Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College" Affiliated to
KBC North Maharashtra University, Jalgaon

KNOWLEDGE IS POWER

ESTD. 1945

SYLLABUS

Physics

T.Y.B. Sc.

(Semester V & VI)

MOOLJI JAITHA COLLEGE, JALGAON · DEPT. OF PHYSICS · AUTONOMOUS

Under Choice Based Credit System (CBCS)

[w. e. f. Academic Year: 2021-22]

HEAD
Department of Physics
Moolji Jaitha College, Jalgaon
(Autonomous)

T.Y.B.Sc. Physics (CBCS pattern)

Program Specific Outcomes (PSO):

- Students are expected to acquire core knowledge in physics, including the major areas of classical mechanics, quantum mechanics, nuclear physics, atomic and molecular physics, solid state physics, electrodynamics, laser physics, material science, electronics and computational physics.
- Students will show that they have learned laboratory skills enabling them to take measurements in a physics laboratory and analyze the measurements to draw valid conclusion.
- Student will be able to develop research oriented skills.
- Students will be capable of oral and written scientific communication and will prove that they can think critically and work independently.

Learning Objectives:

- To acquaint the students with various disciplines of Physics.
- To articulate foundation and pillar level knowledge of Physics for the beneficiaries to apply them for advanced studies in the subject.
- To develop laboratory skills with a sound theoretical background.
- To apply the knowledge gained for higher education, research and profession of their choice.
- To analyse their interests among the various disciplines and implement them in their professional endeavours.

Exam Pattern:

- Each theory and practical course will be of 50 marks comprising of 10 marks internal and 40 marks external examination.

External Theory Examination (40 marks):

- External examination will be of two hours duration for each theory course. There shall be 4 questions each carrying equal marks (10 marks each) while the tentative pattern of question papers shall be as follows;
    - Q1 (A), Q2 (A) and Q3 (A), each will be of 6 marks (attempt any 2 out of 3 sub-questions).
    - Q1 (B), Q2 (B) and Q3 (B), each will be of 4 marks (attempt any 1 out of 2 sub-questions).
    - Q4 will be of 10 marks (attempt any 2 out of 3 sub-questions).

External Practical Examination (40 marks):

- Practical examination shall be conducted by the respective department at the end of the semester. Practical examination will be of minimum 3 hours duration and shall be conducted as per schedule. There shall be 05 marks for journal, 10 marks for *viva-voce*. Certified journal is compulsory to appear for practical examination.

Internal Theory/ Practical Examination (10 marks):

- Internal theory assessment of the student by respective teacher will be comprehensive and continuous, based on written test/ assignment. The written test may comprise of both objective and subjective type questions.
- Internal practical examination should be conducted by respective department as per schedule given. For internal practical examination student should perform at least one experiment and should have completed journal.

Structure of T.Y.B.Sc. (Physics) Curriculum Semester V

Discipline	Course Type	Course Code	Course Title	Credits	Hours/ Week (Clock Hours)	Total Teaching hours	Marks	
							Int	Ext
DSC	Core I	PHY-351	Mathematical Methods For Physics	3	3	45	10	40
	Core II	PHY-352	Solid state physics	3	3	45	10	40
	Core III	PHY-353	Classical Mechanics	3	3	45	10	40
	Core IV	PHY-354	Advanced Electronics	3	3	45	10	40
	Core V	PHY-355	Elements of Material Science	3	3	45	10	40
	Core VI	PHY-356 (A) / PHY-356 (B)	Laser Physics / Medical Physics	3	3	45	10	40
SEC	Skill Based	PHY-350	Technical Electronics	2	2	30	10	40
DSC	Core (Practical)	PHY-357	Laboratory - I	2	4 / batch	60	10	40
		PHY-358	Laboratory - II	2	4 / batch	60	10	40
		PHY-359	Project – I	2	4 / batch	60	10	40

Structure of T.Y.B.Sc. (Physics) Curriculum Semester VI

Discipline	Course Type	Course Code	Course Title	Credits	Hours/ Week (Clock Hours)	Total Teaching hours	Marks	
							Int	Ext
DSC	Core I	PHY-361	Classical Electrodynamics	3	3	45	10	40
	Core II	PHY-362	Quantum Mechanics	3	3	45	10	40
	Core III	PHY-363	Atomic and Molecular Physics	3	3	45	10	40
	Core IV	PHY-364	Nuclear and Particle Physics	3	3	45	10	40
	Core V	PHY-365	Physics of Devices and Communication	3	3	45	10	40
	Core VI	PHY-366 (A)/ PHY-366 (B)	Computational Physics Using C Language / LabVIEW Programming	3	3	45	10	40
SEC	Skill Based	PHY-360	Renewable Energy and Energy harvesting	2	2	30	10	40
DSC	Core (Practical)	PHY-367	Laboratory - I	2	4 / batch	60	10	40
		PHY-368	Laboratory - II	2	4 / batch	60	10	40
		PHY-369	Project – II	2	4 / batch	60	10	40

DSC: Discipline Specific Core Courses/Core Practical; **SEC:** Skill Enhancement Course;
Int : Internal examination; **Ext :** External examination

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-351: Mathematical Methods for Physics

Total Hours: 45 **Credits: 3**

Course objectives:

- To impart knowledge of basic concepts in Mathematical physics.
- To provide the knowledge and methodology necessary for solving problems in Physics.
- To study the direct relevance in other core subjects of physics.

Course outcomes:

After successful completion of this course, students are able to:

- Apply the concept and knowledge of Mathematical physics to understand and solve real life problems.
- Understand the concept of vector integration, gradients, divergence and curl of vector for solving mechanics and electrodynamics problems.
- Understand the concept of special functions for solving a problems based on quantum mechanics.
- Understand the concept of special theory of relativity for solving the problem based on Newtonian Mechanics.

Unit-I: Vector Integration and Orthogonal Curvilinear co-ordinates (15 h)

Ordinary Integral of Vectors. Line, Surface and Volume Integrals. Flux of a Vector Field. Gauss' Divergence Theorem, Green's Theorem and Stokes Theorem. Introduction to Cartesian, Spherical polar and cylindrical co-ordinate systems, transformation equations, General Curvilinear co-ordinate system:, divergence, Laplacian and Curl, special case for gradient, divergence, Laplacian and Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system, metric coefficient.

Unit-II: Differential equations and Special functions (10 h)

Frequently occurring partial differential equations, degree, order, linearity and homogeneity (revision), Method of separation of variables, Singular points, Fuch's theorem (Statement only), Frobenius method for power series solution of Legendre, Hermite and Bessel differential equation. Generating function for Legendre, Hermite Polynomials, Recurrence relations, their differential equations and orthogonality properties. Bessel function of first kind and their properties.

Unit-III: The Special Theory of Relativity (10 h)

Introduction, Newtonian relativity Galilean transformation equation, Michelson-Morley experiment, Postulates of special relativity, Lorentz transformations, Kinematic effects of Lorentz transformation, Length contraction, Proper time, Transformation of velocities, Variation of mass with velocity, Mass-energy relation.

Unit-IV: Complex Analysis (10 h)

Complex numbers and their graphical representation, Argand diagram, Conjugate of a complex number, Basic mathematical operations with complex numbers, Euler's formula, De-Moivre's theorem, Roots of complex numbers, Functions of complex variables, Analyticity and Cauchy - Riemann conditions, Singular functions, Examples, Cauchy's Integral formula.

References:

- Arfken G. B., Weber H. J, Harris F. E. (2013), Mathematical Methods for Physicists, 7th edition, USA
- Boas M. L., (2006), Mathematical methods in the physical sciences, 3rd edition, John Willy and Sons publication, De Paul University.
- Narlikar J. V., (2010), An Introduction to Relativity, 1st edition, Cambridge university press.
- Gupta B. D., (2010), Mathematical physics, 4th Edition, Vis Publishing House Pvt. Ltd., New Delhi.
- Dass H. K., (2014) Mathematical Physics, 7th Revised edition, S. Chand and Company Pvt. Ltd, New Delhi.

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-352: Solid State Physics

Total Hours: 45 **Credits: 3**

Course objectives:

- To impart knowledge of basic concepts in Solid state Physics.
- To provide the knowledge and methodology necessary for calculations of particle size & crystallite size of any solid.
- To create general awareness regarding the structure and application of solid crystal.

Course outcomes:

After successful completion of this course, students are able to:

- Apply the concept and use of knowledge of solid state physics to understand and solve the real life problems.
- Understand arrangements of atoms, Crystal, Lattice, Unit cell, Translation vectors.
- Comprehend free electrons, cohesive energy and band theory of solids.

Unit I: The Crystalline state: (12 h)

Classification of solids, Lattice, Basis & crystal structure, translational vector, Unit cell, Primitive unit cell, symmetry operations, Fundamental types of lattices (2D & 3D), Index system for crystalline planes, Miller indices, Identifying the direction in the crystal, Interplaner distances ,Number of atoms per unit cell, Co- ordination number, atomic radius and packing fraction for SC, BCC and FCC structures, Study of CsCl, NaCl and ZnS structures, Concept of reciprocal lattice and its properties with proofs.

Unit II: X-Rays Diffraction by crystals: (08 h)

Crystal as a grating for X-rays, Bragg's diffraction condition in direct lattice and reciprocal lattice, Ewald's construction, X-ray diffraction methods Laue method, Rotating crystal method and Powder method, Analysis of cubic crystal by powder method, Brillouin zones (1D & 2D).

Unit III: Cohesive energy and Bonding in solids (09 h)

Cohesive energy and formation of molecules, Definition of dissociation energy of molecule, Types of bonding Ionic bond, Covalent bond, Molecular bond, Metallic bond and Hydrogen bond Madelung energy, Madelung constant for one dimensional ionic crystal.

Unit IV: Lattice vibrations, Free electron and Band theory of solids (10h)

Lattice heat capacity, Classical theory of specific heat, Einstein's model, Vibrational modes in one dimension monoatomic lattice, Debye's model Limitations of Debye model. Drude-Lorentz model, Sommerfield's Free electron gas in 1-D and 3-D, Fermi level and fermi energy, Density of states, Formation of Energy band, Distinction between metals, Semiconductors and Insulators Hall Effect, Hall voltage, Hall co-efficient and mobility.

References:

- Kittle C., (2019), Kittel's Introduction to Solid State Physis, Willey India Edition
- Dekkar A.J., (2008), Solid State Physics, Pan Macmillan.

- Pillai S.O., (2018), Solid State Physics, 9th Edition, New Age International Publishers.
- Gupta S.L., Kumar V., (2018), Solid State Physics, K. Nath & CO. Meerut.
- Hemraja C., Kakani S.L., (2005) Solid State Physics: Theory, Applications & Problems 4th Edition, Sultan Chand & Sons.
- Kachhava C.M., (2003), Solid State Physics, Solid State Devices & Solid State Electronics, New Age International Publishers.
- Singhal R.L., Alvi P.A, (2011), Solid State Physics: KNRN Publisher.
- Saxena B.S., Gupta R.C., Saxena P.N., (2020), Fundamentals of Solid State Physics, Pragati Prakashan, Meerut
- MandalJ.N., (2016), Concepts of Solid State Physics, Pragati Prakashan, Meerut.
- Puri R.K., Babbar V.K., (2010), Solid State Physics, S. Chand & CO. Ltd.

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-353: Classical Mechanics

Total Hours: 45 **Credits: 3**

Course Objective:

- To understand the concepts of Newtonian approach and necessity of new approaches to solve advanced problems.
- To understand the concept of the forces, angular momentum central forces, scattering phenomena and knowledge about the constraint.
- To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulations of classical mechanics.

Course Outcomes:

After successful completion of this course, students are able to:

- Demonstration of conceptual understanding of basic principles and other advanced mathematical problems like i) complicated oscillatory systems, ii) the motion of rigid bodies iii) mechanics of continuous media of classical mechanics.
- Understand the motion of a mechanical system using Lagrangian Hamilton formalism.
- Apply advanced mathematical and numerical techniques used in all modern physics to solve the problem.

Unit-I: Introduction to Classical Mechanics **(11 h)**

Introduction of classical mechanics, Newton's laws of motion, Applications of Newton's laws of motion, Limitations of Newton's law, Types of forces: Force of gravitation, Lorentz force, Hooks force, Frictional force, Fundamental forces of nature, Projectile motion in various medium, Rocket motion. Motion of a charged particle in constant electric, magnetic and electromagnetic field.

Unit-II: Motion in Central Force Field **(11 h)**

Concept of central force, Properties of central force, Reduction of two body problem into Equivalent one body problem, Motion in central force field, General features of motion, Equation of an orbit, Orbits of artificial satellites, Kepler's laws of planetary motion and their application.

Unit-III: Scattering of particles **(11 h)**

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.

Unit-IV: Lagrangian& Hamiltonian Formulation **(12 h)**

Types of constraints, degrees of freedom, Concept of virtual displacement and virtual work, D'Alemberts principle, Properties of Lagrange's equation, Applications of Lagrange's equation (simple pendulum, compound pendulum and Atwood's machine) Cyclic coordinates, Hamiltonian equations, Physical significance of Hamiltonian, Applications of Hamilton's equation (simple pendulum and compound pendulum).

References:

- Takawale R. G, Puranik P. S. (2017), Introduction to Classical Mechanics, 1st edition, TMH Publications Ltd.
- Rana. N. C., Joag. P. S, (2015), Classical Mechanics, TMH Publications Ltd.
- Synge. J. L., Griffith. B. A., (1959), Principles of mechanics, 3rd edition, TMH Publications Ltd.
- Herbert G., Charles P., John S., (2001) Classical Mechanics, 3rd edition, Pearson.
- Upadhyaya J. C., (1999), Classical Mechanics, 3rd edition, Himalaya Publishing House.
- Panat P. V., (2013) Classical Mechanics, Narosa Publishing House, New Delhi.
- Gupta, Kumar, Sharma, (2012), Classical Mechanics, 26th edition, Pragati Publication.

Methods of Teaching:

- Classroom teaching, Lecture method, ICT enabled teaching.

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-354: Advanced Electronics

Total Hours: 45 **Credits: 3**

Course objectives:

- To understand the basic concepts of analog and digital electronics
- To learn operational amplifier & oscillator circuits in detail.
- To acquire the basic knowledge of counters & data processing circuits used in digital electronics.
- To learn timer IC 555 & its applications.

Course outcomes:

After successful completion of this course, students are able to:

- Understand and analyze the IC 741 operational amplifier and its characteristics.
- Design the solution for linear & non-linear applications using IC741.
- Design & built oscillator for various applications.
- Use counters multiplexer, demultiplexer , encoder ,decoder in various applications

Unit-I: Differential Amplifier **(05 h)**

Introduction, black box concept, basic circuit of differential amplifier, Need of constant current source in differential amplifier, different configurations of differential amplifier, CMRR.

Unit-II: Operational Amplifier and its applications **(15 h)**

Block diagram, Schematic symbol and Pin diagram of IC 741, Important parameters of OPAMP such as Input impedance, output impedance, input offset voltage, open loop voltage gain, input bias current, slew rate. Ideal and practical parameters of Op-Amp, Concept of virtual ground, inverting and non-inverting amplifier with gain expressions, off-set null, frequency response of operational amplifier, Applications: Adder, Substracter, Integrator, Differentiator, Comparator, logarithmic amplifier, schmitt trigger, precision rectifier

Unit-III: Oscillator **(12 h)**

Principle of feedback oscillators, Tuned collector oscillator, Colpitt's oscillator, Hartley oscillator, Phase shift oscillator, Wien bridge oscillator, Crystal oscillator, frequency stability, Astable & bistable multivibrator using transistors.

Unit-IV: Digital Electronics **(13 h)**

a) **Counters:** Types of counters (Asynchronous and Synchronous), 4-bit Asynchronous up counter (Serial counter), 3-bit Up-down counter, modulus of counter, mod-3 counter, mod-5 counter.
b) **Data Processing circuits:**
Multiplexer (4 to 1 line), De-multiplexer (1 to 4 line), Decoder, Encoder.
c) **Timer:** - Functional block diagram of IC-555 (Timer), Astable, Monostable and Bistable multivibrator using IC 555

References:

- Malvino A. P., (2007), Electronic Principles, 7thedition, Tata McGraw - Hill, New Delhi.
- Mottershead A., (1973), Electronic Devices & Circuits: An Introduction, Goodyear Publishing Company,
- Malvino L., (2006), Digital Principles and Applications, 6thedition, Tata McGraw – Hill, New Delhi
- Jain R.P., (2009), Modern Digital Electronics, 4thedition, McGraw Hill Education
- Clayton B.G., (1979), Operational Amplifier, 2ndedition, Butterworth-Heinemann, Elsevier.
- Gaikwad R.A., (1983), Operational Amplifier & Linear Integrated Circuits, 4th edition, Pearson.

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-355: Elements of Material Science

Total Hours: 45 **Credits: 3**

Course objectives:

- To impart knowledge of basic concepts in Material Science.
- To provide the knowledge and methodology necessary to study different materials and their properties.
- To understand different materials and their performance under different physical and chemical behavior for various applications.

Course outcomes:

After successful completion of this course, students are able to:

- Apply the concept of use of knowledge of Material Science to real life problems.
- Understanding of the course will create scientific temperament.

Unit-I: Introduction to material science **(12 h)**

Introduction to structure and properties of materials, Bonding, variation in bonding Different crystalline types in solid, Defects in solid-Point defects, Line defects, Surface defects, Volume defects, Atomic Diffusion, Definition, Mechanism, Fick's Laws

Properties of materials: Dielectric and electrical properties, Thermal properties, Optical properties, Mechanical and Magnetic properties, Single phases in metals: Single phase alloys, Deformation, Elastic Deformation and Plastic Deformation, Mechanism of plastic Deformation by slip, Critical resolved shear stress (CRSS), Plastic deformation in polycrystalline materials.

Unit-II: Phase diagrams **(09 h)**

Some Basic terms: (System, Surrounding, Component, Coordinates, Phase, Equilibrium.) Phase Diagram Definition, Importance and objective, Gibb's phase rule, Lever rule. Phase diagram: a) Sugar water b)NaCl water. Types of phase diagrams with construction, One component Phase Diagram (Temperature Pressure Curve), Binary Phase Diagram: Type I-Isomorphous Phase Diagram (Cu Ni phase diagram), Type II-Euctetic Phase Diagram (Cu-Ag Phase diagram), Type III-Eutectoid and Peritectic Reaction

Unit-III: Ceramic and Organic Polymer **(10 h)**

Ceramics and composite materials: Ceramic crystal structures, Atomic defects (intrinsic and extrinsic point defects), Electrical properties: Ferroelectrics, Thermistors, Electrical conductors, Dielectrics, Magnetic properties, Ferromagnetic materials, Dielectrics, ferroelectrics and magneto ceramics material, Giant magneto resistance, Tunneling magneto resistance, Colossal magneto resistance, Super paramagnetism High Tc materials, YBCO and Bi-systems (Brief idea), Superconducting nano-materials , Properties of superconducting material, Applications of superconducting material. Organic Polymer: Polymers, Polymerization, Molecular weight of polymers, Mechanics of polymerization, Addition polymerization, Condensation polymerization, Structure of polymer, Linear polymers , Cross linked polymer, Vulcanization of rubber.

Unit-IV: Nanotechonology and Nanomaterials **(14 h)**

A) **Introduction to Nanotechnology:** Physics of low-dimensional materials, Quantum effects (1D, 2D and 3D confinement), Size control of metal nanoparticles, Nanostructures for molecular recognition, Quantum dots, nanorods, nanotubes, Properties of Nanomaterial , Optical properties, Electronic (surface plasmon resonance, change of bandgap), Magnetic properties,

B) **Advantages of nanomaterial and its application:** Electronic devices, Sensors, Actuators, Optical switches, bio-MEMS diodes, Nano-wire transistors., Quantum optical devices, Data memory lighting and displays, filters (IR blocking)), Nano electromechanical systems, Batteries, fuel cells, photo-voltaic cells, electric double layer capacitors, Lead-free solder, nano particle coatings for electrical products, Nanocatalyts, Smart materials, Heterogenous nanostructures and composites

C) **Nanomaterial for drug deliveries:** Drug delivery system, Nanoparticle in drug deliveryavailable applications, Nanotechnology future application understanding for treatment, Manufacture of nanoparticles, nanopowder and nanocrystals, targeting ligands, Applications of nanoparticle (drug delivery, cancer treatment, tissue regeneration, growth and repair, impact of drug discovery and development).

References:

- Callister W.D., Rethwisch D.G., (2009), Materials Science & Engineering: An Introduction, 8th Edition, John Wiley & Sons, Inc.
- Kingery W.D., Bowen H.K., Uhlhmen D.R., (1976) 'Introduction to Ceramics', 2nd Edition, John Wiley.
- Kakani S.L., Kakani A., (2006) Material Science, New Age International Publishers.
- Gowariker V.R., Viswanathan N.V., Sreedhar J. (2021), Polymer science, New age international Publishers
- Poole C.P., Ownes F.J., (2003), Introduction to Nanotechnology, John Wiley Sons, Inc.
- Pillai V.K., Parthasarathi M,, (2013), Functional Materials: A Chemist's Perspective by Orient Blackswan, Published by Universities Press (India) Pvt. Ltd.
- Kulkarni S.K., (2015) Nanotechnology: Principles and Practices: Third Edition, Springer.
- Kreith F., (2002), The MEMS Handbook, CRC press.
- Cao G., (2004), Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Imperial College Press
- Fahrner W.R, (2005), Nanotechnology and Nanoelectronics, Springer

Methods of Teaching:

- Classroom teaching, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-356 (A): Laser Physics

Total Hours: 45 **Credits: 3**

Course objectives:

- To learn the fundamental concepts and characteristics of Laser.
- To develop experimental knowledge of various types of atomic/molecular spectra.
- To learn the basic techniques of experimental spectroscopy.

Course outcomes:

After successful completion of this course, students are able to:

- Know the theoretical and experimental background of atomic and molecular spectra.
- Understand various types of Lasers, their working and applications.
- Understand basic components of spectroscopic instruments and their functions.
- Know about measurements of atomic/molecular spectra using spectrometers.

Unit-I: Introduction to Lasers **(11 h)**

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.

Unit-II: Laser Action **(10 h)**

Condition for large stimulated emission, Population inversion Condition for light amplification, Gain coefficient Active medium, Metastable states Pumping schemes: three level and four level. Characteristics of laser.

Unit-III: Types of laser **(12 h)**

Ammonia maser, Nitrogen laser, Excimer laser, Dye laser, Ruby laser, Nd-YAG laser, Diode – pumped solid state lasers, Semiconductor lasers, High power laser systems.

Unit-IV: Application of laser **(12 h)**

Ultra high resolution spectroscopy with lasers and its applications, Propagation of light in a medium with variable refractive index, Optical fibers, Light wave communication, Qualitative treatment of medical and engineering applications of lasers, Material processing.

References:

1. Avdahanulu M. N., (2001), An Introduction to Lasers: Theory and Applications, S. Chand Publishing.
2. Koichi S., (2020), Introduction to laser physics, 2nd edition, Springer Series in Optical Sciences, Volume 44.
3. Lengyl B. A., (1966), Introduction to laser physics, John Wiley and Sons, Inc,.
4. Letokhov V. S., Chebotayev V. P., (1977), Nonlinear laser spectroscopy, Springer Series in Optical Sciences.
5. William T. S., (2004), Laser physics, Cambridge University Press.

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-356 (B): Medical Physics

Total Hours: 45 **Credits: 3**

Course objectives:

- To develop a broad and fundamental understanding of Physics while developing particular expertise in medical applications.
- To impart functional knowledge regarding need for radiological protection and the sources of an approximate level of radiation exposure for treatment purposes.

Course outcomes:

After successful completion of this course, students are able to:

- Apply the concept of knowledge of medical physics to real life problems.
- Learn about the human body, its anatomy, physiology and bio Physics, exploring
- its performance as a physical machine. Other topics include the Physics of the senses.
- Study diagnostic and therapeutic applications like the ECG, radiation Physics, X-ray
- technology, ultrasound and magnetic resonance imaging.

Unit-I: Physics of the body **(12 h)**

Energy household of the body: Energy consumption of the body, Heat losses of the body, Physics of breathing. **Acoustics of the body:** Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound **Optical system of the body:** Physics of the eye. **Electrical system of the body:** Physics of the nervous system, Electrical signals and information transfer

Unit-II: Physics of diagnostic and therapeutic systems **(10 h)**

X-RAYS: Electromagnetic spectrum, production of x-rays, x-ray spectra, X-ray tubes, Coolidge tube, x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating – quality and intensity of x-ray, high frequency generator, exposure timer.

Unit-III: Radiation physics **(12 h)**

Radiation units, exposure, absorbed dose, relative biological effectiveness, effective dose, inverse square law, interaction of radiation with matter, Radiation Detectors – Geiger counter, Scintillation counter, ionization chamber, area monitors, TLD and semiconductor detectors. Radiotherapy, Tele cobalt machines, Medical linear accelerator.

Unit-IV: Medical imaging physics **(11 h)**

Physics of nuclear magnetic resonance (NMR) , NMR imaging, MRI Radiological imaging, Radiography, Filters , grids , cassette , fluoroscopy , computed tomography scanner , principle function, display generations ,34 mammography. Ultrasound imaging – magnetic resonance imaging (Only Principle, function and display)

References:

- Cameron J.R., Skofronick J.G., (1978), Medical Physics, 1st edition, Wiley
- Thayalan K., (2003), Basic Radiological Physics, 2nd edition, Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi

- Curry, Dowdey, Murry, (1990), Christensen's Physics of Diagnostic Radiology, 4th edition, Lippincot Williams and Wilkins
- Khan F. M., (2003) Physics of Radiation Therapy, 3rd edition, Williams and Wilkins,
- Herman I. P., (2007), Physics of the human body, 2nd edition, Springer.
- Bushberg, Seibert, Leidholdt, Boone L., (2002), The essential physics of Medical Imaging, 2nd edition, Williams and Wilkins,
- Johns H. E., Cunningham, (1983), The Physics of Radiology, 4th edition, Springfield, Illinois, U.S.A.

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester V
Skill Enhancement Course (SEC)
PHY-350: Technical Electronics

Total Hours: 30 **Credits: 2**

Course objectives:

- To learn the physics of semiconductor devices. Different types of semiconductors, their use in making sensors and measuring devices and study their characteristics
- To study optoelectronic devices and conversion devices and their uses.

Course outcome:

After successful completion of this course, students are able to:

- Acquire necessary skills/ hands on experience /working knowledge on electric circuit elements, transducers, sensors, optoelectronic devices, dc power sources, ac/dc generators, inductors, capacitors, transformers and basics of electrical wiring.
- Understand various types of DC and AC circuits and making electrical drawings with symbols for various systems.
- Do electrical wiring with assured electrical protection devices.
- Develop knowledge of solid state devices and their uses.

Unit-I: Components and devices **(06 h)**

Resistors, Capacitors, Inductors (Types, construction and specification), Identification of resistor and capacitor values, Transformers: Types, (Single phase power transformer, auto transformer, isolation, AF, RF, IF), Switches, Types of switches, Relay: Types (list only), Electromagnetic relay: Principle, Construction and Working.

Unit-II: Sensors & Transducers **(08 h)**

Sensors:- Resistance temperature detectors, Bimetal strip, Gas thermometers, Vapour pressure thermometers, Liquid expansion thermometers, solid state temperature sensors, Types of motions, Accelerometers' principles, Types of accelerometers and applications, Thermal radiation, broadband pyrometers, narrowband pyrometers, Conventional light sources, Laser principles.

Transducers: - Definition, Classification, Selection of transducer, Electrical transducer: Thermistor, Thermocouple, Pressure Transducer: Strain gauges (wire, foil, & semiconductor), Displacement transducer: LVDT.

Unit-III: Data Converters & Measuring instruments **(10 h)**

Data Converters: - D to A Converters: Resistive divider network, Binary ladder network. A to D Converters: Successive approximation type, Voltage to Time (Single slope, Dual slope), Voltage to Frequency.

Measuring instruments:- Cathode Ray Oscilloscope: Block diagram, Front Panel Control, Dual beam oscilloscope, measurement of voltage, current, frequency, phase using CRO, Function Generator: Block diagram and features, Digital Frequency meter (Frequency mode only): Block diagram & features, Digital Voltmeter (Ramp type only): Block diagram & features.

Unit-IV: Optoelectronic Device **(06 h)**
LED (Construction, Working & Applications), Multicolor LED, Seven Segment Display, Liquid Crystal Display (LCD), Photodiode (construction, Characteristics & applications), LDR, Introduction to phototransistor, photo voltaic detectors, photo emissive detectors, Optocoupler

References:

- Grob B., (2010), Basic Electronics, 11th edition, McGraw Hill Book Co. New York,
- Sedha R. S., (2008), A Textbook of Applied Electronics, 3rd edition, S Chand & Company, New Delhi.
- Thereja B. L., (2005), Basic Electronics Solid state, 23rd edition, S Chand & Company, New Delhi.
- Kalsi H. S., (1995), Electronic Instrumentation, 1st edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Dhir S. M., (2000), Electronic components and materials: Principles, Manufacture and Maintenance, 1st edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Morris A. S. (2001) Measurement and Instrumentation Principles, 3rd edition Butterworth-Heinemann.
- Sonde B. S. (1977), Transducers and display systems Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Malvino A.P., Leach D. P. (2011), Digital principles and applications, 7th edition, Tata McGraw-Hill.
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- Millman J., Halkias C.C., (1991), Integrated Electronics ,6th edition, Tata Mc-Graw Hill.
- Ryder J.D., (2007), Electronics: Fundamentals and Applications, 5th edition, Prentice Hall.
- Sze S.M., (2002), Semiconductor Devices: Physics and Technology, 2nd edition., Wiley India

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-357: Laboratory-I

Total Hours: 60 **Credits: 2**

Course objectives:

- To develop an awareness about the importance of accurate experimentation in the understanding of natural phenomena.
- To develops students understanding and thinking for developing new materials as well as synthesis techniques for understanding physics and its applications.
- To develop the students practical and technical skills required for physics experimentation.
- To develop an awareness of the value and the power of computer based techniques for experimentation, analysis and presentation and a familiarity in their exploitation.

Course outcomes:

After successful completion of this course, students are able to:

- Understand various material properties and synthesis techniques.
- Understand to do proper selection of material synthesis process and its application for developing new material properties through modification in its morphological as well as chemical structure.
- Understand the various theories parameters and characteristics of different classes of solids showing varying properties like magnetism, polarization, conductivity, piezoelectricity etc.

Sr. No.	Topic Particular	Hours
Section A: Basic General Physics (Any 4)		
1	Moment of Inertia by Bifilar suspension.	**04**
2	Y and η by Searl's method.	**04**
3	Y by Koenig's method.	**04**
4	Viscosity of liquid by Rotating cylinder method	**04**
5	Y by Newton's rings.	**04**
6	Surface tension of mercury by Quincke's method	**04**
7	Thermal Conductivity by Rubber Tubing method	**04**
8	Resistivity by Four probe method	**04**
9	Surface tension liquid by Fergusson method	**04**
10	Frequency of AC/ Tuning fork by stroboscope.	**04**
11	Variation of resistance of a filament of a bulb with its temperature.	**04**
12	Electromagnetic Pendulum.	**04**
13	Hall Effect	**04**
Section B: Solid State Physics: (Any 3)		
1	Determination of Dielectric Constant of Different Materials	**04**
2	To Study the Crystal Structure of a Given Specimen (B.C.C., F.C.C., H.C.P).	**04**
3	To Study the Imperfection in Crystal.	**04**
4	To Study Bravais Lattices with the help of Models.	**04**
5	Measurement of resistivity by four probe method.	**04**
6	Determination of velocity of sound using ultrasonic Interferometer.	**04**

Section C: Elements of Material science / Nanomaterials: Synthesis & Characterization methods (Any 3)

1	Synthesis of metal nanoparticles by chemical route.	**04**
2	Synthesis of semiconductor nanoparticles.	**04**
3	Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.	**04**
4	XRD pattern of nanomaterials and estimation of particle size.	**04**
5	To study the effect of size on color of nanomaterials.	**04**
6	To determine the dipole moment of a given liquid	**04**
7	To determine magnetic susceptibility of $FeCl_3$	**04**
8	To determine the specific heat of graphite	**04**
9	Determination of the yield point and the breaking point of an elastic material	**04**

Perform total **ten experiments** altogether from all Sections: any **four** experiments from **Section (A)** and at least **three experiments** from **Section (B) and (C)** each:

References:

- Poole C.P., Owens F.J., (2003), Introduction to Nanotechnology, Wiley India Pvt. Ltd.
- Kulkarni S.K., (2017), 3rd Edition Nanotechnology: Principles & Practices, Capital Publishing Company.
- Chattopadhyay K.K., Banerjee A.N., (2009), Introduction to Nanoscience & Technology, PHI Learning Private Limited.
- Booker R., Boysen E., (2011), Nanotechnology, Wiley India Pvt, Ltd.
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- Nelson M., Ogborn J.M., (1985), Advanced level Physics Practicals, 4th edition , Heinemann Educational Publishers.
- Prakash I., Ramakrishna, (2011), A Text Book of Practical Physics, 11th Edition., Kitab Mahal
- Srivastava J.P., (2006), Elements of Solid State Physics, 2nd edition. Prentice-Hall of India.

Methods of Teaching:

- Laboratory Method, Lecture cum demonstration methods

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-358: Laboratory-II

Total Hours: 60 **Credits: 2**

Course Objectives:

- To develop the practical and technical skills required for physics experimentation.
- To study the various sensors.
- To study electrical & electronic circuits easily.
- To study and perform various practical based on medical physics.

Course outcomes:

After successful completion of this course, students are able to:

- Design and built various practicals based on technical electronics and medical physics.
- Handle optical, Electrical apparatus smoothly.
- Acquire technical skill to operate medical instruments.

Sr. No.	Topic Particular	Hours
Section A: Advanced Electronics (Any 3)		
1	Instrumental amplifier using three op-amps	04
2	Temperature controller using PT 100 / thermocouple /thermistor temperature sensors	04
3	Object counter (two digit)	04
4	Study of LVDT	04
5	Schmidt trigger	04
6	Measurement of self-inductance of a coil by Anderson's bridge.	04
7	To determine the human audibility.	04
8	Characteristics of JFET.	04
9	UJT characteristics and UJT as relaxation oscillator.	04
10	Study of RC/LC filter (Low pass and High Pass)	04
11	Study of Heartly oscillator. (Calculation of frequency and verification of frequency from sinusoidal output waveform).	04
12	Measurement of self-inductance using Maxwell's induction bridge.	04
13	Multiplexer (2 to 1 or 4 to 1) and/or De-multiplexer (1 to 2 or 1 to 4).	04
Section B: Technical Electronics: (Any 3)		
1	To make two PCB's i) Using discrete components ii) Using IC components.	04
2	To study inverting and non-inverting configuration of Op amp.	04
3	To study of OP AMP as an adder.	04
4	DAC (R- 2R ladder, without OP- AMP).	04
5	To study reverse bias characteristics of photodiode.	04
6	To study characteristics of photo transistor.	04
7	To design and study of regulated power supply using IC 723.	04
8	Designing and fabrication of transformer.	04
9	Triangular, square wave generator using OP AMP.	04
10	V to F converter using IC-741.	04
11	V to T converter using IC-741.	04

12	Study of function generator.	04
13	To study fixed voltage regulator using 78XX and 79XX.	04

Section C: LASER & Optics: (Any 4)

1	Determination of circular aperture of LASER.	04
2	Determination of wavelength of light by Michelson's interferometer	04
3	Determination of wavelength of HeNe Laser by transmission grating and reflection grating.	04
4	Beam divergence of a Diode Laser.	04
5	To study the interference of light using optical fibres	04
6	Measurement of the focal length of a given convex lens using a laser.	04
7	Study of the characteristics of a laser beam.	04

Section D: Medical Physics: (Any 4)

1	Measurement of BP using Mercury sphygmomanometer and digital BP meter	04
2	Recording of ECG and its analysis	04
3	Absorbance using calorimeter/ Absorption spectra using Spectrophotometer	04
4	Pulse oxymetry	04
5	Use of biosensor	04
6	Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure.	04
7	Understanding the working of a manual optical eye-testing machine and to learn eye-testing.	04
8	Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard.	04
9	Correction of Hypermetropia / Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard.	04
10	To learn working of Thermoluminescent dosimeter (TLD) badges and measure the background radiation.	04

Perform total **ten experiments** altogether from all Sections: any **three** experiments from **Section (A)** and (B) each and at least **four experiment** from **Section (C) or (D)**

References:

- Zbar P.B., Malvino A.P., Miller M.A., (1994), Basic Electronics: A text lab manual, Mc-Graw Hill.
- Gayakwad R.A., (2000), OP-Amps and Linear Integrated Circuit, 4th edition, Prentice Hall.
- Malvino A., (2008), Electronic Principle, Tata Mc-Graw Hill.
- Boylestad R.L., Nashelsky L.D., (2009), Electronic Devices & circuit Theory, Pearson.
- Tietze U., Schenk C., (2008), Electronic circuits: Handbook of design and applications, Springer.
- Sayer M., Mansingh A., (2005), Measurement, Instrumentation and Experiment Design in Physics & Engineering, PHI Learning.
- Thayalan K., (2003), Basic Radiological Physics, Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi.
- Curry, Dowdey, Murry, (1990), Lippincot Christensen's Physics of Diagnostic Radiology: Williams and Wilkins.

- Khan F.M., (2003), Physics of Radiation Therapy, 3rd edition Williams and Wilkins.
- Bushberg, Seibert, Leidholdt, Lippincot B., (2002), The essential physics of Medical Imaging, 2nd edition, Williams and Wilkins.
- Johns H.E., Cunningham, (1983), The Physics of Radiology, 4th Edition, Springfield.

Methods of Teaching:

- Laboratory Method, Lecture cum demonstration methods

स्थापना १९४५
खान्देश कॉलेज एज्युकेशन सोसायटी

T.Y. B.Sc. (Physics): Semester V
Discipline Specific Core (DSC) Course
PHY-359: Project -I

Total Hours: 60 **Credits: 2**

Course objectives:

- To develop technical skills to perform experiments in details.
- To encourage research and development activities.
- To develops students understanding and thinking for developing techniques for understanding physics and its applications.

Course outcomes:

After successful completion of this course, students are able to:

- Aware of various techniques to perform physics experiments in detail.
- Carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines

Course contents:

Student should perform the following activities. He should prepare a progress report and submit it to the guide for the internal assessment.

1. Project Selection
2. Literature Survey
3. Literature Review
4. Project Planning.
5. Experimental work (30 to 40 %)

Instructions:

1. Student should prepare the project report for the examination of first term and it should be produced to the examiner of second term also.
2. The internal as well as external assessment of the student will be done on the basis of seminar/power point presentation given by him/her on the above topics using LCD projector and the actual project work done by him/her.
3. Once the internal and external project examination of first term is over, student should continue the same topic for the examination of final semester. He/she cannot change the topic of the project in any circumstances.

Scheme of marking at end-semester examination:

Sr. No.	Performance Criteria	Max. Marks
1	Selection of Project	5
2	Planning and implementation	10
3	Project outcomes	5
4	Regularity of Work	5
5	Report Writing Skills	5
6	Self Expression, Communication Skill and Presentation	5
7	Viva -Voce	5
Total		**40**

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) Course
PHY-361: Classical Electrodynamics

Total Hours: 45 **Credits: 3**

Course objectives:

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

Course outcomes:

After successful completion of this course, students are able to:

- Appreciate the need and necessity of electrostatic and the magneto static field.
- Know the basic concepts of electrodynamics; fundamental laws of the electromagnetic field; basic principles of the theory of electromagnetic field in vacuum; basic concepts of the theory of radiation.
- Know the basics of scattering and absorption and relate them to real life phenomena.
- Learnt about wave-guides and transmission lines and propagation of waves through them.

Unit-I: Electrostatics **(08 h)**

Coulomb's law, Electric field, Electrostatic Potential, Potential energy of system of charges, Statement of Poisson's equation, Boundary Value problems in electrostatics-solution of Laplace equation in Cartesian system, Gauss law Differential form of Gauss's law, Applications of Gauss's law- i) Electrical field outside the charged sphere ii) Electric field inside charged sphere iii) Electric field due to infinite sheet of charge. Electric dipole, Expression for potential and intensity.

Unit II: Electrostatic field in dielectrics **(08 h)**

Dielectric materials, polar and non polar molecules, Method of image charges: Point charge near an infinite grounded conducting plane, Point charge near grounded conducting sphere. Polarization **P**, Electric displacement **D**, Electric susceptibility and dielectric constant, bound volume and surface charge densities. Electric field at an exterior and interior point of dielectric.

Unit-III: Magnetostatics **(14 h)**

Concepts of magnetic induction, magnetic flux and magnetic field, Magnetic induction due to straight current carrying conductor, Energy density in magnetic field, magnetization of matter. Relationship between **B, H** and **M.** Biot-Savart's law, Ampere's law for force between two current carrying loops, Ampere's circuital law, Equation of continuity, Magnetic vector potential **A.** Magnetic susceptibility and permeability, Hysteresis loss, B-H curve.

Unit-IV: Electrodynamics **(15 h)**

Concept of electromagnetic induction, Faradays law of induction, Lenz's law, displacement current, generalization of Amperes' law. Maxwell's equations (Differential and Integral form) and their physical significance, Polarization, reflection & refraction of electromagnetic waves through media, Wave equation and plane waves in free space, Poynting theorem & Poynting vector, Polarizations of plane wave, Microscopic form of ohm's law ($J=\sigma.E$)

References:

- Griffith D. J., (2012), Introduction to Electrodynamics, 4th edition, Addison-Wesley
- Jackson J. D. ,(1999), Classical Electrodynamics, 3rd edition, Wiley.
- Capri A. Z., Panat P. V., (2000), Introduction to Electrodynamics, Narosa Publishing House.
- Reitz J.R., Milford J., (2008), Electricity and magnetism,4th edition, Addison-Wesley.
- Gupta S.L., Kumar V., Singh. S.P., (2017), Electrodynamics, Pragati Prakashan
- Paul L., Corson D.R., (1987), Electromagnetic field and waves, W. H. Freeman and Company New York.
- Murugeshan R., (2017), Electricity and magnetism, 10th edition, S. Chand

Methods of Teaching:

- Classroom teaching, Lecture method, ICT enabled teaching, Online Teaching.

स्थापना १९४४
खान्देश कॉलेज एज्युकेशन सोसायटी

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) Course
PHY-362: Quantum Mechanics

Total Hours: 45 **Credits: 3**

Course objectives:

- To impart knowledge of basic concepts in Quantum Mechanics.
- To provide the detail knowledge of quantum mechanics and its application towards the new era of Quantum Physics.

Course outcomes:

After successful completion of this course, students are able to:

- Apply the concept and knowledge of Quantum Mechanics to real life problems.
- Understanding of the course will create scientific attitude towards the subject application.

Unit I: Schrodinger's Wave Equation **(13 h)**

Introduction to Quantum Mechanics, Interpretation of Wave function Normalized and Orthogonal wave functions, Requirements of wave function, Formulation of time dependent and time independent Schrödinger equation (Steady state equation), Probability current density and equation of continuity, Solution of Schrodinger's wave equations, Energy eigen values and eigen functions, Expectation value, Ehrenfest's theorem, Postulates of Quantum Mechanics. (Ref:1, 2 and 9).

Unit II: Applications of Schrödinger (Steady State)equation **(09 h)**

Particle in a one-dimensional rigid box, Step potential, Potential barrier, Particle is square well potential (Non rigid 1D box), Linear Simple Harmonic oscillator (derivation of energy eigen values and eigen functions) (1D).

Unit III: Quantum theory of Hydrogen atom **(09 h)**

Schrödinger equation in spherical polar co-ordinate system, Schrödinger equation for Hydrogen atom-separation of radial and angular part, Solutions of R,Θ,Φ equations, Physical Significance of quantum numbers n, l, m_l.

Unit IV: Operators in Quantum Mechanics **(14 h)**

Operators and linear operators, Position, Momentum operator, Angular momentum operator, and total energy operator (Hamiltonian), Commutator algebra, Commutator bracket, Commutator brackets using position, momentum and angular momentum operator, Commutation relations and Hamiltonian operator; Commutation rules for components of orbital angular momentum; Commutation relations of L^2 with components of orbital angular momentum; Commutation relation of components of orbital angular momentum with position operator, Ladder operators L_+, L.Concept of parity, parity operator and its eigen values.

References:

- Beiser A., (1969), Perspectives of Modern physics, McGraw-Hill Inc., US,
- Prakash S.,, Kedarnath R., (2012), Advanced Quantum Mechanics:, KNRN publisher, Meerut

- Gupta, Kumar, Sharma, (2018), Quantum Mechanics. Jay Prakash Nath publisher, Meerut
- Chatwal and Anand, (2012), Quantum Mechanics, Himalaya Publ. Co.
- Schiff L.I., (1968)., Quantum Mechanics, McGraw-Hill, New York,
- Powell and Crasemann , (1961), Quantum Mechanics, Addison-Wesley Pub. Co.
- Griffiths D., (2005), Introduction to Quantum Mechanics, Prentice Hall,
- Verma H.C., (2009) , Quantum Physics, 2nd Edition., Surya Publications, Ghaziabad (UP),
- Zettili N., (2009), Quantum Mechanics: Concepts and Applications, Wiley Publications.

Methods of Teaching:

- Classroom teaching, Lecture method, ICT enabled teaching, Online Teaching.

ज्ञानप्रसारो व्रतम्
स्थापना १९४५
खान्देश कॉलेज एज्युकेशन सोसायटी

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) course
PHY-363: Atomic and Molecular physics

Total Hours: 45 **Credits: 3**

Course objectives:

- To impart knowledge of basic concepts in Atomic and Molecular Physics.
- To provide the knowledge and methodology necessary for solving problems in Physics.

Course outcome:

After successful completion of this course, students are able to:

- Apply the concept and knowledge of Atomic and Molecular Physics to understand and solve the real-life problems.
- Understanding of the course will create scientific temperament.
- This area covers a wide spectrum ranging from conventional to new emerging multi-
- disciplinary areas like molecular physics, optical science especially spectroscopy.

Unit-I: Atomic Structure: **(09 h)**

Introduction, Rutherford model of atom, Bohr atom, Electron orbits, Energy levels and spectra. **Vector atom model** - Concepts of space quantization and electron spin, Quantum numbers, atomic excitation and atomic spectra, Physical interpretation of quantum numbers, Larmor precession of electron orbit, Pauli's exclusion principle, Spectral terms, Spin-Orbit interaction, Selection rules, Spectra of single valence electron system (sodium), Problems.

Unit-II: Two Valence Electron System: **(09 h)**

Introduction, Spin-spin and orbit-orbit interaction, Definition of L-S coupling and j-j coupling, L-S and j-j coupling schemes, Singlet triplet separations for interaction energy of LS coupling, s-p and p-d configuration in L-S coupling and j-j coupling, Lande Interval rule, Spectra of Helium, Problems.

Unit-III: Zeeman & Paschen Back effect: **(09 h)**

Introduction, Magnetic dipole moment, Zeeman Effect: Experimental set up, Normal and Anomalous Zeeman Effect for single valence electron system, Lande 'g' factor for two valence electron system (L-Sand j-j coupling), Stark effect (Qualitative discussion), Paschen Back effect for single valence electron system, Zeeman effect applications, Problems.

Unit-IV: X-ray and Molecular spectra: **(09 h)**

A) X-ray spectra:

Origin and nature of X-ray, Characteristic X-ray spectra, Duane and Hunt's Rule, X-ray emission spectra, Moseley's law and its importance, Energy level of Cadmium, Regular and Irregular doublets and their laws, Applications of X-ray (List only), Auger effect, Problems.

B) Molecular spectra: **(09 h)**

Introduction, Regions of electromagnetic spectrum, Types of molecular spectra, Rotational spectra of rigid diatomic molecule, Rotational energy levels of rigid diatomic molecule, Vibration of atoms in a diatomic molecule, Vibrational energy levels for Diatomic molecule, **Raman spectroscopy:** Experimental setup, Explanation of Stoke's and Anti-stoke's lines, Applications of Raman effect, Applications of Spectroscopy.

References:

- Banwell. C. N., (2016), Fundamental of Molecular spectroscopy, 4th edition, Tata McGraw hill.
- Hertzberg G., (1979), Spectra of Diatomic Molecules, 2nd Revised edition, D Van Nostrand company, New York.
- Beiser A., (1969), Perspectives of Modern Physics, McGraw Hill Kogakusha Ltd, Tokyo.
- Kumar R., (2019), Atomic spectra and Molecular spectra, 20th edition, Kedarnath Ramnath Prakashan.
- Ferraro. J. R., (2002) Introductory Raman spectroscopy, 2nd Edition, Elsevier publication.
- White. H. E., (1934), Introduction to Atomic spectra, international edition, McGraw Hill.
- Friedrich. H., (2017), Theoretical Atomic physics, 4th Edition, Springer.
- Bransden B. H, Joachain. C. J, (1990), Physics of Atoms and Molecules, 2nd edition, Longman group, UK limited.
- Brooks R. L., (2013), The fundamentals of Atomic and Molecular Physics, 1st edition Springer-Veriag, New York.
- Rajam. J. B., (2008), Atomic physics, 7th edition, S Chand & Company Pvt.

Methods of Teaching:

- Classroom teaching, Lecture method, ICT enabled teaching.

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) course
PHY-364: Nuclear and Particle Physics

Total Hours: 45 **Credits: 3**

Course objectives:

- To impart knowledge about basic nuclear physics properties and nuclear models for understanding of related reaction dynamics
- To explain the ground state properties of the nucleus for study of the nuclear structure behavior.
- To explain the deuteron behavior at ground and excited states.
- To understand the nuclear energy, nuclear power generation and nuclear Accelerators.
- To get ideas regarding Particles, nuclear medicine, magnetic resonance imaging and radiocarbon dating in geology and archaeology which we have tried to incorporate.

Course outcomes:
After successful completion of this course, students are able to:

- Understand the fundamental principles and concepts governing classical nuclear and particle physics and have a working knowledge of their application to real-life problems,
- Demonstrate knowledge and understanding of: scientific phenomena, facts, laws, definitions, concepts, theories, scientific vocabulary, terminology, conventions, scientific quantities and their determination, order-of-magnitude estimates, scientific and technological applications of Nuclear Physics.
- Relativistic kinematics for computations of the outcome of various reactions and decay processes.
- Classify elementary particles according to their quantum numbers and draw simple reaction diagrams

Unit-I: Basic Properties of Nucleus **(07 h)**
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.

Unit-II: Radioactivity and Nuclear forces **(12 h)**
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, Archiological). Meson theory of nuclear forces, Properties of nuclear forces, properties of deuteron system, Problems

Unit-III: Nuclear Reactions and Nuclear Energy: **(14 h)**
Introduction to Nuclear reaction, compound nucleus, Q value equation, Exothermic and Endothermic reaction, Threshold energy, Conservation laws, nuclear cross section. problems. Nuclear fission, Fusion and Fission Reactions, chain reaction and critical mass, nuclear

reactor and its basic components, homogeneous and heterogeneous reactors, power reactor, fast breeders, nuclear fusion, stellar energy.

Unit-IV: Detectors, Particle Accelerator and Elementary Particles (12 h)
Classification of Nuclear Detector, Gas filled Detectors (G. M. counter), Solid state detectors (NaI (Tl) scintillation counter), Introduction to particle Accelerators, Linear (electron/proton Linac) Cyclic (Cyclotron), Elementary particles, Quarks model for elementary particles. Problems

References:

- Enge H. A. , (1966), Introduction to Nuclear Physics, Addition Wesley co.
- Evans R. D., (1969), The Atomic Nucleus, Tata McGraw Hill co.
- Cohen B. L., (1971), Concepts of Nuclear Physics, Tata McGraw Hill co.
- Patel S. B,.(1991), Introduction to Nuclear Physics, Wiley- Backwell.
- Sharma S., (2008), Atomic and Nuclear Physics, 1stedition, Pearson Education.
- Kaplan, (1962), Nuclear Physics, Narosa Publishing House.
- Waghmare Y.R., (1981), Introduction to Nuclear Physics, Oxford IBH.

Methods of Teaching:

- Classroom teaching, Lecture method, ICT enabled teaching, Online Teaching

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) course
PHY-365: Physics of Devices and Communication

Total Hours: 45 **Credits: 3**

Course objectives:

- To learn principle of operation, construction and characteristics of various electronic devices.
- To learn different fabrication processes of semiconductor devices.
- To understand the communication standards.
- To learn different types of modulation use in electronic communication.

Course outcomes:

After successful completion of this course, students are able to:

- Describe the properties of materials and application of semiconductor electronics
- Apply the knowledge of semiconductors to illustrate the functioning of basic electronic devices.
- To understand communication systems with emphasis on analog & digital modulation techniques

Unit-I: Devices **(15 h)**

FET: Types (n-channel and p-channel), Constructional detail, electronic symbol, working principle and I-V Characteristics, FET parameters, Introduction to MOSFET, Applications: FET as a VVR, FET as an amplifier.

UJT: Constructional detail, Equivalent circuit, symbol, working principle and I-V Characteristics, Applications: UJT as a switch, UJT as a relaxation oscillator

SCR: Constructional detail, symbol, Equivalent circuit of SCR, working principle and I-V Characteristics, Transistor analogy and its working, Important terms (break over voltage, holding current, forward current rating), Applications: SCR as a switch, Controlled rectification using SCR.

CMOS. Charge coupled devices. Tunnel diode

Unit-II: Processing of Devices **(12 h)**

Basic process flow for IC fabrication, Electronic grade silicon. Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation Technique for Si. Metallization technique. Positive and Negative Masks. Optical lithography. Electron lithography. Feature size control and wet anisotropic etching. Lift off Technique. Diffusion and implantation.

Unit-III: Digital Data Communication Standards **(05 h)**

Serial Communications: RS232, Handshaking, Implementation of RS232 on PC.

Universal Serial Bus (USB): USB standards, Types and elements of USB transfers. Devices (Basic idea of UART).

Parallel Communications: General Purpose Interface Bus (GPIB), GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through a COM port.

Unit-IV: Introduction to communication systems **(13 h)**

Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave. Sideband frequencies in AM wave. CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK

References:

- Sze S.M., Ng K.K., (2008), Physics of Semiconductor Devices, 3rd edition, John Wiley & Sons
- Singh A. K., (2011), Electronic devices and integrated circuits, PHI Learning Pvt. Ltd.
- Gayakwad R.A., (2000), Op-Amps & Linear Integrated Circuits, ,4th edition, PHI Learning Pvt. Ltd
- Mottershead A., (1998), Electronic Devices and Circuits, PHI Learning Pvt. Ltd.
- Kennedy G., (1999), Electronic Communication systems, Tata McGraw Hill.
- Ghosh A. K., (2009), Introduction to Measurements & Instrumentation, 3rd edition, PHI Learning Pvt. Ltd.
- Mathivanan N., (2007), PC based instrumentation; Concepts & Practice, Prentice-Hall of India

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) course
PHY-366 (A): Computational Physics Using C Language

Total Hours: 45 **Credits: 3**

Course objectives:

- To provide basic knowledge of C Programming.
- To study numerical methods for solving integration and differentiations.
- To learn how to design and write C programs to solve various numerical methods
- To develop problem-solving skills and their implementation through C Programming.

Course outcomes:

After successful completion of this course, students are able to:

- To design and write C programs.
- To understand the numerical method in physics
- To solve, design and write C programs for various numerical methods.

Unit-I: Fundamental of C **(16 h)**

Introduction to C, Importance of C, Character set, Tokens, keywords, identifier, constants, basic data types, variables, Structure of C program. operators, precedence of operators, I/O statements.

Decision making and Branching: if, if-else, else-if, switch statement, break, Goto statement.

Looping statement: while loop, do loop and for loop.

Unit-II: Array and Function **(06 h)**

Arrays: concepts, declaration, accessing elements, storing elements, two-dimensional and multi-dimensional arrays.

Function: Defining functions, function call and declaration, function arguments andpassing, returning values from functions, recursion. Passing array to function.

Unit-III: Solution of Equations or system **(17 h)**

Solution of Transcendental and Polynomial Equations f(x)=0: Bisection method, Newton Raphson method, Rate of convergence, (algorithm, flow chart and Examples)

Solution of Differential equations: Euler's Method, Modified Euler's method Runge-Kutta Method, Boundary value problems, Examples

Curve Fitting: Least square fitting, Curve fitting, Interpolation by Spline functions, Examples.

Unit-IV: Numerical Differentiation and Integration: **(06 h)**

Interpolation, Langrange Interpolation, Newton Divided Difference Interpolation

Numerical Differentiation: Finite difference method and Examples

Numerical Integration: Trapezoidal Rule, Simpson's Rules, Error of Simpson's rule, Examples

References:

- Kernigham B., Ritchie D., (2015), The C-Programming language, 2nd edition, Pearson Education India.

- Balagurusamy E., (2018), Programming in ANSI C, 3rd edition, Tata McGraw Hill Education.
- Kanetkar Y. P., (2016), Let us C, 15thedition, BPB Publication.
- Kochen S. G., (2004), Programming in C, 3rdedition, Sams Publishing.
- Sastry, S.S., (2012), Introduction to Numerical Analysis, Prentice Hall India.
- Rao S.B., Shantha C. K., (2004), Numerical Methods, University Press.
- Jain M.K., Iyengar S.R.K., Jain R.K., (2007), Numerical Methods: Problems and Solutions, New Age International.
- Grewal B.S., (2012), Numerical Methods in Engineering and Science with Programs in C and C++, 11th edition, Khanna Publishers.
- Rajaraman V., (1993), Computer Oriented Numerical Methods, 3rd edition, Prentice Hall India.

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

ज्ञानप्रसारो व्रतम्
स्थापना १९४४
खान्देश कॉलेज एज्युकेशन सोसायटी

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) course
PHY-366 (B): LabVIEW Programming

Total Hours: 45 **Credits: 3**

Course objectives:

- To know the basic introduction to virtual instrumentation.
- To familiar with measurement and automation.

Course outcomes:

After successful completion of this course, students are able to:

- Develop a program using LabVIEW.
- Work on data acquisition and controls with LabVIEW.

Unit-I: Introduction to Virtual Instrumentation **(08 h)**

Computers in Instrumentation, What is Virtual Instrumentation (VI), History of VI, LabVIEW and VI, Conventional and Graphical Programming, Distributed Systems. Components of LabVIEW, Owned and Free Labels, Tools and Other Palettes Arranging Objects, Pop-Up Menus, Colour Coding, Code Debugging, Creating Sub-VIs,

Unit-II: LabVIEW Programming

(A) Loops and Structure: **(08 h)**

For Loop, While Loop, Loop Behaviour and Inter loop Communication, Local Variables, Global Variables, Shift Registers, Feedback, Auto indexing, Loop Timing, Timed Loops,

(B)Structure and Array: **(05 h)**

Sequence Structures, Case Structure, Formula Node, Event Structure, Arrays, Clusters, Inter-Conversion of Arrays and Clusters,

(C) Input/ Output: **(08 h)**

Waveform Chart, Resetting Plots, Waveform Graph, Use of Cursors, X-Y Graph, introduction to a State Machine, Event Structures, The Full State Machine, File Formats, File I/O Functions, Path Functions.

Unit-III: Basics of Data Acquisition **(10 h)**

Classification of Signals, Real-World Signals, Analog Interfacing, Connecting the Signal to the Board. **Data Acquisition with LabVIEW:** Measurement and Automation Explorer, Waveform DataType, Working in DAQmx, Working in NI-DAQ, Use of Simple analog and digital Vis, Continuous data acquisition, acquisition of data in bursts

Unit-IV: Interfacing with DAQ assistant **(06 h)**

DAQ Assistant, Analysis Assistant, Instrument Assistant, GPIB interfacing, standard command for programmable instrument.

References:

- Gupta S., John, J., (2017), Virtual Instrumentation using LabVIEW, 2nd edition, TMH Pvt. Ltd.
- Travis J., Kring J., (2006), LabVIEW for Everyone, 3rd edition, Prentice Hall.
- Johnson G.W., Jeninngs, R., (2006), LabVIEW Graphical Programming, 4th edition, McGraw Hill.

- Jerome J., (2010), Virtual Instrumentation Using Labview, Prentice Hall India Learning Private Limited.
- Mihura B., (2001), LabVIEW for Data Acquisition, Prentice Hall.

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester VI
Skill Enhancement Course (SEC)
PHY-360: Renewable Energy and Energy Harvesting

Total Hours: 30 **Credits: 2**

Course objectives:

- To Develop the alternative in Renewable Energy sector is the present need of the country.
- To provide physics students with an introduction to energy systems and renewable energy resources.
- To explore society's present needs and future energy demands; also, it will examine conventional energy sources and systems. Ultimately, it will help to create self-employment, promote research and help to develop the skills required in the energy sector

Course outcomes:

After successful completion of this course, students are able to:

- Apply the concept of use of knowledge of Renewable energy sources to real life energy problems.
- Create and apply their skills through gained knowledge.

Unit-I: Energy Sources **(04 h)**

Introduction to Renewable Energy Sources: Sun, Wind, Hydropower, Biomass and Geothermal energy sources, Introduction to Non-renewable Energy Sources, Fossil fuel, coal, Natural gas and Nuclear energy, An overview of developments in offshore.

Unit-II: Solar energy **(07 h)**

Solar energy, Its importance, storage of solar energy, Solar pond, non-convective solar pond, Applications of solar pond and solar energy, Solar water heater, Flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

Unit-III: Renewable Energies & Harvesting **(11 h)**

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. Geothermal Resources, Geothermal Technologies. Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Unit-IV: Piezoelectric and Electromagnetic Energy harvesting **(08 h)**

Introduction, Physics and characteristics of piezoelectric effect, Materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications Carbon captured technologies, cell, batteries, power consumption

References:

- Rai G.D., (1988), Non-Conventional energy sources, Khanna Publishers, New Delhi.
- Agarwal M.P., (1983), Solar energy, S Chand and Co. Ltd.
- Sukhatme S.P.,, Nayak J.K., (2010), Solar energy: Principles of Thermal Collection & Storage, Tata McGraw - Hill Publishing Company Ltd.
- Boyle G., (2004), Renewable Energy, Power for a sustainable future, Oxford University Press.
- Jayakumar P., (2009), Solar Energy: Resource Assesment Handbook.
- Balfour J., Shaw M., Jarosek S., Goodrich L.J., (2009), Photovoltaics,
- http://en.wikipedia.org/wiki/Renewable_energy

Methods of Teaching:

- Classroom teaching, Online lectures, Lecture method, ICT enabled teaching

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) Course
PHY-367: Laboratory-I

Total Hours: 60 **Credits: 2**

Course objectives:

- To develop an awareness of the importance of accurate experimentation in the understanding of natural phenomena.
- To develop the students practical and technical skills required for physics experimentation.
- To understand various concepts in general physics, classical electrodynamics, atomic and molecular physics, quantum mechanics, nuclear physics and devices & communication practically.

Course outcomes:

After successful completion of this course, students are able to:

- Understand basic concepts of Physics easily.
- Learn the laws and theorems in Physics.
- Determine and verify the values of constants

Sr. No.	Topic Particular	Hours
A) Section A: Basic General Physics & Classical Electrodynamics (Any 4)		
1	To determine g by Bar Pendulum.	04
2	To study the Motion of a Spring and calculate (a) Spring Constant, (b) g.	04
3	Determination of 'g' by conical pendulum	04
4	To determine work function of material of cathode using photocell.	04
5	Verification of Stefan's law by torch bulb filament.	04
6	To determine value of Plank's constant using LEDS of at least four different colors.	04
7	To study intensity response of photocell and verify inverse square law of radiations.	04
8	To measure the numerical aperture of an optical fiber.	04
9	Study of bending loss in optical fiber	04
Section B: Atomic and molecular physics: (Any 2)		
1	Determination of Rydberg's constant	04
2	Zeeman Effect	04
3	Determination of wavelength by Constant deviation spectrometer	04
4	Determination of refractive index of liquid using hollow prism	04
Section C: Nuclear Physics and Quantum Mechanics: (Any 2)		
1	Characteristics of G.M. tube	04
2	Inverse square law (γ-rays)	04
3	e/m by Thomson method	04
4	Determination of Planck's constant.	04
5	Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).	04
6	Study of counting statistics using background radiation using GM counter.	04

7	Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage.	**04**
8	Study of absorption of beta particles in Aluminum using GM counter.	**04**
9	Detection of α particles using reference source & determining its half life using spark counter	**04**
10	Gamma spectrum of Gas Light mantle (Source of Thorium)	**04**
Section D: Physics of Devices & Communication: (Any 2)		
1	To design PWM, PPM, PAM and Pulse code modulation using ICs.	**04**
2	To design an Astable multivibrator of given specifications using transistor.	**04**
3	To study a PLL IC (Lock and capture range).	**04**
4	To study envelope detector for demodulation of AM signal.	**04**
5	Study of ASK and FSK modulator.	**04**
6	Glow an LED via USB port of PC.	**04**
7	Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port.	**04**

Perform total **ten experiments** altogether from all Sections: any **four** experiments from **Section (A)** and at least **two experiments** from **Section (B), (C) and (D)** each:

References:

- Worsnop B.L., Flint H.T., (1961), Advanced Practical Physics for students, Asia Publishing House.
- Nelson M., Ogborn J.M., (1985), Advanced level Physics Practicals, 4th edition, Heinemann Educational Publishers.
- Prakash I., Ramakrishna, (2011), A Text Book of Practical Physics, 11th edition, Kitab Mahal.
- Burcham W.E., Jobes M., (1995), Nuclear and Particle Physics, Longman
- Knoll G.F.,(2010), Radiation detection and Measurements, Wiley Publishers.
- Mcknlay A.F., (1981), Thermoluninescense Dosimetry, Medical Physics Handbook, Bristol, Adam Hilger.
- Meredith W.J., Massey J.B., (1968), Fundamental Physics of Radiology, Bristol: John Wright and Sons Ltd.

Methods of Teaching:

- Laboratory method, Lecture cum model demonstration methods.

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) Course
PHY-368: Laboratory-II

Total Hours: 60 **Credits: 2**

Course Objectives:

- To develop programming skill for writing some program in computational physics.
- To understand various concepts in C programming and Lab view programming.
- To develop the technical skills required for physics experimentation.
- To study the various characteristics of solar cell and various applications of solar energy.

Course outcomes:

After successful completion of this course, students are able to:

- Write program of computational physics in C language
- Write program using Lab view.
- Do the carrier in use solar energy applications such as solar cooker, solar water heaters, solar lighting system, solar water distillation and so on.

Sr. No.	Topic Particular	Hours
Section A: Solar Cell & Its Characteristics (Any 6)		
1	Study of I-V characteristics of solar cell.	**04**
2	Determination of fill factor and efficiency of solar cell.	**04**
3	To determine the solar constant.	**04**
4	Study of Solar Box Cooker: Evaluation of F1 and F2.	**04**
5	Study of Solar still for Water distillation.	**04**
6	Study of Solar Hot water system.	**04**
7	Study of Concentrating type Solar Cooker – SK 14.	**04**
8	Study of Solar Dryer: Hot air collector.	**04**
Section B: Computational Physics Using C Language (Any 4)		
1	Factorial of a number by simple and recursive method.	**04**
2	To find out the first 100 prime numbers	**04**
3	Matrix multiplication	**04**
4	Graphics (line, circle, arc, ellipse, bar, draw poly)	**04**
5	Position time data using kinematic equations	**04**
6	Finding pressure using Vander Waals' equation of state	**04**
7	Roots of an algebraic equation (Bisection)	**04**
8	Roots of polynomial (Newton Raphson)	**04**
9	Trapezoidal and Simpson's 1/3 rule	**04**
Section C: LabVIEW Programming (Any 4)		
1	Introduction to LabVIEW	**04**
2	Application of LabVIEW for Material Testing	**04**
3	Write a simple LabVIEW program for binary number generator.	**04**
4	Write a simple program with the help of LabVIEW for Norton's theorem.	**04**
5	Write a simple program with the help of LabVIEW for noise level in the given circuit.	**04**
6	Write a simple program with the help of LabVIEW to calculate the value of resistance present in the circuit.	**04**

Perform Total **Ten experiments** altogether from all Sections: any **Six** experiments from **Section (A) and Any Four experiments from Section (B)** or (C)

References:

- Solanki C., (2013), Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers, 3rd edition Paperback, PHI Learning.
- Oualline S., (1997), Practical C Programming, 3rd edition, O'Reilly Media, Inc.
- Walker D., (2016), Computational Physics (Essentials of Physics Series), Mercury Learning & Information.
- Wong S.S.M., (1997), Computational Methods in Physics And Engineering, 2nd edition, Paperback, World Scientific Publishing Co. Pte. Ltd.
- Deamb S., (2015), From Sunlight to Electricity: A practical handbook on solar photovoltaic applications, 3rd edition, TERI Press
- Abraham L., (2011), Labview - A Lab Manual, Scitech Publications (India) Pvt. Ltd.
- Pradhan N., (2020), Let Us LabVIEW Paperback, Notion Press.

Methods of Teaching:

- Laboratory method, Lecture cum model demonstration methods.

T.Y. B.Sc. (Physics): Semester VI
Discipline Specific Core (DSC) Course
PHY- 369: Project-II

Total Hours: 60 **Credits: 2**

Course objectives:

- To develop technical skills to perform experiments in details.
- To encourage research and development activities.
- To develops students understanding and thinking for developing techniques for understanding physics and its applications.

Course outcomes:

After successful completion of this course, students are able to:

- Aware of various techniques to perform physics experiments in detail.
- Successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines

Course contents:

Student should perform the following activities in continuation with the work done in first term.

1. To complete the experimental work such as measurements, characterisations, analysis and so on.
2. To obtain the results.
3. To draw the conclusions.
4. To write the project report.
5. To prepare power point presentation for the internal and external assessment/examination

Project Report:

1. Students have to write a 'project report'.
2. A report should be a concise account of project work containing full descriptions of the aims, method and outcomes.

Assessment Criteria of the project:

The following criteria are to be used in assessing the project work:

(i) The conduct of project work:

The following questions are considered in assessing how well students have carried out the project work.

1. How difficult was the project?
2. How well did the student understand the scientific principles behind the project?
3. How well did the student plan the project work?
4. How much effort was put into the project?
5. Was an interim report presented on time?
6. Was the student's project logbooks adequate?
7. How much initiative and/or originality did the student contribute to the project.
8. How well did the student cope with problems that arose during the course of project?
9. Did a project reach a stage of completion where meaningful results were obtained and definite conclusions could be drawn?

(ii) The Project Report:

1. How well did the report set out the background?
2. How well did the report describe the underlying them?
3. was the report a reasonable length?
4. How well was the report structured?
5. How understandable was the written content?
6. How well did the report describe the execution of the project?
7. Did the report have an adequate summary or conclusions?

(iii) Oral Examination:

1. Did the student adequately describe what he/she had done in their project?
2. Did the student have a clear interpretation of his/her results?
3. What was the clarity and overall standard of the presentation?
4. How well was the talk/presentation structured?
5. Did the student cover all the relevant material in a reasonable time?

Scheme of marking at end-semester examination:

Sr. No.	Performance Criteria	Max. Marks
1	Working model of project	10
2	Regularity of Work	05
3	Report and Report Writing Skills	10
4	Self Expression, Communication Skill and Presentation	05
5	Viva -Voce	10
	Total	**40**

Skills acquired and Job prospects for the Physics students -

Physics is crucial to understanding the world around us, the world inside us, and the world beyond us. Physics challenges our imaginations with concepts like relativity and string theory, but also addresses real-world problems like the development of sustainable forms of energy production or treating cancer, through radiotherapy, development of computer games, design and manufacture of sports equipment and understanding and predicting earthquakes. Physics helps in understanding the universe. Many apparently complicated things in nature can be understood in terms of relatively simple mathematical relationships.

Knowledge & Skills Gained as a Physics student:

Knowledge:

Learn how to solve quantitative problems and find relationships between physical factors. Learn how to obtain, organize, analyze, and interpret scientific data. Develop knowledge of natural laws in various fields including optics, classical and quantum mechanics, and electricity and magnetism, astronomy and astrophysics, biomedical physics and beyond. Effectively research, organize, and arrange information and develop new ideas

Skills:

- Ability to conduct experiments
- Ability to develop theories
- Ability to perform calculations
- Ability to prepare technical reports
- Ability to use computer technology
- Ability to research and gather information
- Ability to analyze and organize data

Job Opportunities:

After successful completion of B.Sc. in Physics, student may continue further studies like M.Sc. in Physics and then Ph.D. in Physics and make career in research field. Students have opportunities in private as well as public (Government) sectors.

Private Sector:

Medicine, Patent Law, Finance, Design Engineering, Technical Writing, Industry jobs of all types, especially those emphasizing qualitative literacy, high-tech, and computer industry etc.

Public Sectors:

Research Scientist, Astrophysicist, Astronomer, Optical Physicist, Geophysical Surveyor, Marine Geophysicist, Chemical Analyst, Ballistics Expert, Aviation Inspector, Computational Scientist, Teacher/College Professor, climatology, meteorology, Nanotechnology etc.

Opportunities in higher studies

After successful completion of B.Sc. in Physics, student may continue further studies like M.Sc. in Physics and pursue higher studies. Even students can pursue other courses where graduation is essential. After completing B.Sc / M.Sc. in Physics, student can take admission to M.B.A., M.C.A., B.Tech, B.Ed, Ph.D. etc.