Deccan Education Society's

FERGUSSON COLLEGE, PUNE

(AUTONOMOUS)

SYLLABUS FOR THIRD YEAR B. Sc. PHYSICS - Semester V

Effective from Academic Year 2018-2019

Deccan Education Society's
FERGUSSON COLLEGE (AUTONOMOUS), PUNE 411004
Scheme of Course Structure (Faculty of Science)
2018-2019
T. Y. B. Sc. - Physics

Semester	Course Code	Title	Paper No.	Credits	Exam (I / E)	Marks (50 / 50)
V	PHY3501	Mathematical Methods in Physics	I	3	I and E	50 + 50
	PHY3502	Solid State Physics	II	3	I and E	50 + 50
	PHY3503	Classical Mechanics	III	3	I and E	50 + 50
	PHY3504	Atomic and Molecular Physics	IV	3	I and E	50 + 50
	PHY3505	Analog Electronics	V	3	I and E	50 + 50
		OR				
	PHY3506	C-Programming		3	I and E	50 + 50
	PHY3507	LASERS	VI	3	I and E	50 + 50
		OR				
	PHY3508	Elements of Materials Science		3	I and E	50 + 50
		OR				
	PHY3509	Radiation Physics		3	I and E	50 + 50
	PHY3511	Physics Practical - I	Physics Practical - I	2	I and E	50 + 50
	PHY3512	Physics Practical - II	Physics Practical - II	2	I and E	50 + 50
	PHY3513	Physics Practical - III	Physics Practical - III	2	I and E	50 + 50
VI	PHY3601	Classical Electrodynamics	I	3	I and E	50 + 50
	PHY3602	Quantum Mechanics	II	3	I and E	50 + 50
	PHY3603	Thermodynamics & Statistical Mechanics	III	3	I and E	50 + 50
	PHY3604	Nuclear Physics	IV	3	I and E	50 + 50
	PHY3605	Digital Electronics	V	3	I and E	50 + 50
		OR				
	PHY3606	Computational Physics		3	I and E	50 + 50
	PHY3607	Astronomy & Astrophysics	VI	3	I and E	50 + 50
		OR				
	PHY3608	Renewable Energy Sources		3	I and E	50 + 50
		OR				
	PHY3609	Biophysics		3	I and E	50 + 50
	PHY3611	Physics Practical - IV	Physics Practical - IV	2	I and E	50 + 50
	PHY3612	Physics Practical - V	Physics Practical - V	2	I and E	50 + 50
	PHY3613	Physics Project	Physics - Project	2	I and E	50 + 50

T.Y. B.Sc. (PHYSICS) SEMESTER – V
PHYSICS PAPER - I
TITLE: MATHEMATICAL METHODS IN PHYSICS
PAPER CODE: PHY3501

[CREDITS - 3]

Learning Objectives:

1. To learn mathematical tools required to solve physical problem.
2. To understand mathematical concepts related to physics.

	Title and Contents	No. of Lectures
Unit - I	Vector Integration and multiple integrals: Ordinary Integral of Vectors. Line, Surface and Volume Integrals. Flux of a Vector Field. Gauss' Divergence Theorem, Green's Theorem and Stokes Theorem. Multiple Integrals Double and Triple Integrals: Change of Order of Integration. Change of Variables and Jacobian. Applications of Multiple Integrals: (1) Area Enclosed by Plane Curves, (2) Area of a Curved Surface, (3) Volumes of Solids.	12
Unit - II	Orthogonal Curvilinear co-ordinates: Introduction to Cartesian, Spherical polar and cylindrical co-ordinate systems, transformation equations, General Curvilinear co-ordinate system: Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system, metric coefficient. Orthogonal Curvilinear co-ordinate system, Expressions for gradient, divergence, Laplacian and Curl, special case for gradient, divergence, Laplacian, and curl in Cartesian, spherical polar and cylindrical co-ordinate system.	12
Unit - III	Partial differential equations and Special functions: Frequently occurring partial differential equations, degree, order, linearity and homogeneity (revision), Method of separation of variables, Frobenius method for power series solution of Legendre, Hermite and Bessel differential equation.	12
Unit - IV	Fourier series: Fourier Series Fourier Series and fourier transform. Dirichlet Conditions (Statement only). Kronecker's Method for Computation of Fourier Coefficients. Even and Odd Functions. Orthogonality of Sine and Cosine Functions. Sine and Cosine Series. Applications: Square Wave, Triangular Wave. Summing of Infinite Series Term-by-Term Differentiation and Integration of a Fourier Series. Fourier transforms, inverse transform and some application oriented problems.	12

References:

1. Mathematical methods for physicists - Arfken and Weber, Academic Press New York.
2. Mathematical Physics - Rajput, Pragati Prakashan
3. Mathematical methods in the physical sciences - Marry L. Boas, John Willy and sons publication.
4. Introduction to special relativity - Robert Resnick, Wiley Eastern Ltd.
5. Mathematical Physics - B. D. Gupta
6. Mathematical Physics - H. K. Dass

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - II
TITLE: SOLID STATE PHYSICS
PAPER CODE: PHY3502

[CREDITS - 3]

Learning Objective:

1. Solid state physics is an extremely broad area. In the present syllabus students are introduced to basic concepts right from the crystal structure, occurrence of magnetism and some characterization techniques.
2. This syllabus will also help students to lay a foundation for Materials science, electronics and more advanced subjects like condensed matter in future.

	Title and Contents	No. of Lectures
Unit - I	**Crystal Physics:** Introduction, lattice, basis, crystal structure, unit cell & primitive cell, Translational vectors, Symmetry operations, crystal classes & crystal systems in 2D and 3D, Bravais lattices, atomic packing fraction in cubic systems SC,FCC,BCC. Miller indices, Interplanar spacing. Brillouin zones, Concept of reciprocal lattice and its properties. Crystal structures of diamond, ZnS, NaCl, CsCl, HCP. Structure determination using X ray Diffraction: Bragg's law and Bragg's Diffraction condition indirect and reciprocal lattice, Ewald's construction.	14
Unit - II	**Free Electron and Band Theory of Metals:** Free Electron model, Energy levels and Density of orbital in 1D and 3D, Bloch theorem (statement only), Nearly free electron model, Fermi energy, Fermi level, Hall Effect, Origin of energy gap, Energy bands in Solids, Effective mass of electron (with derivation), Distinction between metal, semiconductor and insulator. Band theory of Semiconductors: Electrons and Holes in an Intrinsic Semiconductor, Conductivity, Carrier concentrations, Donor and Acceptor impurities, Charge densities in a Semiconductor, Fermi level in extrinsic semiconductors, Diffusion, Carrier lifetime, The continuity equation.	14
Unit - III	**Magnetism:** Diamagnetism, Langevin theory of Diamagnetism, Application of diamagnetic material: (Superconductor), concept, Occurrence of Superconductivity, Critical magnetic field and Meissner effect achievement at low temp, attempts at room temp. Examples, Paramagnetism, Langevin theory of Paramagnetism, ferromagnetism, ferromagnetic domains, Hysteresis, Curie temperature. Ferromagnetism, Ferrites and its applications, antiferomagnetism, Neel temperature.	12
Unit - IV	**Solid state devices:** Semiconductors, intrinsic, extrinsic, temp dependence, doping, conductivity, hall effect hall coeff. semiconductor devices. e.g. metal semiconductor junction, p-n junction diodes, zener and tunnel diodes, LED's transistor, solar cells.	08

References:

1. Solid State Physics - S. O. Pillai, 3rd Edition, New Age International (P.) Ltd., Publisher, (1999).
2. Solid State Physics - Kakani and Hemrajani, S. Chand Publication.
3. Solid State Physics - Saxena, Gupta and Saxena, Pragati Prakashan.
4. Introduction to Solid State Physics - Charles Kittel, John Wiley and Sons, 7th Edition.

5. Solid State Physics - A. J. Dekker, Macmillan India Ltd., (1998).
6. Solid State Physics - R. K. Puri, V. K. Babbar, S. Chand Publication.
7. Problems in Solid State Physics - S. O. Pillai, New Age International (P.) Ltd.
8. Solid State Physics - Palanisamy.
9. Solid State Physics - David, Snoke, Pearson Publication.

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - III
TITLE: CLASSICAL MECHANICS
PAPER CODE: PHY3503

[Credits - 3]

Learning Objectives:

1. Students should understand the drawbacks of Newtonian approach and necessity of new approaches
2. Students should understand the concept of central forces and scattering phenomena
3. Students should understand the forces in non inertial systems

	Title and Contents	No. of Lectures
Unit - I	**Mechanics of system of particles:** Introduction - Newton's laws, Applications of Newton's laws of motion, Projectile motion in resistive medium, Rocket motion, Motion of a charged particle in constant electric, magnetic and electromagnetic field. System of particles, Centre of mass, Conservation of linear momentum, angular momentum, energy of system of particles	10
Unit - II	**Motion in Central Force Field:** Central force, equivalent one body problem, Motion in central force field, General features of motion, equation of orbit, Deduction of Kepler's laws of planetary motion and their applications, Deduction of force from general orbit, Orbits of artificial satellite, Stability of circular orbits, tidal force field.	10
Unit - III	**Scattering of particles:** Elastic and inelastic scattering, Elastic scattering - Laboratory and centre of mass system. Scattering, Relation between scattering angles in laboratory and centre of mass system. Differential cross-section, impact Parameter, total cross-section, Rutherford scattering.	10
Unit - IV	**Langrangian and Hamiltonian formulation:** Limitations of Newtonian formulation, Types of constraints, degrees of freedom, generalized coordinates, configuration space, D'Alembert's principle of virtual work, Langrangian equation from D'Alembert's principle, variational principle, cyclic coordinates, Configuration space, Phase space and State space, Hamilton's equations.	10
Unit - V	**Non Inertial frames of systems:** Coordinate systems moving with constant velocity, constant acceleration, uniformly rotating frames of references, Effects of Earths motion on acceleration due to gravity, Effect of Coriolis force, Motion of a particle on a earth, Focault's pendulum.	8

References:

1. Introduction to Classical Mechanics - R. G. Takawale, P. S. Puranik, Tata McGraw Hill Publishing Company Ltd.
2. Classical Mechanics- N. C. Rana, P. S. Joag, Tata Mc Graw Hill Publishing Company Ltd.

3. Principles of mechanics, J. L. Synge, B. A. Griffith, Tata McGraw Hill Publishing Company Ltd.
4. Classical Mechanics - Herbert Goldstein, Narosa Publishing House.
5. Classical Mechanics - J. C. Upadhyaya, Himalaya Publishing House.
6. Problem solution of classical mechanics - P. V. Panat, Narosa Publishing House.
7. Mechanics - Klepner and Marion and Thornton.

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - IV
TITLE: ATOMIC AND MOLECULAR PHYSICS
PAPER CODE: PHY3504

[CREDITS - 3]

Learning Objective:

1. The subject of Atomic and Molecular Physics has reached a significant advancement in high–precision experimental measurement techniques.
2. This area covers a wide spectrum ranging from conventional to new emerging multi-disciplinary areas like molecular physics, optical science especially spectroscopy.
3. In the present syllabus sequence of articles in each chapter enables the student to understand the gradual development of the subject.

	Title and Contents	No. of Lectures
Unit - I	**Atomic Structure:** Dalton, J. J. Thomson to Rutherford model of atom. Bohr atom Electron orbits, Energy levels and spectra. Vector atom model (Concepts of space and quantization and electron spin), Atomic excitation and atomic spectra. One and two valence electron systems Pauli Exclusion principle and electron configuration, quantum states, Spectral notations of quantum states. Spin-Orbit Interaction (Single valence electron atom), selection rules, spectra of sodium atom, sodium Doublet. Two valence electron systems Spectral terms of two electron atoms, terms for equivalent electrons, LS and JJ coupling schemes. Singlet Triplet separation for interaction energy of LS coupling. Lande's Interval rule, spectra of Helium atom. Frank-Hertz experiment	16
Unit - II	**Zeeman Effect:** Early discoveries and developments Experimental arrangement, Normal and anomalous Zeeman Effect Problems, Stark effect (Qualitative discussion)	06
Unit - III	**X-ray Spectroscopy:** Nature of X-rays, Discrete and continuous X-ray spectra, Duane and Hunt's Rule, X-ray emission spectra, Mosley's law and its applications Auger effect , Problems	08
Unit - IV	**Molecular Spectroscopy:** Rotational energy levels Vibrational energy levels Rotational and Vibrational spectra Electronic spectra of molecules Problems	08
Unit - V	**Spectroscopic Techniques:** Raman spectroscopy: Classical theory of Raman Effect. Molecular polarizability, Quantum theory of Raman Effect, Experimental set up for Raman Effect, Stokes and Antistokes lines. Zeeman effect applications, Spectroscopy applications in areas like Astrophysics, Geology, Archaeology, Materials Science, Medical science.	10

References:

1. Concepts of Modern Physics 4th edition - Arthur Beiser (McGraw Hill International edition)
2. Atomic physics - J. B. Rajam
3. Introduction to Atomic spectra - White. H. E. (McGraw Hill International edition)
4. Fundamentals of Molecular spectroscopy - C. N. Banwell and E. M. Mc Cash (McGraw Hill International edition)
5. Modern Physics - J. B. Rajam

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - V (Elective - I)
TITLE: ANALOG ELECTRONICS
PAPER CODE: PHY3505

[CREDITS - 3]

Learning Objective:

1. Students should understand the concepts of various types of power supplies and their characteristics.
2. Students should learn various solid state devices.
3. Students learn amplifiers, oscillators and other analog circuits.

	Title and Contents	No. of Lectures
Unit - I	**Circuit Theorems and Power Supplies:** Statements of Thevenin's Theorem, Norton's Theorem, Superposition Theorem and Maximum Power Transformer Theorem (Without proofs) and solutions of numerical problems based on these theorems. Study of half wave, full wave rectifiers. Calculations of output dc and ripple voltage, ripple factor, efficiency, transformer utilization factor, PIV. Use of Capacitor, LC and pi filters in power supplies. Line and load regulation. Zener diode as a voltage regulator. Series and shunt regulators, short circuit protection. Block diagrams of 3 pin regulators in 78xx and 79xx series and their application in design of dual power supply. Block diagram of IC 723 and design of basic low and high voltage regulator using it. Block diagram, working and application of LM 317 and LM 337.	12
Unit - II	**Basic Electronic devices and circuits:** Construction, working and characteristics of P-N junction diode, LED, Photo Diode, Optocouplers and Varactors. BJT: Construction, study of I-V characteristics and transfer characteristics in CE, CB and CC configurations. Different methods of transistor biasing and thermal stability. Frequency response of transistor amplifier, RC coupled amplifier. Class A, Class B and Class C amplifiers. Concept of feedback and study of phase shift, Wein bridge, Hartely and Colpitt's oscillators. Applications of Hartley and Colpitt's oscillators in AM transmitters. Construction, working and characteristics of FET MOSFET and CMOS (n - channel and p - channel) transistors. Comparison of BJT, FET and MOSFET. Construction, working, characteristics and applications of UJT and SCR.	12
Unit - III	**Operational Amplifiers:**	12

	Differential amplifier. Block diagram of Op-amp. Study of parameters of op-amp. Inverting and Non Inverting amplifiers, adder, subtractor using op-amp. Applications of op-amp as Integrator, Diffrentiator, exponential and logarithmic amplifiers, multiplier, divider, I to V convertor, high impedance voltmeter, comparator, Schmitt trigger, V-F and F-V convertor, oscillators, astable and monostable multivibrator, square wave, triangular wave generator, low pass, high pass , band pass and band stop filters.	
Unit –IV	**Special Function ICs:** IC 555 - Block diagram and functions of various pins. Astable operation: Circuit diagram, frequency of oscillations and duty cycle. Applications as tone burst oscillators, voltage controlled frequency shifters. Monostable Operation and application of one-shot multivibrator in water level control, touch switch and frequency divider. XR 2240 Programmable timer/counter – Study of circuit diagram, counting operation and programming of outputs. Application in timing circuits, free running oscillator, synchronized outputs, binary pattern generator and frequency synthesizer, VCO 566 - Block diagram and working. PLL 565 - Block diagram, working and applications in AM and FM detection, Frequency divider and FSK demodulation.	12
References: 1. OP Amps and Linear Integrated Circuits - Gaikwad - PHI 2. Integrated Circuits - Botkar PHI		

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - V (Elective - II)
TITLE: C - PROGRAMMING
PAPER CODE: PHY3506

[CREDITS - 3]

Learning Objectives:
1. To introduce students with the basic structure of C-language.
2. To make students able to write the C-Programs on their own.
3. To make students able to apply these skills to the basic problems in physics.

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Programming:** What is programming, how to convert given problem into a pseudo code, writing algorithm, efficiency of algorithms, loops and repetitions, writing algorithms for simple problems, writing flowcharts, flowchart symbols.	12
Unit - II	**Introduction to C-Programming - I:** Data types and structures: Integers, float, real, characters, logical Declaration of variables, Input and Output of data: printf, scanf reading and writing data from files, formatting input and output**,** operators, writing simple programs using data types, Arrays and pointers: uses, simple programs using arrays.	12
Unit - III	**Introduction to C-Programming - II:** **Control statements:** if, if-else, for, do, while loops etc. **Functions and Subroutines:** simple examples.	12
Unit - IV	**Graphics in C:**	12

	Using graphics libraries in C.	

References:

1. C-Programming for Physicists, by W. H. Bell.
2. Computer Basics and C-Programming, by Y. Rajaraman (PHY Learning Publications).
3. Let us C, by Yashwant Kanetkar.

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER - VI
TITLE: LASERS
PAPER CODE: PHY3507

[CREDITS - 3]

Learning Objectives:

This course has been design to :

1. Understand fundamental concepts related to emission of laser light.
2. Understand characteristics of laser light.
3. Learn different types of lasers.
4. Learn applications of lasers in various fields.

	Title and Contents	No. of Lectures
Unit -I	**1. Introduction to Lasers and its characteristics:** Ordinary light and Lasers, Brief history of Lasers, Interaction of radiation with matter, Energy levels, Population density, Boltzmann distribution, Transition Lifetimes, Allowed and Forbidden Transitions, Stimulated Absorption, Spontaneous Emission and Stimulated Emission, Einstein's Coefficients, Einstein's relations. Directionality, Monochromaticity, Coherence, Brightness	12
Unit -II	**2. Laser Action:** Condition for large stimulated emission, Population inversion Condition for light amplification, Gain coefficient Active medium, Metastable states Pumping schemes: three level and four level	06
Unit –III	**3. Laser Oscillator:** Optical feedback, round trip gain, threshold gain, critical population inversion, Optical resonator, condition for steady state oscillations, cavity resonance frequencies.	06
Unit –IV	**4. Laser Output:** Lineshape broadening: - Lifetime broadening - Collision broadening - Doppler broadening	04
Unit –V	**5. Types of Lasers:** Solid State Lasers – Ruby Laser, Diode Laser Gas Lasers – HeNe Laser, CO_2 Laser Liquid Lasers: Tunable dye laser	12
Unit –VI	**7. Applications of Lasers:** Industrial – welding, cutting, drilling Nuclear Science – laser isotope separation, laser fusion, Defense - range finder Medical - eye surgery Optical - holography, supermarket scanners, compact discs	08

Reference Books:

1. An introduction to Lasers – theory and applications, M. N. Avadhanulu, S. Chand and Co. New Delhi
2. Experiments with HeNe Laser by Sirohi
3. Optical fibre and Laser – Principle and applications, Anuradha De, New Age International Publishers, Second edition

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - VI
TITLE: ELEMENTS OF MATERIALS SCIENCE
PAPER CODE: PHY3508

[CREDITS - 3]

Learning Objectives:

1. Learn the fundamental principles underlying and connecting the structure, processing, properties and performance of materials systems.
2. Learn to apply knowledge of mathematics and advanced science and engineering principles to materials systems.
3. To be able to select materials for design and construction.

	Title and Contents	No. of Lectures
Unit - I	**Introduction to Materials Science:** Introduction to Materials Science, Space lattices and crystal structures, Crystal directions and planes, The Bragg's law of X-ray diffraction, The powder diffraction method, Structure determination. Characterization Techniques: Thermal gravimetric analysis (TGA), UV-visible spectroscopy, Electron microscopy(SEM)	8
Unit - II	**Defects in Solids:** Types of materials: Conductors, Semiconductors and Insulators, Materials properties: Mechanical, Electrical and thermal, Impurities in solids. Solid solutions in metals, Rules of solid solubility. Defects in solids: Point, Line, Surface and Volume. Deformation: Elastic deformation and Plastic deformation. Mechanism of Plastic deformation by slip, Critical resolved shear stress (CRSS), Plastic deformation in poly-crystalline materials. **Diffusion in Solids:** Fick's law of diffusion, Solution to Fick's second law, Applications based on the second law solution, Kirkendall effect, Atomic model of diffusion	15
Unit - III	**Ceramic Materials:** Ceramic Phases, Classification of ceramic materials, Ceramic crystals (AX), Mechanical behaviour of ceramics, Electromagnetic behaviour of ceramics - Electric properties: dielectrics, semiconductors, piezoelectric, Magnetic Properties: Magnetic Ceramics, hard and soft ferrites.	10
Unit - IV	**Phase Diagrams; Molecular Phases:** Basic terms: System, Surrounding, Component, Coordinates, Phase, Equilibrium. Phase Diagram: definition, importance and objective, Lever rule, Gibb's phase rule. Phase diagram of a) Sugar water b) NaCl water. Types of phase diagrams with construction - Type-I Lens type CuNi phase diagram, Type-II Only introduction, Type-III Eutectic type PbSn phase diagram. Introduction, Polymers, Polymerization, Molecular weight of polymers, Linear polymers addition and condensation, Cross linked polymer	15

	vulcanization of rubber	

References:

1. Elements of Materials Science and Engineering - L. H. Van Vlack (6^{th} Edition)
2. Materials Science and Engineering - V. Raghavan (5^{th} Edition)
3. Solid State Physics - A. J. Dekker

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER - VI
TITLE: RADIATION PHYSICS
PAPER CODE: PHY3509

[CREDITS - 3]

Learning Objectives:

1. To study of different types of radiations.
2. To study of different types of detectors.
3. To understand radiation protection and safety codes for handling radioactive sources.
4. To understand radioactive isotopes and its applications.
5. Measurement of radioactivity and lifetime of radioactive sources.

	Title and Contents	No. of Lectures
Unit -I	**Low Energy Radiation:** Introduction to Microwave and Radio waves covering spectrum, power levels and detection methods. Laboratory sources of infrared, visible and ultra- violet radiation with details of energy spectrum. Detectors for microwaves, Infrared and Ultra violet radiation. Interactions of ultra violet and microwave radiation with matter	08
Unit -II	**Energetic Radiation :** Introduction to Cosmic radiation .Types of particles and their energies in cosmic rays. Basic laboratory sources of electrons and ions up to 50 keV. Focusing of electron and ion beams with magnetic and electrostatics lenses. Methods for measurement of electron and ion beam current and flux. Different types of neutron sources based on radioactive sources.	08
Unit –III	**X-Ray Radiography:** Principle and methods of generation of characteristics X-Rays. Interaction of X-Rays with matter, attenuation coefficient..Methods for recording X-Ray radiograph using photographic plate. Modern digital methods for recording X-ray radiograph. Medical applications of Xrays.	08
Unit –IV	**Radiation Detectors and Dosimetry:** Working principle of ionization chamber and Scintillator detector, Units for radiation exposure, absorbed dose, Relative biological effective dose and dose equivalent. Fricke Dosimeter. Personal dosimeters, Film badge dosimeters, thermoluminescent dosimeter. Calibration of dosimeters. Measurement of dose delivered by an electron accelerator and high strength Cobalt -60 source.	08
Unit –V	**Radiation Protection:** Interaction of MeV energy electrons, ions and gamma-rays with matter. Materials for radiation shielding. Radiation Protection and Safety rules as per the regulatory guidelines of the Government of India, Safety codes for handling radioactive sources. Monitoring of	08

	radiation levels around an open radioactive source and MeV energy electron accelerator.	
Unit –VI	**Radioactive Isotopes and Applications:** Naturally occurring radioactive isotopes. Production of radioactive nuclides in nuclear reactors and by charged particle beams from accelerators. Measurement of radioactivity and lifetime of radioactive sources. Radioactive pharmaceuticals and labeled compounds. Radioactive nuclei used in diagnostic applications. Applications of gamma-rays in sterilization of medical instruments, medication items and preservation of food.	08

References

1. Nuclear and Radiation Physics in Medicine. Tony Key. World Scientific.2014
2. Radiation Protection and Health Science. Marilyn E. Noz .World Scientific. 2007.
3. Introduction to radiation Protection. Grupen C. Springer. 2008.
4. Introduction to Radiological Physics and radiation dosimetry. Frank H. Attix. Wiley.1986.
5. Radiation Physics for Medical Physicists. Podgorsak Ervin B. Springer.2005.
6. Techniques for Nuclear and Particle Physics experiments. Leo. W. R. Springer.2005.

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PRACTICAL PAPER - I
TITLE: PHYSICS PRACTICAL - I
PAPER CODE: PHY3511

[CREDITS - 2]

Sr. No	Title and Contents
1.	Viscosity by Rotating Cylinder Method
2.	Study of X-ray diffractogram of any material
3.	Michelson Interferometer
4.	Surface tension by Fergusson Method
5.	Study of Hall Effect
6.	Energy gap of Semiconductor
7.	Four Probe Method
8.	Platinum resistance thermometer

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PRACTICAL PAPER - II
TITLE: PHYSICS PRACTICAL - II
PAPER CODE: PHY3512

[CREDITS - 2]

Sr. No	Title and Contents
1.	Refractive index of liquid using hollow prism
2.	Lloyd's mirror
3.	Thermal conductivity by Forbe's Method
4.	Thermal Conductivity of Rubber tubing
5.	e/m by Thomsons Method
6.	Planck's constant
7.	Self Inductance by Andersons Bridge
8.	Hysteresis Loop Tracer

T.Y. B.Sc. (PHYSICS) SEMESTER - V PHYSICS PRACTICAL PAPER - III TITLE: PHYSICS PRACTICAL - III PAPER CODE: PHY3513 [CREDITS - 2]	
Sr. No	**Title and Contents**
1.	Determination of Wavelength of He - Ne Laser by Reflection Grating
2.	Beam Divergence of a Diode Laser
3.	Magnetic Susceptibility of $FeCl_3$
4.	Specific Heat of Graphite
5.	Adder and Subtractor using OP-AMP
6.	Integrator and Differentiator using OP-AMP
7.	IC555 Astabble Multivibrator
8.	IC723 as a Regulated Power Supply
5.	Factorial of a number, first 100 prime numbers
6.	Use of pointers, arrays and loops.
7.	Ascending / Descending numbers using arrays, Matrix Multiplication
8.	Graphics – line, circle, arc, ellipse, rectangle, concentric circles

Deccan Education Society's

FERGUSSON COLLEGE, PUNE

(AUTONOMOUS)

SYLLABUS FOR THIRD YEAR B. Sc. PHYSICS - Semester VI

Effective from Academic Year 2018-2019

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER – I
TITLE: CLASSICAL ELECTRODYNAMICS
PAPER CODE: PHY3601

[CREDITS - 3]

Learning Objectives:

1. To understand properties of the electrostatic and the magnetostatic field.
2. To understand the methods of calculating the electrostatic potential and the field of a given charge distribution.
3. To understand the Maxwell's equations.
4. To develop the electromagnetic wave equation and study properties of electromagnetic waves

	Title and Contents	No. of Lectures
Unit -I	**A: Electrostatics:** Electric field, Divergence and curl of electrostatic field. Electric Potential. Boundary Conditions Work and energy in electrostatics. **B: Electrostatic fields in matter:** Polarization Electric field of a polarized object The electric displacement	12
Unit -II	**Calculating Potentials** **A. Laplace's equation** Examples: p-n junction, two parallel plates, **B. Method of images** Examples of 1) point charge near an infinite grounded conducting plane. 2) Point charge near grounded conducting sphere	12
Unit –III	**A: Magnetostatics** The Lorentz Force Law The Biot-Savart Law The Divergence and Curl of Magnetic Field Magnetic Vector Potential **B: Magnetostatic Fields in Matter** Magnetization The field of a magnetized object The Auxiliary Field	12
Unit –IV	**Electrodynamics** **A: Maxwell's equations** Faraday's law of induction Generalization of Ampere's law Maxwell's equations (Differential and Integral form) The continuity equation Poynting's theorem **B. Electromagnetic Waves in Vacuum** The wave equation for E and B Monochromatic plane wave	12
References:		

1. Introduction to Electrodynamics, David J Griffiths, 4th edition, Pearson
2. Electricity and magnetism, Reitz, Milford and Christie, Narosa Publishing House
3. Introduction to Electrodynamics, By A. Z. Capri and P. V. Panat, Narosa Publishing House
4. Classical Electrodynamics, J. D. Jackson.
5. Feynman Lecture Series, Volume II

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER – II
TITLE: QUANTUM MECHANICS
PAPER CODE: PHY3602

[CREDITS - 3]

Learning Objectives:
1. To understand and learn Theoretical aspects at Quantum Level.
2. To know more about the insight of the microscopic world.

	Title and Contents	No. of Lectures
Unit -I	**Towards Quantum mechanics** Review of Black body radiation.[Revision and problems] Review of photoelectric effects. [Revision and problems] Matter waves - De Broglie hypothesis. Davisson and Germer experiment. [Revision and problem] Wave particle duality Wave function of a particle having definite momentum. Concept of wave packet, phase velocity, group velocity and relation between them Heisenberg's uncertainty principle with thought experiment. - Electron diffraction experiment, different forms of uncertainty. The Schrodinger equation: Physical interpretation of wave function , Schrodinger time dependent equation. Schrodinger time independent equation.(Steady state equation),Requirements of wave function. Probability current density, equation of continuity, and its physical significance	16
Unit -II	**Operators in Quantum Mechanics** Definition of an operator in Quantum mechanics. - Eigen function and Eigen values. Expectation value – Ehrenfest's theorem Hermitian operator. Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian). Commutator brackets- Simultaneous Eigen functions. Commutator algebra. Commutator brackets using position, momentum and angular momentum operator. Raising and lowering angular momentum operator. Concept of parity, parity operator and its Eigen values.	16
Unit –III	**Applications of Schrodinger Steady state equation** Free particle. Particle in infinitely deep potential well (one - dimension). Particle in three dimension rigid box.	16

	Step potential. Potential barrier. (Qualitative discussion).Barrier penetration and tunnelling effect. Harmonic oscillator (one-dimension) Spherically symmetric potentials: i) Schrodinger's equation in spherical polar co-ordinate system. ii) Rigid rotator (free axis). iii) Hydrogen atom: Qualitative discussion on the radial and angular parts of the bound state energy, energy state functions, Quantum numbers n, l, m_l, m_s–Degeneracy.	

References:

1. Introduction to Quantum Mechanics. - By D. Griffiths Published by Prentice Hall.
2. Quantum Mechanics of Atoms, Molecules, Solids, Nuclei and particles. - By R. Eisberg and R. Resnik Published by Wiley.
3. Concepts of Modern physics. - By A. Beiser Published by Mc. Graw Hill. Chapter 2,3,5,6.
4. Quantum Mechanics. - By Ghatak and Lokanathan Published by Mc. Millan.
5. Quantum Mechanics. - By L. I. Schiff.

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER - III
TITLE: THERMODYNAMICS AND STATISTICAL MECHANICS
PAPER CODE: PHY3603

[CREDITS - 3]

Learning Objectives:

1. To understand various concepts of statistics and to apply them in thermodynamics.
2. To understand the necessity of studying Statistical Mechanics in light of knowledge of Classical and Quantum Mechanics.
3. To understand the behavior of particles under Classical and Quantum conditions.

	Title and Contents	No. of Lectures
Unit -I	**Transport Phenomena and Thermodynamics** Mean free path, Transport Phenomenon, Viscosity, Thermal conductivity, Diffusion. Thermodynamical functions: Internal Energy, Enthalpy, Helmholtz function, Gibb's function, Derivation of Maxwell Relations, First and Second TdS Equations, Specific heat and latent heat Equations.	12
Unit -II	**Basic Concepts of the Theory of Probability** Random events, Probability, Probability and frequency, Probability from an ensemble, Some basic rules of probability theory, Mean value of a discrete variable, Variance: Dispersion, Probability distribution, Binominal distribution, Mean value when the distribution is binominal, Fluctuations, Stirling approximation, Poisson distribution, Mean value and standard deviation in the case of Poisson distribution, Gaussian distribution, Standard deviation in the case of Gaussian distribution, Random walk problem.	12
Unit –III	**Macroscopic states and Microscopic states (Statistical Description of System of Particles)** Macroscopic states, Microscopic states, Phase space, μ-space, Γ- space, Postulate of equal a priori probabilities, Behavior of the density of	12

	states, Thermal interaction, Mechanical interaction, General interaction, Distribution of energy between systems in equilibrium, The approach to thermal equilibrium.	
Unit –IV	**Statistical Ensembles and Quantum Statistics of Ideal gases** Microcanonical ensemble, Canonical ensemble, Mean value and fluctuations. Identical particles and symmetry requirements, Formulation of the statistical problem, The quantum distribution functions, Maxwell-Boltzmann statistics, Bose-Einstein statistics, Fermi-Dirac statistics, The Boltzmann limit of Boson and Fermion gases, Problems.	12

References:

1. Fundamentals of Statistical and Thermal Physics – F. Reif
2. Fundamentals of Statistical Mechanics - B. B. Laud
3. Perspectives of Modern Physics- A. Beiser
4. Statistical and Thermal physics -Lokanathan, R. S. Gambhir,
5. A primer of Statistical Mechanics - R. B. Singh
6. Statistical Mechanics - Gupta, Kumar

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER - IV
TITLE: NUCLEAR PHYSICS
PAPER CODE: PHY3604

[CREDITS - 3]

Learning Objectives:

1. The present Nuclear Physics course is designed to cover all areas of the subject with research and application of nuclear energy.
2. In India, courses on nuclear physics are provided on different levels like bachelor, master, and doctoral.
3. The subject is mainly applied in nuclear power generation and nuclear weapons.
4. A few other applications of the subject are nuclear medicine, magnetic resonance imaging and radiocarbon dating in geology and archaeology which we have tried to incorporate

	Title and Contents	**No. of Lectures**
Unit -I	**Basic Properties of Nucleus** Composition, charge, size, density of nucleus, Nuclear Angular momentum, Nuclear magnetic dipole moment, Electric quadrupole moment, parity and symmetry, Mass defect and Binding energy, packing fraction, classification of nuclei, stability of nuclei (N Vs Z Curve) and problems.	10
Unit -II	**Radioactivity** Radioactivity disintegration (concept of natural and artificial radioactivity, Properties of α, β, γ rays, laws of radioactive decay, half life, mean life, specific activity and its units, successive disintegration and equilibriums and radioisotopes). Application of radioactivity (Agricultural, Medical, Industrial, Archaeological).	10
Unit –III	**Nuclear forces** Meson theory of nuclear forces, Properties of nuclear forces, properties of deuteron system, Elementary particles, Quarks model for elementary particles.	10
Unit –IV	**Particle Accelerator and Detectors** Introduction to particle Accelerators, Linear (electron / proton Linac) Cyclic (Cyclotron)	06

	Classification of Nuclear Detector Gas filled Detectors (G. M. counter) Solid state detectors (NaI scintillation counter)	
Unit –V	**Nuclear Reactions & Nuclear Energy** Introduction to Nuclear reactions, compound nucleus, Q value equation, Exothermic and Endothermic reaction, Threshold energy, Conservation laws, nuclear cross-section. Nuclear fission, chain reaction and critical mass, nuclear reactor and its basic components, homogeneous and heterogeneous reactors, power reactor, fast breeders, nuclear fusion, stellar energy.	12

References:

1. Introduction to Nuclear Physics H. A. Enge (Addition Wesley co.)
2. The Atomic Nucleus R. D. Evans (Tata McGraw Hill co.)
3. Concepts of Nuclear Physics – B. L. Cohen (Tata McGraw Hill co.)
4. Schaum's Outline Series Modern Physics R. Gautrearu (McGraw Hill Co.)
5. Introduction to Nuclear Physics, S. B. Patel Additional References
6. Atomic and Nuclear Physics Shatendra Sharma (PearsonEducation,1st Edition)
7. Nuclear Physics Kaplan (Narosa Publishing House)
8. Introduction to Nuclear Physics Y. R. Waghmare (Oxford IBH.)

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER – V
TITLE: DIGITAL ELECTRONICS
PAPER CODE: PHY3605

[CREDITS - 3]

Learning Objectives :

1. Students should understand design of combinational circuits.
2. Students should learn design and development of sequential circuits.
3. Students should learn various types of data convertors.

	Title and Contents	**No. of Lectures**
Unit -I	**Number systems, Logic Gates, Boolean Algebra and Combinational Circuits :** Binary, Octal and Hexadecimal number systems and inter conversions. Logic gates, Boolean algebra and axioms, De Morgan's Theorems, Karnaugh's maps upto 4 variables for simplification of Boolean expressions. Half, full and parallel adder. Logic families (TTL, ECL & CMOS) TTL NAND Gate, input, output, current sourcing and current sinking characteristics of TTL NAND Gate. Worst case input, output voltages and currents. Noise Margin, Fan –In, Fan-Out, compatibility. Combinational circuit design. Encoders, Decoders, Multiplexers and Demultiplexers.	12
Unit -II	**Sequential Circuits :** R-S, J-K, D and T flip-flops. Master –slave flip-flops. Level triggered and edge trigged flip-flops. Counters (Synchronous and asynchronous). Decoding Gates. MOD – 3, MOD – 5 and Decade Counter, up-down counter. Study of IC 7490. Digital Clock Shift registers. SISO, SIPO, PISO and PIPO operations of shift registers. Shift left, shift right registers. Ring Counter. Study of IC	12

	7495.	
Unit –III	**Data Converters :** Introduction to Analog and Digital Systems. Digital to Analog Converters – Weighted resistor method, Binary Ladder method, 4 – bit D/A converter. D/A accuracy and resolution. Analog to Digital Converters – Simultaneous conversion, counter method, continuous conversion, successive approximation method, single slope and dual slope techniques for A/D conversion. Accuracy and resolution of A/D converters.	12
Unit –IV	**Semiconductor Memories :** Use of simple switch, a capacitor and a flip-flop as a memory element. Study of diode matrix as a ROM. Study of PROM, EPROM and EEPROM. RAMs, Static and Dynamic RAMs. Memory cells, organization and addressing of memory cells. Study of ICs 2114, IC 21256 and IC 2716.	12

References:

1. Digital Principles and Applications – Leach, Malvino, Saha - Mc Graw Hill
2. Digital Integrated Electronics – Taub, Schilling – Mc Graw Hill

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER – V
TITLE: COMPUTATIONAL PHYSICS
PAPER CODE: PHY3606

[CREDITS - 3]

Learning Objectives:

1. To aid the students with basic methods of computational physics.
2. To make students familiar with dynamical behaviour of classical, quantum and some ecological systems.
3. To make students ready to handle such problems on their own.

	Title and Contents	**No. of Lectures**
Unit - I	**Algorithms and Computational Errors:** What is an algorithm, properties of algorithms, repetitions and decision statements, efficiency of algorithms. Writing algorithms for simple programs like ascending and descending ordering, factorization, etc. **Errors:** Estimating errors, random and systematic errors, relative errors, floating point errors, general formula for errors, error propagation, and least square method.	12
Unit -II	**Simple Numerical Techniques:** **Eigen value problems:** Algorithms for solving the systems of linear equations (Gauss, Jordanian, LU decomposition). **Root finding algorithms:** Newton Raphson's, secant, bisectionetc. and discussion about their convergence (efficiency of algorithms). Interpolation**:** Lagrange polynomial **Numerical derivatives:** Forward, backward and central difference methods. **Modelling the data:** Least square fit for functions.	12
Unit - III	**Ordinary Differential Equations:** Euler's method, Runge-Kutta method ($2^{nd}$and 4^{th}order) finite difference method, boundary value problems. Trapezoidal and Simpson's method of	12

	integration. **Examples:** **Free fall and Projectile Motion:** Ideal as well as real case (velocity dependent friction). **Two body problem:** studying orbits for different sets of parameters (masses), verifying Kepler's laws etc. **Motion of electron in external electromagnetic field:** Studying the shape of trajectory for different initial conditions and parameters. **Oscillations:** Simple harmonic oscillator, simple pendulum, ideal and real cases (damping forces), studying phase trajectories for all cases. **Quantum Mechanical systems:** Potential wells and barriers, solving Schrödinger's equation using shooting methods (eg. Numerov strategy) and variational methods.	
Unit - IV	**Random Deterministic systems and Chaotic Systems:** **Random Processes:** Using random number generators to simulate 1-D / 2-D / 3-D random walk, verifying the simulation results using theory. Simulating chaotic systems like Logistic and Tent Maps (Bifurcation and period doubling, Lyapunov Stability etc.), Strange Attractors (Lorenz System, Sierpinski gasket etc.)	12

References:

1. Computational Physics, by N. J. Giordano and Hisao Nakanishi (Pearson Education India)
2. Numerical methods for scientists and engineers, by H. M. Antia (Hindustan Book Agency)
3. Computer Oriented Numerical Methods, by V. Rajaraman (PHI Learning Publications)

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - VI
TITLE: ASTRONOMY AND ASTROPHYSICS
PAPER CODE: PHY3607

[CREDITS - 3]

Learning Objectives:

1. It is noted that many physics students in our colleges get trained for a professional career in physics without a proper basic knowledge of Astronomy & Astrophysics which today is the most active research areas of modern physics.
2. This subject has grown tremendously in the past few decades and is hence necessary to incorporate it at the undergraduate level.
3. The syllabus has been designed as an introduction to the subject and covers almost all major areas of Astronomy and Astrophysics to develop, liking and inquisitiveness in the subject.

	Title and Contents	No. of Lectures
Unit - I	**Fundamentals of Astronomy:** Introduction: Components of the Universe; Stars, Planets, Asteroids, Meteors, Comets, Galaxies. Solar System: Age, Origin Basic measurements: Planetary orbits, distances, physical size, mass, density, temperature, rotation period determination, Kepler's laws, EM Spectrum: radiation from heated objects', Wien's law, radiation curves, Doppler effect.	12
Unit - II	**Star and Star Systems:** **Sun a typical star:** Sun: Interior, Atmosphere, Radiative transfer, convection zone, Solar Cycle, Solar Activity, Butterfly diagram, Photosphoric phenomenon. **Stars life cycle:** Stellar processes (Nuclear). Neutron stars, black	12

	holes, Chandrasekhar limit. Spectral classification of stars, O, B, A, F, G, K, M. Star Systems: Binaries / Cepheids / RR Lyrae HR diagram: Significance Stars as distance estimators.	
Unit - III	**Galaxies, Dark Matter and Dark Energy :** Galaxies, types, their formation, Quasars. Open and Globular clusters Dark Matter / Energy Cosmology: BBT, Steady State, Oscillating Universe Theory Hubble's law with equation, it's significance Concept of space time, fate of our universe Multiverse (only introduction)	10
Unit - IV	**Observational Astronomy & Astronomical instruments:** Co-ordinate system, Celestial hemisphere, Concept of time, Magnitudes: apparent and absolute, constellations. Star dial, Observation of Sun, Eclipses, Moon, planets, meteor showers, transits, occultation's. Optical telescopes, mounts, light gathering power, magnification, and resolution. Spectroscopes, CCD camera, photometer, filters Radio telescopes, interferometry UV, IR, X-ray and Gamma ray telescopes. Orbiting space based telescopes: HST, Chandra.	14

References:

1. The physical universe, An Introduction to astronomy, Frank H. Shu, Uni. Sci. Books
2. Astronomy and Astrophysics, A. B. Bhattacharya, S. Joardar, R. Bhattacharya, Overseas Press.
3. Astronomy structure of the Universe. A. E. Roy and D. Clarke, Adam Hilger Publication.
4. Astrophysics for physicists, Arnab Rai Choudhari, Cambridge University Press.
5. Source Book of Space Sciences, Samuel Galsstone; D. VanNostrand Co. Inc.
6. Astrophysics - Stars and Galaxies, K. D. Abhyankar, Tata McGraw Hill Pub.
7. Textbook of Astronomy and Astrophysics with elements of cosmology, V. B. Bhatia, Narosa.
8. Structure of the Universe, J. V. Naralikar

T.Y. B.Sc. (PHYSICS) SEMESTER - V
PHYSICS PAPER - VI (Elective – V)
TITLE: RENEWABLE ENERGY SOURCES
PAPER CODE: PHY3608

[CREDITS - 3]

Learning Objectives:

1. Developing the human recourse in Renewable Energy sector is the present need of the country.
2. This course will provide physics students with an introduction to energy systems and renewable energy resources.
3. This paper will explore society's present needs and future energy demands, it will examine conventional energy sources and systems.
4. Further, it will help create self-employment, promote research and help develop the skills required in the energy sector.

	Title and Contents	**No. of Lectures**
Unit - I	**An Introduction to Energy Sources:** Conventional and non-conventional sources of energy, Structure and	10

	characteristics of sun, Solar Constant, Electromagnetic energy spectrum, Solar radiations outside earth atmosphere, Solar radiation at the earth surface, problems.	
Unit - II	**Photothermal Applications:** Liquid flat plate collector, construction and working, Energy balance equation (without thermal analysis), Concentrating collectors, Advantage and disadvantage, Solar distillation, Solar drying, Solar cooker(box type), Solar water heating systems.	10
Unit - III	**Photovoltaic systems:** Introduction, Photovoltaic principle, Power output and conversion efficiency, Limitation to photovoltaic efficiency, Basic photovoltaic system for power Generation, Advantages and disadvantages, Types of solar cells, Application of solar photovoltaic systems.	10
Unit - IV	**Energy from Biomass:** Introduction, Bio-mass conversion technologies, Bio-gas generation Factors affecting bio-digestion (list of factors), Working of biogas plant, Advantages and disadvantage of floating and fixed dome type plant, Bio-gas from plant wastes, Methods for obtaining energy from biomass, Thermal gasification of biomass, Working of downdraft gasifier, Advantages and disadvantages of biological conversion of solar energy	12
Unit - V	**Wind Energy:** Introduction, Classification and description of wind machines, Wind data	06

References:

1. Non conventional Energy sources- G. D. RAI (4th edition), Khanna Publishers, Delhi
2. Solar Energy - S. P. Sukhatme (Second Edition), Tata Mc Graw Hill Ltd., New Delhi.
3. Solar Energy Utilisation - G. D. RAI (5th edition), Khanna Publishers, Delhi.

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PAPER - VI
TITLE: BIOPHYSICS
PAPER CODE: PHY3609

[CREDITS - 3]

Learning Objectives:

1. Many prestigious institutions in India and abroad offer Bachelors and Masters level courses in Biophysics. However, only few universities offer Biophysics courses in undergraduate level in India.
2. This course is intended to be an introduction to biophysics with an interdisciplinary approach.
3. This is the first biophysics course taught by the Physics department hence participation of third year B.Sc. students from other departments is also encouraged.
4. The course will cover a wide range of topics, in Physics, biology and Chemistry and will apply physical principles and techniques to different problems in biology.

	Title and Contents	**No. of Lectures**
Unit -I	**Introduction of Biophysics** Definition and History of Biophysics [Physical properties applied to biology- Surface tension, Viscosity, adsorption, diffusion, osmosis, dialysis and colloids] Cell: Animal and plant cell, types of cell and composition, Functional	14

	aspects of cell membrane, cytoplasm, nucleus, mitochondria, chloroplast (Bioenergetics of mitochondria and chloroplast) Protein structure (Primary, Secondary, Tertiary and Quaternary structure): Amino-acids structure (Specify types), Bond length, Bond angles, peptides, and Bond-Rigid planer peptides. Cis and trans configuration, torsion angle, Ramchandran plot. Photosynthesis process:- electron transport, Gibbs's free energy, Redox couple. [Redox potential, Oxidation and reduction, Examples of redox potential in biological system.] Genetic code- symmetry, DNA structure	
Unit -II	**Biopotentials** Bioelectric signals: structure of neuron, resting potential, action Potential, Nernst equation Biopotential amplifier: input impedance, frequency characteristics, gain, CMRR, Calibration, Noise, Temperature sensitive stability. Compaind action potentials of the human body ECG, EEG, ERG, EOG (in brief) Transducers: Definition, types- resistive, capacitive and inductive transducers, LVDT, photo diode Bioelectrodes- Half cell potential, polarizable and non-polarizable electrodes, metal and glass electrodes, types and electric characteristics	14
Unit –III	**Bio – Instruments** Basic principle, Construction and working of colorimeters, spectrophotometer, ECG machine, PH meter, Centrifuge measurement. Electron microscope: SEM, TEM.	08
Unit –IV	**Radiation Biophysics** Definition, Units of Radioactivity and radiation doses, X-Ray Crystallography as a method for a structure determination of biomolecules NMR. Nuclear detector (G M Counter), radioimmunoassays (in brief)	06
Unit –IV	**New Fields** Biostatistics and Biometry, Definition and concept in brief Mathematical modelling and Computational biology (Concept only)	06

Reference Books:

1. Introduction to Biophysics - by P. Narayanan. New Age P.
2. Medical Instrumentation - by Khandpur, TMH
3. Laboratory Manuals of Biophysics Instruments - by P. B. Vidyasagar
4. Biophysics -by Vatsala Piramal, Dominant Publisher and Distributors, New Delhi-110002
5. Textbook of Biophysics - by R. N. Roy
6. Photosynthesis - by Hall and Rao.

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PRACTICAL PAPER - IV
TITLE: PHYSICS PRACTICAL - IV
PAPER CODE: PHY3611

[CREDITS - 2]

Sr. No.	Title and Contents
	For All Students
1.	Determination of Solar Constant
2.	Determination of Temperature of the Sun
3.	Determination of Calorific Value of given wood and Efficiency of domestic water heater (Bumb)
4.	Solar cell and solar cooker
	For Students of Electronics
5.	Study of R – S and J – K Flip Flops
6.	Study of Shift Register using IC7495
7.	Study of Decade Counter using IC7490
8.	Study of 4 – Bit DAC using R – 2R ladder network and study of 8 – Bit ADC using IC0809
	For Students of Computational Method
5.	Roots of Polynomial using Newton Raphson's / Bisection / Bessel Function Method
6.	Roots of Legendre's Polynomial / Gauss Elimination Method / Lagnrangian Interpolation
7.	Integration of a Function by Simpson's 1/3 rule and trapezoidal Method
8.	Plotting of Trajectory of a projectile and a particle performing linear S. H. M.

T.Y. B.Sc. (PHYSICS) SEMESTER - VI
PHYSICS PRACTICAL PAPER - V
TITLE: PHYSICS PRACTICAL - V
PAPER CODE: PHY3612

[CREDITS - 2]

Sr. No.	Title and Contents
1.	G. M. Tube characteristics
2.	Mechanical equivalent of heat
3.	'Y' by Koenig's Method
4.	Optical fibre – loss and numerical aperture (NA) measurement
5.	Stefan's constant
6.	Frequency response of loudspeaker

7.	Constant Deviation Spectrometer
8.	Displacement measurement by LVDT

T.Y. B.Sc. (PHYSICS) SEMESTER – VI
PHYSICS PRACTICAL PAPER - VI
TITLE: PHYSICS PRACTICAL (PROJECT)
PAPER CODE: PHY3613

[CREDITS - 2]

Title and Contents

Project