiconductors. **CO-3.** Know about Unbiased and biased p-n junctions, Varactor diodes, Zener diodes, Photodiode, LED , Metal semiconductor junction diode, Half wave and full wave rectifiers, Bridge rectifier. Capacitor filters. L-Section and π section filters, Voltage regulators – Zener diode-based

	regulators. Three terminal IC regulators. **CO-4.** Know on Bipolar junction transistor, CE, CB, CC configuration, Introduction of α and β parameters. Cut-off, active, saturation and breakdown regions, DC models of BJT at different , SCR . **CO-5.** Learn about Biasing of BJT. Operating point, Typical biasing circuits, Other biasing circuits – collector bias, emitter bias. AC equivalent circuit of BJT. Simplified h-parameter ac mode, CE, CB and CC amplifiers,High frequency equivalent circuit of transistor, Miller effect, Single stage R-C coupled amplifier.. **CO-6.** Take concepts about Feed back principle. Negative and positive voltage feedback. Effect of negative feedback , Cascaded BJT amplifiers – two stage RC coupled and transformer coupled amplifiers, Class A, class B and class C operation of amplifiers Class A power amplifier. **CO-7.** Learn on Barkhausen criterion and oscillator principle, R-C Phase Shift Oscillator. Wien bridge oscillator, Hartley and Colpitts oscillators. Astable multivibrator circuit using BJT. **CO-8.** Take knowledge on amplitude modulation, Envelope detector using diode. Frequency modulation (single tone), Cursson's rule. Principle of detection of FM signal. Phase modulation-relation between FM and PM. **CO-9.** Learn on Properties of Op-amp, ideal op- amp, CMRR,Virtual ground. inverting amplifier, Unity gain buffer, adder, phase shifter, integrator, differentiator and differential amplifier. Basic principle of analog to digital converter. Digital-to-analog converter circuit. **CO-10.** Understand on Number systems , binary arithmetic,Boolean algebra,De Morgan's theorem, Karnaugh map, logic gates with their truth tables : AND, OR, NOT and Ex-OR gates. NOR and NAND gates as universal gates. Implementation of OR and NAND gates with diodes and resistors. Combinational logic circuits – Half adder, full adder, binary comparator, multiplexer and de-multiplexer. Sequential logic circuits – SR, JK , D and T flip-flops.
Paper-XII[Practical]	**CO-1.** Experimentally determine the radius of curvature of a convex lens by Newton's ring.

	CO-2. Experimentally draw the I-δ curve for a prism. **CO-3.** Experimentally determine diffraction pattern due to a thin wire by using a laser source. **CO-4.** Experimentally determine the angle of the prism and to draw μ–λ curve for the material of a prism using a spectrometer. **CO-5.** Experimentally determine the mean wavelength of D-lines of sodium with the help of Fresnel's bi-prism. **CO-6.** Experimentally determine the width of the given single slit producing a Fraunhofer diffraction pattern. **CO-7.** Experimentally determine the number of ruling per mm of a plane diffraction grating and the wavelength of an unknown line with the help of a spectrometer. **CO-8.** Experimentally determine the number of ruling per mm of a plane diffraction grating and the width of a slit adjusted for resolving D-lines of sodium. **CO-9.** Experimentally Calibrate a polarimeter and determination of the concentration of an active solution. **CO-10.** Experimentally determine excitation potential using Franck-Hertz experiment.
Paper-XIII[Practical]	**CO-1.** Experimentally determine the band gap of a semiconductor by using a thermistor. **CO-2.** Experimentally determine amplitudes, frequencies and phase differences of two sinusoidal voltages with a CRO. **CO-3.** Experimentally determine the characteristics of a Zener diode and location of the break down voltage of the Zener diode. **CO-4.** Experimentally determine the mutual inductance of two coils at different angles (ϕ). **CO-5.** Experimentally determine high resistance by the method of charge-leakage from capacitor. **CO-6.** Experimentally draw B-H loop for a ferromagnetic material in the form of an anchor. **CO-7.** Experimentally draw static anode and mutual characteristics curves and dynamic characteristics curves of a triode valve and determine the triode parameters.

	CO-8. Experimentally study the transistor characteristics in CE mode transistor and to find α. β. **CO-9.** Experimentally study the frequency response of a CE transistor amplifier. **CO-10.** Experimentally study the response of op-amp based circuits with offset null adjustment. **CO-11.** Experimentally determine *e/m* ratio for electron by using a cathode ray tube and a pair of bar magnets.

B. Sc. PHYSICS GENERAL

Department of Physics	After successful completion of three year degree general course in physics a student should be able to:
Programme Outcomes	PO-1. Get an overall idea about the various fields of physics. PO-2. Solve the problem and also think methodically, independently and draw a logical conclusion. PO-3. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Physics experiments. PO-4. Create an awareness of the impact of Physics on the society, and development outside the scientific community. PO-5. To inculcate the scientific temperament in the students and outside the scientific community. PO-6. Exhibit disciplined work habits as an individual
Programme Specific Outcomes	PSO-1. Gain the knowledge of Physics through theory and practical. PSO-2. Understand good laboratory practices and safety. PSO-3. Gain capability of oral and written scientific communication, and will prove that they can think critically and work independently.

	PSO-4. Make aware and handle the sophisticated instruments/equipments.
Course Outcomes B. Sc Physics **Part-I**	
Course	**Outcomes** After completion of these courses students should be able to:
Paper-I	**CO-1.** Know about the unit and dimension, Vector Calculus and some related theorems. **CO-2**. Clear understanding about conservation laws in Classical mechanics, Central force problems and applications & dynamics of rigid bodies. **CO-3.** Think about the various general properties of matters like Gravitation, Elasticity, Viscosity, Surface tension with detail mathematical calculations and applications. **CO-4.** Know about Kinetic theory of gases, real gas, ideal gas, pressure exerted by gas molecules and Thermal conduction in details. **CO-5.** Clear understanding about thermal conductivity and diffusivity, Fourier equation for one dimensional heat flow and its solution, theory of Ingen Hausz's experiment, cylindrical flow of heat, experimental determination of Lee's method. **CO-6.** Understand thermal equilibrium and zeroth law of thermodynamics, 1st law of thermodynamics , work done and p-v diagram, Carnot cycle, Carnot engine and its efficiency; 2nd law of thermodynamics - concept of entropy (S), physical interpretation of entropy, change in entropy in reversible and irreversible processes, Carnot theorem, thermodynamic scale of temperature; Joule Thomson effect, enthalpy and temperature of inversion. **CO-7.** Gain the knowledge of emissive and absorptive power, black body and blackbody radiation, Kirchhoff's law, Stefan's law, Newton's law of cooling; Planck's idea of quantization, Planck's distribution law and graphical interpretation, Wien's displacement law, pyrometer principle.

	CO-8. Gain the knowledge of Superposition of two S.H. vibrations, Lissajous figures, damped and forced vibration, resonance and its sharpness, Wave motion and differential equation of plane progressive waves, energy and intensity, velocity of longitudinal wave in solid and gas, velocity of transverse wave in string, standing waves and energy- distribution, Doppler effect.

P O , C O, P S O

Department of Physics

ACADEMIC YEAR :2017-18

B. Sc. PHYSICS HONOURS

Department of Physics	After successful completion of three year degree Honours course in physics a student should be able to:
Programme Outcomes	PO-1. Get a brief idea about the various fields of physics. PO-2. Solve the problem and also think methodically, independently and draw a logical conclusion. PO-3. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Physics experiments. PO-4. Create an awareness of the impact of Physics on the society, and development outside the scientific community. PO-5. PO-6. To inculcate the scientific temperament in the students and outside the scientific community. PO-5. Exhibit disciplined work habits as an individual.
Programme Specific Outcomes	PSO-1. Gain the knowledge of Physics through theory and practical. PSO-2. Understand good laboratory practices and safety. PSO-3. Gain capability of oral and written scientific communication, and will prove that they can think critically and work independently. PSO-4. Make aware and handle the sophisticated instruments/equipments.

Course Outcomes B. Sc Physics SEM-I	
Core/SEC/DSE	**Outcomes** After completion of these courses students will:
Core-T1 Mathematical Physics (4 Credits)	**CO-1.** Know about First Order Differential Equations and Integrating Factor. Calculus of functions of more than one variable. **CO-2**. Know about Recapitulation of vectors. Vector Differentiation. Vector Integration. **CO-3.** Study about the Orthogonal Curvilinear Coordinates. Spherical and Cylindrical Coordinate Systems. **CO-4.** Learn about gamma function, beta function , relation between them , Dirichlet's integral . **CO-5.** Understand Complex representation of Fourier series, Parseval Identity, method of separation of variables. **CO-6.** Learn about Frobenius method and its applications to differential equations. Properties of Legendre Polynomials. Bessel Functions. **CO-7.** Study on Beta and Gamma Functions. Error Function. **CO-8.** Understand Laplace's Equation, Wave equation, Diffusion Equation.
Core-P1 Mathematical Physics Lab (2 Credits)	**CO-1.** Know about Computer architecture and organization. **CO-2**. Know about Basics of scientific computing. **CO-3.** Discuss about the Errors and error Analysis. **CO-4.** Know about plotting graphs with Gnuplot , 2D & 3D plot, data plot, polar & parametric plot etc. **CO-5.** Know how to fit a curve using Least square fit method in Gnuplot, Goodness of fit, standard deviation.
Core-T2 Mechanics (4 Credits)	**CO-1.** Know about Reference frames, Galilean transformations; motion of rocket, motion of a projectile in Uniform gravitational field Dynamics of a system of particles, centre of Mass, Principle of conservation of momentum, Impulse.

	CO-2. Study on Work and Kinetic Energy Theorem. Conservative and non- conservative forces. Potential Energy, stable and unstable equilibrium, Elastic potential energy. Force as gradient of potential energy, Work done by non-conservative forces. Law of conservation of Energy. **CO-3.** Learn about the motion of ideal fluids, the continuity equation. Euler's equation for an incompressible fluid. Steady flow. Bernoulli's theorem, Venturimeter. Kinematics of Moving Fluids, Poiseuille's Equation. **CO-4.** Understand Hooke's law, Elastic moduli and their interrelationship. Strain-energy in a stretched wire, Torsion of a wire, Loaded beams. Bending moment. Stresses induced by bending, cantilever. **CO-5.** Know about gravitational potential energy, central force field, Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). **CO-6.** Know about Non-inertial frames and fictitious forces, centrifugal force. coriolis force and its applications, components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. **CO-7**. Learn about Michelson-Morley Experiment, postulates of special theory of relativity, Lorentz Transformations, Length contraction. Time dilation, Relativistic transformation of velocity, frequency and wave number, relativistic addition of velocities, variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect, Relativistic Kinematics. Transformation of Energy and Momentum.
Core- P2 Mechanics Lab (2 Credits)	**CO-1.** Experimentally determine length (or diameter) using verniercaliper, screw gauge and travelling microscope. **CO-2**. Experimentally determine Motion of Spring and calculate, (a) Spring constant, (b) g and (c) Modulus of rigidity. **CO-3.** Experimentally determine the Young's modulus of a material in the

	form of a bar by the method of flexure. **CO-4.** Experimentally determine the coefficient of viscosity of water by capillary flow method (Poiseuille's method). **CO-5.** Experimentally determine the coefficient of viscosity of highly viscous liquid by Stoke's method. **CO-6.** Experimentally determine the value of g using Bar Pendulum. **CO-7.** Experimentally determine the acceleration due to gravity with the help of Kater's pendulum. **CO-8.** Experimentally determine the Moment of Inertia of a Flywheel.
Course Outcomes B. Sc Physics **SEM-II**	
Core/SEC/DSE	**Outcomes** After completion of these courses students will:
Core-T3 **Electricity & Magnetism** **(4 Credits)**	**CO-1.** Know about Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Capacitance. **CO-2**. Learn about Polarization, Electrical Susceptibility and Dielectric Constant. Capacitor filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics. **CO-3.** Learn about Biot-Savart's Law and its simple applications. Ampere's Circuital Law and its application. **CO-4.** Know about Faraday's Law, Lenz's Law, Self-Inductance and Mutual Inductance, Introduction to Maxwell's Equations, Charge Conservation and Displacement current **CO-5.** Understand Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis. **CO-6.** Learn about Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit, Parallel LCR Circuit.

	CO-7. Learn about Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem and Maximum Power Transfer theorem.
Core-P3 **Electricity & Magnetism Lab** **(2 Credits)**	**CO-1.** Experimentally determine Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses. **CO-2**. Experimentally verify the Thevenin, Norton and Maximum power transfer theorems. **CO-3.** Experimentally determine self-inductance of a coil by Anderson's bridge. **CO-4.** Experimentally study response curve of a Series LCR circuit and determine its (a) Resonant frequency (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width. **CO-5.** Experimentally determine the ECE of copper. **CO-6.** Experimentally construct the one Ohm coil.
Core-T4 **Waves & Optics** **(4 Credits)**	**CO-1.** Discuss about Simple Harmonic Oscillations, Differential equation of SHM and its solution, Damped oscillation. Forced oscillations, sharpness of resonance, Quality Factor. **CO-2.** Know about superposition of two collinear oscillations, Superposition of N collinear Harmonic Oscillations, Superposition of two perpendicular Harmonic Oscillations, Graphical and Analytical Methods. Lissajous Figures. **CO-3.** Know about plane and spherical Waves, Longitudinal and Transverse Waves, Plane Progressive Waves, Wave Equation. Particle and Wave Velocities, Energy Transport, Water Waves, Gravity Waves. **CO-4.** Learn about waves in a String, Vibrating String, Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves, Open and Closed Pipes, Superposition of N Harmonic Waves. **CO-5.** Think about Electromagnetic nature of light, wave front, Huygens Principle, Coherence, Young's double slit experiment. Lloyd's Mirror,

	Fresnel's Biprism, Stokes' treatment, parallel and wedge-shaped films, Haidinger Fringes, Fringes of equal thickness, Newton's Rings, Michelson Interferometer, Fabry-Perot interferometer. **CO-6.** Understand about Fraunhofer diffraction, Resolving Power of a telescope, Diffraction grating, Fresnel's Half-Period Zones for Plane Wave, Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire. Holography, Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.
Core-P4 **Waves & Optics Lab** **(2 Credits)**	**CO-1.** Experimentally determine the angle of prism. **CO-2.** Experimentally determine refractive index of the Material of a prism using sodium source. **CO-3.** Experimentally determine dispersive power and Cauchy constants of the material of a prism using mercury source. **CO-4.** Experimentally determine wavelength of sodium light using Fresnel Biprism. **CO-5.** Experimentally determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating. **CO-6.** Experimentally determine dispersive power and resolving power of a plane diffraction grating.
Course Outcomes B. Sc Physics **SEM-III**	
Core/SEC/DSE	**Outcomes** After completion of these courses students will:
Core-T5 **Mathematical Physics-II** **(4 Credits)**	**CO-1.** Learn about Functions of a complex variable. Single- and multivalued functions. Analytic functions. Cauchy-Riemann equations. **CO-2.** Take concepts on Cauchy's integral theorem, Cauchy's integral formula. Jordan's Lemma, The Taylor, Laurent expansion, Singular points, Removable singularity, Poles, Essential singularity. Residue at a pole of order m, Cauchy's residue theorem.

	CO-3. Know about Hermitian, orthogonal and unitary matrices, inverse of a matrix. Solution by matrix method. Eigenvalues and eigenvectors of a matrix. Matrix representations of Linear operators. Similarity transformation. **CO-4.** Think on Probability distribution functions; binomial, Gaussian, and Poisson, Mean and variance, Conditional Probability. Bayes' Theorem. **CO-5.** Understand about Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. **CO-6.** Learn about Functionals, Basic ideas of functional, Extremization of action as a basic principle in mechanics, Lagrangian formulation, Euler's equations of motion for simple systems, Cyclic coordinates. Symmetries and conservation laws. Legendre transformations and the Hamiltonian formulation of mechanics. Canonical equations.
Core-P5 **Mathematical Physics-II Lab** **(2 Credits)**	**CO-1.** Learn about an introduction to programming in python. **CO-2.** Learn about an introduction to Computer Programming using python. **CO-3.** Learn about Numerical Computation in python.
Core-T6 **Thermal Physics** **(4 Credits)**	**CO-1.** Discuss about Zeroth and First Law of Thermodynamics, Second Law of Thermodynamics, Heat Engines. Carnot's Cycle, Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements, Carnot's Theorem, Concept of Entropy, Clausius Theorem, Principle of Increase of Entropy,Third Law of Thermodynamics. Unattainability of Absolute Zero. **CO-2.** Take concept on Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation, Ehrenfest equations **CO-3.** Learn about Maxwell's Thermodynamic Relations.

	CO-4. Know about behavior of real gas. The Virial Equation.Van der Waal's Equation of State for Real Gases. Joule- Thomson Cooling.
Core-P6 **Thermal Physics Lab** **(4 Credits)**	**CO-1.** Experimentally determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method. **CO-2.** Experimentally determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus. **CO-3.** Experimentally determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method. **CO-4.** Experimentally determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT). **CO-5.** Experimentally determine the variation of Thermo-emf of Thermocouple with Difference of Temperature of its Two Junctions. with the help of Fresnel's bi-prism.
Core-T7 **Digital Systems and Applications** **(4 Credits)**	**CO-1.** Learn about Integrated Circuits(SSI, MSI, LSI , VLSI and ICs) **CO-2.** Learn about Binary Numbers, conversion between number systems, AND, OR and NOT Gates, NAND and NOR Gates as Universal Gates, XOR and XNOR Gates, De Morgan's Theorems, Minterms and Maxterms, Karnaugh Map, Multiplexers, De-multiplexers, Decoders, Encoders, Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor. **CO-3.** Learn about SR, D, and JK Flip-Flops, M/S JK Flip- Flop, 555, Timer, Astable multivibrator and Monostable multivibrator, Shift registers,Counters , Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter. **CO-4.** Learn about Computer Organization, Data storage, Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.
Core- P7 **Digital Systems and**	**CO-1.** Experimentally measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.

Applications Lab **(2 Credits)**	**CO-2.** Experimentally test a Diode and Transistor using a Multimeter. **CO-3.** Experimentally design a switch (NOT gate) using a transistor. **CO-4.** Experimentally verify and design AND, OR, NOT and XOR gates using NAND gates. **CO-5.** Experimentally design a combinational logic system for a specified Truth Table. **CO-6.** Experimentally convert a Boolean expression into logic circuit and design it using logic gate ICs. **CO-7.** Experimentally study Half Adder, Full Adder and 4-bit binary Adder. **CO-8.** Experimentally build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
SEC-T2 **Renewable Energy and Energy Harvesting** **(2 Credits)**	**CO-1.** Learn about Fossil fuels and alternate Sources of energy. **CO-2.** Learn about Solar energy and related topics. **CO-3.** Know about Wind Energy and its utility on energy harvesting. **CO-4.** Understand the fact and uses of Ocean Energy. **CO-5.** Take clear understanding about the using of Geothermal energy. **CO-6.** Learn about hydro-energy. **CO-7.** Know about Piezoelectric Energy harvesting. **CO-8.** Discuss about Electromagnetic Energy Harvesting.
Course Outcomes B. Sc Physics **SEM-IV**	
Core/SEC/DSE	**Outcomes** After completion of these courses students will:
Core-T8 **Mathematical Physics-III** **(4 Credits)**	**CO-1.** Know about Linear Vector Spaces, Abstract Systems, Binary Operations, Groups, Fields, Vector Spaces and Subspaces. Linear Transformations, Orthogonal and unitary Transformations. **CO-2.** Know about Fourier Transforms, its properties, Convolution theorem,

	application of FT in differential equation, Laplace Transform, Inverse LT, application of FT in differential equation. **CO-3.** Know about the Cayley- Hamiliton Theorem, diagonalization of Matrices, solutions of Coupled Linear Ordinary Differential Equations. Functions of a Matrix.
Core- P8 **Mathematical Physics-III lab** **(2 Credits)**	**CO-1.** Know how to solve differential equations in MATLAB or Scilab. **CO-2.** Able to derive Fourier Series to evaluate the Fourier coefficients of a given periodic function in Scilab. **CO-3.** Able to do calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through Scilab program. **CO-4.** Able to know how to compute the nth roots of unity for n = 2, 3, and 4. **CO-5.** Know how to find the square roots of different function.
Core-T9 **Elements of Modern Physics** **(4 Credits)**	**CO-1.** Learn about Planck's quantum, Blackbody Radiation, Photo-electric effect and Wave amplitude and wave functions. **CO-2.** Know about Wave-particle duality, Heisenberg uncertainty principle, Energy-time uncertainty principle Schrodinger equation. **CO-3.** Understand on the One dimensional infinitely rigid box, energy eigenvalues and eigenfunctions, Quantum mechanical scattering and tunnelling in one dimension- across a step potential & rectangular potential barrier. Nature of nuclear force, NZ graph, Liquid Drop model, Nuclear Shell Model. **CO-4.** Take concept on Radioactivity, Fission and fusion , Lasers: Three-Level and Four-Level Lasers, Ruby Laser and He-Ne Laser.
Core- P9 **Elements of Modern Physics Lab** **(2 Credits)**	**CO-1.** Experimentally determine work function of material of filament of directly heated vacuum diode. **CO-2.** Experimentally determine the wavelength of H-alpha emission line of Hydrogen atom. **CO-3.** Experimentally determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

	CO-4. Experimentally determine the wavelength of laser source using diffraction of single slit. **CO-5.**Experimentally determine the Boltzmann constant using I-V characteristics of PN junction diode.
Core-T10 **Analog Systems and Applications** **(4 Credits)**	**CO-1.** Learn about semiconductor junction, junction diodes, junction related phenomenon, different types of junvtions. **CO-2.** Know about rectifier diodes, rectification procedure and circuit modifications, LED, photodiodes, solar cell. **CO-3.** Understand the basic mechanism of BJT & FET, biasing of transistors, stability of biasing, I-V Characteristics, different regions of operation. **CO-4.** Take concept on transistor amplifier, types of amplifier, amplification factors, feedback in amplifier, its uses. **CO-5.** Learn on Barkhausen criteria, basic of oscillators circuits, sinusoidal oscillators. **CO-6.** Take concepts on Operational Amplifier, its characteristics, constructions and its uses.
Core- P10 **Analog Systems and Applications Lab** **(2 Credits)**	**CO-1.** Experimentally study the characteristics of a Bipolar Junction Transistor in CE configuration and designing a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias. **CO-2.** Experimentally study the frequency response of voltage gain of a RC-coupled transistor amplifier. **CO-3.** Experimentally design a digital to analog converter (DAC) of given specifications. **CO-4.** Experimentally design inverting amplifier and non-inverting using Op-amp (741,351) for dc voltage of given gain. **CO-5.** Experimentally design inverting amplifier and non-inverting amplifier using Op-amp (741,351) and study its frequency response.

	CO-6. Experimentally study the zero-crossing detector and comparator. **CO-7.** Experimentally investigate the use of an op-amp as adder inverting and non-inverting mode, Differentiator and Integrator.
SEC-T3 **Radiation Safety** **(2 Credits)**	**CO-1**. Know about the Interaction of Radiation with matter and related topics. **CO-2.** Know about radiation detection, detectors and monitoring devices. **CO-3.** Understand about radiation safety management. **CO-4.** Know about application of nuclear techniques.
Course Outcomes B. Sc Physics **SEM-V**	
Core/SEC/DSE	**Outcomes** After completion of these courses students will:
Core-T11 **Quantum Mechanics and Applications**	**CO-1:** Understand the basic requirement and fundamentals of quantum Mechanics. **CO-2:** Know the importance of the uncertainty principle and the acceptable Wave functions. **CO-3:** Discuss bound states in arbitrary potentials. **CO-4:** Study the quantum theory of hydrogen-like atoms. **CO-5:** Analyze the effects of electric and magnetic fields on atoms. **CO-6:** Apply the concepts of Pauli's exclusion principle and spin-orbit couplings in dealing with many electron atoms.
Core-T11 **Quantum Mechanics and Applications Lab** **(4 Credits)**	**CO-1:** Experimentally determine the ionization potential of mercury. **CO-2:** Experimentally show the tunneling effect in tunnel diode using I-V characteristics. **CO-3:** Experimentally measure Planck's constant using black body radiation and photo-detector. **CO-4:** Experimentally determine the Planck's constant using LEDs of at least

	4 different colours. **CO-5:** Experimentally determine the absorption lines in the rotational spectrum of Iodine vapour.
Core-T11 **Solid State Physics** **(4 Credits)**	**CO-1:** Understand the basic difference between crystalline and amorphous solids and analyze x-ray diffraction by crystals and the structural properties of different solids such as inter-atomic spacing, Brillouin zones. **CO-2:** Deal with lattice vibrations to make out phonons behavior in explaining the propagation of solid waves and hence lattice specific heat. **CO-3:** Classify materials on the basis of the process of magnetization. **CO-4:** Know various contributions to the net polarizability, understand ferroelectric properties of materials. **CO-5:** Describe the formation of energy band in solids, to explain Hall Effect. **CO-6:** Familiar with various factors on the process of transition to the superconducting phase of matter.
Core-T11 **Solid State Physics Lab** **(2 Credits)**	**CO-1:** Experimentally measure the "Dielectric Constant" of dielectric Materials with frequency. **CO-2:** Experimentally draw the BH curve of Fe using Solenoid & determine "energy-loss" from Hysteresis. **CO-3:** Experimentally measure the resistivity of a semiconductor (Ge) with temperature by "four-probe method" (room temperature to 150^{o}C) and determine its band- gap. **CO-4:** Experimentally determine the "Hall coefficient" of a semiconductor sample.
DSE-1 **Classical Dynamics** **(6 Credits)**	**CO-1:** Understand the applications of Newton's Laws of motion in describing the motion of a charged particle in electric and magnetic fields.

	CO-2: Find the importance of Lagrangian and Hamiltonian mechanics, which are the two main branches of analytical mechanics with an emphasis on system energy, rather than on forces and solve various problems using Lagrangian and Hamiltonian formulations. **CO- 3:** Deal with the motion of a particle in a "central force field" . **CO-4.** Acquire knowledge about "small amplitude oscillations". **CO-5:** Study detailed description of "special theory of relativity". **CO-6:** Distinguish streamline and turbulent flows of fluids, derive the equations of motion for incompressible fluid flows, i.e., the Navier-Stokes equations.
DSE-2 **Nuclear and Particle Physics** **(6 Credits)**	**CO-1:** Gain the concept of general properties of nuclei, various nuclear models and nuclear force. **CO-2:** Learn various aspects and mechanisms of α, β and γ-decays from radioactive nuclei. **CO-3:** Understand various types of nuclear reactions and conservation laws. **CO-4:** Know about the ways of interaction of nuclear radiations with matters. **CO-5:** Acquainted with the working principles of nuclear radiation counters and detectors. **CO-6:** Distinguish particle accelerators on the basis of their properties. **CO-7:** Classify particles and their interactions into a number of easily identifiable categories and establish a number of empirical rules leading to a fundamental theory of the strongly interacting particles' properties and structure on the basis of "quark model".

B. Sc. PHYSICS GENERIC/ PROGRAMME

Department of Physics	After successful completion of three year degree general course in physics a student should be able to:
Programme Outcomes	PO-1. Get a brief idea about the various fields of physics. PO-2. Solve the problem and also think methodically, independently and draw a logical conclusion. PO-3. Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of Physics experiments. PO-4. Create an awareness of the impact of Physics on the society, and development outside the scientific community. PO-5. PO-6. To inculcate the scientific temperament in the students and outside the scientific community. PO-5. Exhibit disciplined work habits as an individual.
Programme Specific Outcomes	PSO-1. Gain the knowledge of Physics through theory and practical. PSO-2. Understand good laboratory practices and safety. PSO-3. Gain capability of oral and written scientific communication, and will prove that they can think critically and work independently. PSO-4. Make aware and handle the sophisticated instruments/equipments.
Course Outcomes U.G. Physics **SEM-I**	
Core/GE	**Outcomes** After completion of these courses students will:
T1 – Physics I **(4 Credits)**	**CO-1.** Know vector Calculus and some related theorems. **CO-2**. Clear understanding Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. **CO-3.** Concept about Work and energy. Conservation of energy, Motion of rockets, Torque, Conservation of angular momentum. **CO-4.** Concept about Newton's Law of Gravitation. Motion of a particle in a central force field, Kepler's Laws, Satellite in circular orbit. **CO-5.** Discussion on Elastic moduli, work done in stretching twisting couple on a cylinder, Torsional pendulum, Searles method. **CO-6.** Discuss on the Postulate of special theory of relativity. Lorentz

	transformations. Simultaneity and order of events. lorentz contraction. Time dilation, relativistic transformation of velocity, relativistic addition of velocities. **CO-7.** Know about Differential equation of SHM and its solutions, Oscillations having equal frequencies, Beats, Lissajous Figures, Damped oscillations. Forced vibrations and resonance, musical notes, musical scale. Acoustics of buildings, Sabine's formula **CO-8.** Study on Gauss theorem and its applications, electric dipole, Calculation of electric field from potential. Capacitor, Dielectric medium, Polarisation, Displacement vector.
P1 – Physics I Lab (2 Credits)	**CO-1.** Experimentally determine length (or diameter) using verniercaliper, screw gauge and travelling microscope. **CO-2**. Experimentally determine the Moment of Inertia of a Flywheel. **CO-3.** Experimentally determine the Modulus of Rigidity of a Wire by Maxwell's needle. **CO-4.** Experimentally determine the Elastic Constants of a Wire by Searle's method. **CO-5.** Experimentally determine g by Kater's Pendulum. **CO-6.** Experimentally determine motion of a Spring and calculate (a) Spring Constant, (b) g. **CO-7.** Experimentally investigate the motion of coupled oscillators. **CO-8.** Experimentally study Lissajous Figures. **CO-9.** Experimentally determine the Moment of Inertia of cylindrical body about an axis passing through its centre of gravity. **CO-10.** Experimentally determine the Modulus of Rigidity of a Wire by dynamical method. **CO-11.** Experimentally determine Frequency f vs 1/l curve for a sonometer-wire and hence unknown frequency of a tuning fork.

Course Outcomes U.G. Physics SEM-II	
Core/GE	**Outcomes** After completion of these courses students will:
T2 – Physics II **(4 Credits)**	**CO-1.** Understand Biot-Savart's law and its applications, Ampere's circuital law, Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferro- magnetic materials, Faraday's laws of EM induction, Lenz's law, self and mutual inductance. **CO-2.** Know the basic concept of EM wave, Maxwells equation, displacement current, EM energy density. **CO-3.** Concept about Mean free path ,Law of equipartion of energy and its applications, Blackbody radiation, Plank's distribution law, Stefan Boltzmann Law and Wien's displacement law. **CO-4.** Study on Thermodynamic system, Zeroth Law of TDS and temperature. First law, Applications of First Law, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Unattainability of absolute zero. **CO-6.** Concept about Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell- Boltzmann law Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose- Einstein distribution law.
P2 – Physics II Lab **(2 Credits)**	**CO-1.** Experimentally determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.. **CO-2.** Experimentally determine Stefan's Constant. **CO-3.** Experimentally use a Multimeter for measuring, Resistances, AC and DC Voltages, DC Current, Checking electrical fuses. **CO-4.** Experimentally determine the Characteristics of a Series RC Circuit. **CO-5.** Experimentally determine a Low Resistance by Carey Foster's Bridge. **CO-6.** Experimentally verify the Thevenin and Norton theorems . **CO-7.** Experimentally verify the maximum power transfer theorem.

	CO-8. Experimentally study a series LCR circuit. **CO-9.** Experimentally determine the coefficient of linear expansion of the material of a rod using Optical Lever Method. **CO-9.** Experimentally determine Potential difference across a low resistance and hence the current through it with the help of a meter bridge.
Course Outcomes U.G. Physics **SEM-III**	
Core/GE	**Outcomes** After completion of these courses students will:
T3 – Physics III **(4 Credits)**	**CO-1.** Learn about Electromagnetic nature of light, wave front, Huygens Principle. **CO-2.** Take concepts on Young's Double Slit experiment, Lloyd's Mirror, Fresnel's Biprism, Stokes' treatment, Fringes of equal inclination , Fringes of equal thickness, Newton's Rings, diffraction- Single slit, Double Slit, Diffraction grating, Half-period zones. Zone plate. **CO-3.** Know about Transverse nature of light waves. Plane polarized light – production and analysis, Circular and elliptical polarization. **CO-4.** Take concepts on amorphous and crystalline Materials, Unit Cell. Miller Indices, Reciprocal Lattice,Bragg's Law. **CO-5.** Understand about Heisenberg uncertainty principle,Time dependent Schrodinger equation, Properties of Wave Function, Wave Function , Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum & Energy operators, Expectation values of position and momentum. Wave Function of a Free Particle. **CO-6.** Learn about Packing fraction, mass defect, binding energy, systematics of stable nuclei, Radioactivity, Fission and fusion. Mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons.

P3 – Physics III (2 Credits)	**CO-1.** Experimentally measure angle of prism with spectrometer. **CO-2.** Experimentally determine Resolving Power of a Plane Diffraction Grating. **CO-3.** Experimentally determine wavelength of sodium light using Newton's Rings **CO-4.** Experimentally determine value of Boltzmann constant using V-I characteristic of PN diode. **CO-5.** Experimentally value of Planck's constant using LEDs of at least 4 different colours. **CO-6.** Experimentally Refractive index of water by travelling microscope . **CO-7.** Experimentally determine Refractive index of the material of a lens by lens mirror method . **CO-8.** Experimentally determine Refractive index of the liquid by lens-mirror method. **CO-9.** Experimentally determine Focal length of a convex lens by combination method and calculation of its power.
SEC-T2 Renewable Energy and Energy Harvesting (2 Credits)	**CO-1.** Learn about Fossil fuels and alternate Sources of energy. **CO-2.** Learn about Solar energy and related topics. **CO-3.** Know about Wind Energy and its utility on energy harvesting. **CO-4.** Understand the fact and uses of Ocean Energy. **CO-5.** Take clear understanding about the using of Geothermal energy. **CO-6.** Learn about hydro-energy. **CO-7.** Know about Piezoelectric Energy harvesting. **CO-8.** Discuss about Electromagnetic Energy Harvesting.

Course Outcomes U.G. Physics SEM-IV	
Core/GE	**Outcomes** After completion of these courses students will:
T4 – Physics IV **(4 Credits)**	**CO-1.** Know about Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect (only statement), Hall coefficient. **CO-2.** Know about PN junction and its properties, current flow in PN junction, LEDs, Photodiode, Solar CellBipolar Junction transistors, CB, CE and CC Configurations. Active, Cutoff& Saturation regions, Current gains α and β, DC Load line,Voltage Divider Bias Circuit for CE Amplifier. H-parameter, Equivalent Circuit. Analysis of single-stage CE amplifier using hybrid Model and gain calculations, Class A, B & C Amplifiers. **CO-3.** Know about the Characteristics of an Ideal and Practical Op-Amp, Open-loop and closed- loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps. **CO-4.** Know about Binary Numbers, AND, OR and NOT gate ,NAND and NOR Gates as Universal Gates. XOR and XNOR Gates, De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra, Karnaugh Map, Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor. **CO-5.** Know about Half-wave Rectifiers, Full-wave Rectifiers, Zener Diode and Voltage Regulation.
P4 – Physics IV **(2 Credits)**	**CO-1.** Experimentally verify and design AND, OR, NOT and XOR gates using NAND gates **CO-2.** Experimentally minimize a given logic circuit. **CO-3.** Experimentally study zener diode characteristics and its application as voltage regulator. **CO-4.** Experimentally design an inverting amplifier of given gain using Op-amp 741 and study its frequency response. **CO-5.** Experimentally draw the I-V characteristics of a suitable resistance and

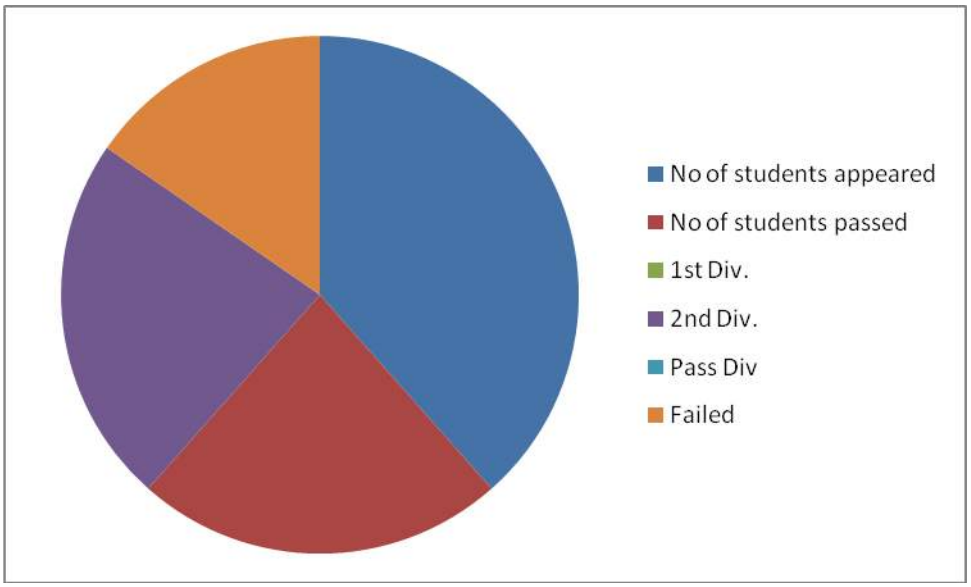
	that of a junction diode within specified limit on a graph, and hence to find d.c. and a.c. resistance of both the elements at the point of intersection. **CO-6.** Experimentally design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
SEC-T3 **Radiation Safety** **(2 Credits)**	**CO-1**. Know about the Interaction of Radiation with matter and related topics. **CO-2.** Know about radiation detection, detectors and monitoring devices. **CO-3.** Understand about radiation safety management. **CO-4.** Know about application of nuclear techniques.
Course Outcomes U.G. Physics **SEM-V**	
Core /DSE	**Outcomes** After completion of these courses students will:
DSE-2 **Classical Dynamics** **(6 Credits)**	**CO-1:** Understand the applications of Newton's Laws of motion in describing the motion of a charged particle in electric and magnetic fields. **CO-2:** Find the importance of Lagrangian and Hamiltonian mechanics, which are the two main branches of analytical mechanics with an emphasis on system energy, rather than on forces and solve various problems using Lagrangian and Hamiltonian formulations. **CO- 3:** Deal with the motion of a particle in a "central force field" . **CO-4.** Acquire knowledge about "small amplitude oscillations". **CO-5:** Study detailed description of "special theory of relativity". **CO-6:** Distinguish streamline and turbulent flows of fluids, derive the equations of motion for incompressible fluid flows, i.e., the Navier-Stokes equations.
SEC-T6 **Electrical circuits and network skills** **(2 Credits)**	**CO-1**. Know about the Basic Electricity Principles. **CO-2.** Know about Understanding Electrical Circuits. **CO-3.** Understand about Electrical Drawing and Symbols. **CO-4.** Know about Generators and Transformers.

	CO-5. Know about Electric Motors. **CO-6.** Know about Solid-State Devices. **CO-7.** Know about Electrical Protection. **CO-8.** Know about Electrical Wiring.

Annexure-III

Result Analysis
Department of Physics
Session: 2017 -18

No. of Students Appeared	No. of Student Passed	Division/Class		No. of Student Failed
05	03	1st	00	02
		2nd	03	
		Pass	00	



Analysis:

1. Updated information regarding the subject should be provided in the class hours.
2. Some special classes apart from the regular classes should be taken in certain week.
3. Students should be inspired to take online classes for better knowledge and perfection.
4. Analyze the previous year's questions and follow the question pattern accordingly the preparation should be started and thoroughly practice more and more question answers.
5. The number of reference books, journals, and magazines and text books should be increased in the library.

Annexure - IV

Publications & Presentations

Academic year 2017-18

Department of Physics

Sl. No.	Name of the faculty	Designstion	Research Publication		Book Publication
			National	International	
1	Goutam Mandal	Asst. Professor	0	02	01
2	Thakurdas Mahato	Guest Teacher	0	0	0
3	Sagarika Mandal	Guest Teacher	0	0	0
4	Apurba Paramanik	Guest Teacher	0	0	0

Details of Publication:

(A) Research Article :

SL. No.	Title of the paper	Journal name	ISSN No.	Date of publication
1	STUDY ON OPTICAL FREQUENCY ENCODED TRI-STATE S-R FLIP FLOP [Page No:2214-2221]	JASC	1076-5131 [I.F.:5.8]	VOL- 5, ISSUE- 11 (November 2018)
2	A BRIEF REVIEW ON SYNTHESIS TECHNIQUES OF NANOPARTICLE [Page No:172-175]	JASRAE	2230-7540 [I.F: 3.46]	VOL- 15, ISSUE- 12 (Dec-2018)

(B) Book :

Sl No.	Title of the publication with page no. and year of publication	Name of the publisher	ISSN/ISBN No.	No. of Co-author
1	Environmental Education A need of the day [total:208] Year: August 2017	Kabitika	*ISBN:978-93-81554-25-8*	2