"Dissemination of Education for Knowledge, Science and Culture"
- Shikshanmaharshi Dr. Bapuji Salunkhe

Shri Swami Vivekanand Shikshan Sanstha's

Vivekanand College, Kolhapur (Autonomous)

DEPARTMENT OF PHYSICS

B.Sc. Part - III
Semester-V & VI

SYLLABUS

Under Choice Based Credit System

to be implemented from Academic Year 2023-24

Semester	Paper No.	Course Code	Course Title	Percentage of change in syllabus	No. of credits
V	IX	DSC-1001E$_1$	Mathematical Physics	15	2
	X	DSC-1001E$_2$	Nuclear and particle physics	12	2
	XI	DSC-1001E$_3$	Quantum Physics	10	2
	XII	DSC-1001E$_4$	Solid State Physics – I	15	2
VI	XIII	DSC-1001F$_1$	Semiconductor Device and Instrumentation	15	2
	XIV	DSC-1001F$_2$	Classical Mechanics	10	2
	XV	DSC-1001F$_3$	Elements of Modern Physics	12	2
	XVI	DSC-1001F$_4$	Solid State Physics II	15	2
V&VI	-	SEC-I	Renewable Energy and Energy Harvesting	10	2
	-	SEC-II	Basic Instrumentation Skills	15	2
V&VI	-	DSE-1101F-PR	Practical Group I, II, II, IV, V(A), V(B)	20	8

VIVEKANAND COLLEGE KOLHAPUR
ESTD JUNE 1964
(Empowered Autonomous)

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR
B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023
Semester V
PHYSICS Paper IX
Discipline Specific Elective Course (DSE-1001E1)

Mathematical Physics

Theory: 36 Hours (45 Lectures of 48 minutes)
Marks : 50 (Credits: 02)

CO's:
After completion, Students are able to
1) understand Cartesian, spherical polar and cylindrical co-ordinate systems.
2) understand Solve partial differential equations.
3) understand applications of partial differential equations.
4) Solve problems based on mathematical Physics

Unit	Syllabus	Lectures
Unit 1	**1. Orthogonal curvilinear co-ordinates** Introduction to Cartesian, spherical, polar and cylindrical co-ordinates system, concept of orthogonal curvilinear co-ordinates, unit tangent vectors, arc length, area and volume elements in orthogonal curvilinear co-ordinates system, Expression for gradient, divergence, Laplacian and curl in Cartesian, spherical, polar and cylindrical co-ordinate system. **2. Partial differential equation** Partial differential equation, degree, order, linearity and homogeneity of differential equations, methods of separation of variables, Frobenius method of power series, solution of Legendre, Hermite and Bessel differential equation	18
Unit 2	**1. Complex analysis** Revision of complex numbers and their graphical representation, Euler's formula, DeMoiver's theorem, Roots of complex number, Functions of complex numbers, Analyticity and Cauchy- Reimann condition, examples of analytical function, Singular functions, Poles and branch points, order of singularity, Integration of function of complex variable, Cauchy's inequality, Cauchy's integral formula. **2. Fourier series and integrals** Fourier series and Fourier transform, Dirichlet condition, (Statement only) Properties of Fourier series: 1) convergence, 2) Integration 3) Differentiation. Physical applications of Fourier series 4) square wave (high frequencies) 5) full wave rectifier, Differentiation and integration of Fourier series, Fourier transform, Inverse functions.	18

Reference books:

1. Advanced calculus (2nd Edition); Robert C. Wrede, Murray Spiegel.
2. Differential Equations with Modeling Applications (11th Edition); Dennis G.Zill.
3. Partial Differential Equations; Gupta Malik& Mittal.
4. Differential Equations; Gupta Malik& Mittal.
5. Differential Equations; Ramachandra Rao, H. R. Anuradha.

6. Partial Differential Equations; N. P. Bali.
7. Differential Equations; Dr. N. Ch. S. N. Iyenger (Ist edition 2000).
8. Mathematical Physics ; Dr. B. S. Rajput.
9. Mathematical Methods for Physicists (6th Edition); Arfken, Weber, 2005, Elsevier.
10. Mathematical Methods for Scientists and Engineers; McQuarrie, 2003, Viva Books.
11. Mathematical Physics; H. K. Das, Rama Varma.
12. Essential Mathematical methods; K. F. Riley, M. P. Habson, 2011,Cambridge.
13. Mathematics for Physicists; Susan M.Lea, 2004, Thomson Books/Cole.

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR
B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023
Semester V
PHYSICS Paper X
Discipline Specific Elective Course (DSE-1001E2)
Nuclear and Particle Physics
Theory: 36 Hours (45 Lectures of 48 minutes)
Marks: 50 (Credits: 02)

CO's:

After completion, students are able to;

1. Explain about the knowledge of particles.
2. Explain significance of various decays in the nuclear process.
3. Understand the spin parity concept & magic no. related to shell.
4. Know about the detectors and accelerators.

Unit	Syllabus	Lectures
Unit 1	**1. Nucleus (Nuclear Structure & General Properties of nuclei)** Introduction, Constituents of nuclei, Nuclear size, Nuclear magnetic moment, Electric quadrupole moment, Nuclear spin, Unit of atomic mass (amu), Mass defect, Packing fraction, Packing fraction curve, Binding energy, B.E. curve, Nuclear forces, Liquid drop model, Semiempirical B.E. formula, Magic numbers, Introduction of elementary particles. **2. Particles Accelerators** Need of accelerators, Types of accelerators (Qualitative) orbital accelerators, Cyclotron, (Principle, construction, working, theory, merits, demerits). Limitation of cyclotron, Synchrocyclotron, (construction, working, theory). Betatron, (principle, construction, working, mathematical theory, merits) Accelerators in India.	18
Unit 2	**1. Nuclear Radiation Detectors** Introduction : Ionization chamber, G. M. counter, (principle, construction, working mechanism, limitations, merits) Scintillation Counter (principle, construction, working, advantages) Introduction to cosmic radiations, Wilson cloud chamber, Bubble chamber. **2. Radioactive Decay**	18

	Natural radioactivity, Artificial radioactivity, Study of alpha decay by magnetic spectrograph, Velocity of alpha particles, Range of α- particles, α-disintegration energy, fine structure of α- rays. Beta decay, Study by β - ray spectrometer, continuous nature, neutrino hypothesis, Gamma Decay, origin & gamma rays, γ- ray spectrum, internal conversion, Isomerism.	

Reference Books

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
5. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
6. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde(IOP-Institute of Physics Publishing, 2004).
7. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
8. Theoretical Nuclear Physics, J.M. Blatt &V.F.Weisskopf (Dover Pub.Inc., 1991)
9. Nuclear Physics by John Lilley,The Manchester Physics Series – Willy
10. Nuclear Physics by S. B. Patel, New age international (p) lit. Publishers New Delhi.
11. Modern Physics by R. Murugeshan, S. Chand & company Ltd, Ram Nagar New Delhi
12. 12. Nuclear Physics by D. C. Tayal, Himalaya Publishing house
13. Concept of modern physics by Arthir Beiser, Tata McGraw- Hill publishing company ltd. New Delhi
14. Atomic and nuclear structure by D. K. JHA, Discovery publishing house New Delhi
15. Nuclear energy by D. K. JHA Discovery publishing house New Delhi)
16. Nuclear physics by S. N. Ghoshal , S. Chand & company Ltd, Ram Nagar New Delhi

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR.
B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023
Semester V
PHYSICS Paper XI
Discipline Specific Elective Course (DSE-1001E3)

Quantum Mechanics

Theory: 36 Hours (45 Lectures of 48 minutes)
Marks: 50 (Credits:02)

CO's:

After completion, Students are able to:

1. Define Concept of wave packet and Uncertainty principle.
2. Understand Schrödinger time dependent and time independent wave equations
3. understand applications of Schrodinger equation.
4. understand operators, Commutation relations and Hilbert space.

Unit	Syllabus	Lectures
Unit 1	**1. Introduction to Quantum Mechanics** Origin of quantum mechanics, Review of black body radiation, Photoelectric effect, matter waves, De-Broiglie hypothesis , experimental evidence of de Broglie theory (Davisson and Germer experiment), wave particle duality, Heisenberg's uncertainty principle and different forms uncertainty principle **2. The Schrodinger's Equation** Physical interpretation of wave function, Schrodinger's time dependent and independent equation (one and three dimensional) Requirements of wave function, Eigen value, Eigen function, Normalized orthogonal and orthonormal wave functions, Probability current density (Continuity equation). Examples on Normalization of wave function **3. Operator in Quantum Mechanics** Definition of an operator in quantum mechanics, commutation relation in quantum mechanics, position, momentum and angular momentum operator, Angular momentum operator in spherical polar coordinate system, Hamilton operator, Hamilton operator commutation relation between x' and p. Expectation value of an operator communication relation between L2 and components of L, Raising and lowering operator L+ and L-. Eigen values of L2 and L1. Concept of parity operator. Concept of Hermitian operator.	18
Unit 2	**1. Applications of Schrodinger's Steady State Equation** Quantum mechanics treatment of particle in rigid box (1D and 3D). Step potential relation and transmission coefficient. Barrier potential- Tunnelling effect, α-decay, simple harmonic oscillator. 2. Quantum Theory of Hydrogen Atom Schrodinger's equation in spherical polar co-ordinates, Schrodinger's equation for hydrogen atom in spherical polar co-coordinators (r, θ, ϕ), separation of angular and radial part and their solution, quantum numbers. n, l, ml, ms and their significances.	18

Reference Books:

1. A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, 2nd Edn..2010, Tata McGraw Hill,
2. Quantum Mechanics, Leonard I. Schiff, 3rdEdn. 2010, Tata McGraw Hill.
3. Quantum Mechanics Theory and Applications, A.K. Ghatak and S Lokanathan,1995,Macmillan India Ltd.
4. Quantum MechanicsTheory and Applications,Ajoy Ghatak and S. Lokanathan, 5th Ed., 2017. Trinity.
5. Quantum Mechanics,Chatwal and Anand, Reprint 2010, Himalaya Publishing house
6. Quantum Mechanics, Gupta, Kumar, Sharma, Thirtieth Ed., 2011, Jai PrakashNath Publications.
7. Advanced Quantum Mechanics, SatyaPrakash, Reprint 2011, KedarNath Ram Nath Meerut.
8. Advanced Quantum Mechanics, B. S. Rajput, Ninth Ed., 2009, PragatiPrakashan.
9. Quantum Mechanics, B. N. Srivastava, Reprint 2011, PragatiPrakashan.
10. Quantum Mechanics, P. J. E. Peebles, 2003, Prentice Hall of India.
11. Quantum Mechanics, S. P. Singh,M. K. Bagde, Kamal Singh, S. Chand& company Ltd, New Delhi
12. Modern Physics, R. Murugeshan, 1997, S. Chand & Company Ltd.
13. Atomic Physics J. B. Rajam, S.Chand& Company Ltd.
14. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill International Editions.
15. Concepts of Modern Physics,ArthurBeiser, Shobhit Mahajan, S. Rai Choudhury, Sixth Edition, Tata McGraw Hill Education Private Ltd.
16. Modern Physics, S. L. Kakani and Shubhra Kulkarni, 2006, Viva books Private Ltd.
17. Modern Physics, D. L. Sehgal, K. L. Chopra and N. K. Sehgal, Reprint 1995, Sultan Chand & sons.
18. Introduction to Modern Physics, F. K. Richtmyer, E. H. Kennard, John N. Cooper, Sixth Edition, Tata McGraw Hill Education Private Ltd.

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR.

B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023

Semester V

PHYSICS Paper XII

Discipline Specific Elective Course (DSE-1001E4)

Solid State Physics I

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks : 50 (Credits:02)

CO's :

After completion, students are able to

1. define various types of solids depending on crystal structure
2. know different methods for structural analysis of crystal
3. explain concept of energy bands in solid
4 explain superconductivity phenomenon and its types

Unit	Syllabus	Lectures
Unit 1	**1. Crystal Structure** Types of the solids, Amorphous, crystalline, lattice, lattice translation vectors, lattice with basis (Central , non central elements) Unit cell , Examples of crystal structure NaCl, KCl, ZnS, Diamond, Miller Indices, Calculations of coordination number, lattice constant, reciprocal lattices, types of lattices, Brillouin Zones, Diffraction of X-rays, Bragg's law, atomic, geometrical factor, Bragg's X-ray spectrometer, **2. Lattice Vibration and Thermal Properties of Solid** Lattice vibrations, Phonons, normal modes of one dimensional and diatomic chain, Acoustical and optical phonons, Phonons spectrum in solids, Dulong Petit's law (Classical Theory), Einstein and Debye theories of specific heat of solids.	18
Unit 2	**1. Magnetic Properties of Materials** Magnetic materials, permeability, susceptibility, magnetization, magnetic moment, electron spin, Diamagnetic materials, Paramagnetic materials, ferromagnetic, ferromagnetic, classical theory of diamagnetism and paramagnetism, Curie law, Curie constant, Weiss theory of ferromagnetism, and ferromagnetic domain, Hysteresis loop for ferromagnetic materials. **2. Superconductivity** Idea of superconductivity, Critical temperature, Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth, Isotope effect	18

Reference Books:

1. Introduction to Solid State Physics-Charles Kittle, 8th Ed.,2004,Wiley India Pvt. Ltd.
2. Elements of Solid State Physics - J.P. Srivastava, 2nd Ed., 2006,Prenice-Hall of India
3. Introduction to Solid - Leonid V.Azaroff,2004,Tata Mc-Graw Hill
4. Solid State Physics - Neil W. Aschroft and N. David Mermin, 1976, Cengage Learning
5. Solid State Physics ,Rita John,2014,Mc-Graw Hill

6. Solid State Physics, Adrianus J. Dekker, Macmillan Publishers India Ltd.
7. Solid State Physics, M.A.Wahab,3rd Ed.,2018,Narosa Publishing House Pvt. Ltd.
8. Solid State Physics, S.O.Pillai,5th Ed., New Age International(P) Ltd., Publishers.
9. Fundamentals of Solid State Physics, Saxena-Gupta- Saxena, (Pragati Prakashan Meerut)
10. Solid State Physics : R. L. Singhal
11. Solid State Physics- C.M. Kachhava (Tata McGraw Hill Publication)
12. Elements of X-ray diffraction – B.D.Cullity and Stock

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR.

B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023

Semester VI

PHYSICS Paper XIII

Discipline Specific Elective Course (DSE-1001F1)

Semiconductor Devices and Instrumentation

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks : 50 (Credits:02)

CO's :

After completion, students are able to

1. learn about the CRO, IC's.
2. Understand the knowledge of digital electronics.
3. Know the devices made up of semiconductors
4. develop critical skill of device fabrication

Unit	Syllabus	Lectures
Unit 1	**1. Instrumentations: Introduction to CRO** Block Diagram of CRO. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. **2. Special functions of ICs** IC 555, Block diagram and special functions if ICs, Astable Operation: Circuit diagram, frequency of oscillation and duty cycle, Applications as tone brust oscillator, voltage-controlled frequency shifters. Monostable operation: circuit diagram, Applications as touch switch and frequency divider. Bistable Operation: Circuit diagram and circuit action. **3. Digital Electronics** Introduction to logic gates, De-Morgan's theorem, NAND and NOR gates as universal gates, R-S and J-K flip flops, half and full adder, parallel binary adder. **4. Semiconductor Devices** Introduction to semiconductor devices, p-n junction diode: current flow mechanics in forward and reversed biased diode, characteristics of p-n junction diode, static and dynamic resistance, Principle, construction and working of (1) LEDs (2) Photodiode (3) Solar Cell.	18
Unit 2	**1. Bipolar Junction transistors** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC	18

	Configurations. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q point. Active, Cut-off, and Saturation Regions. Voltage Divider Bias Circuit for CE Amplifier. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance, Current, Voltage and Power Gains. 2. **Operational Amplifiers (Black Box approach)**: Introduction of differential amplifier and its types, symbol of Op-Amp, different parameters of Op-Amp, Characteristics of Op-Amp (IC 741), Open-loop & Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator	

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronic devices and circuits, S. Salivahanan and N.Suresh Kumar, 2012, Tata Mc-Graw Hill. • Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning.
3. Modern Electronic Instrumentation & Measurement Tech.,Helfrick&Cooper,1990, PHI Learning
4. Digital Principles & Applications, A.P.Malvino, D.P.Leach&Saha, 7th Ed.,2011, Tata McGraw Hill
5. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
6. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd 7.Basic Electronics: A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1994, McGraw Hill.

8.Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR.

B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023

Semester VI

PHYSICS Paper 10

Discipline Specific Elective Course (DSE-1001F2)

Classical Mechanics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks : 50 (Credits: 02)

CO's :

After completion of the unit, Students are able to:

1. define constraints, Degree of freedom and generalized coordinates etc., and understand principle of virtual work and D'Alembert's principle.
2. derive Lagrange's equation from D'Alembert's principle and understand its of Langrange's equation.
3. define Inertial and Non–Inertial reference frames, Understand Michelson Morley Experiment, define Relativistic addition of velocities, Length contraction, Time dilation. Describe mass energy relation.
4. Define Poisons and Laplace equation and their physical significance and describe motion of charged particles in electric and magnetic fields

Unit	Syllabus	Lectures
Unit I	**1. Lagrangian Dynamics** Introduction Basic Concepts: (1) Co-ordinate system (2) Degrees of freedom; Constraints: Holonomic constraints, Nonholonomic constraints,	18

	Forces of constraints, Configuration space, Generalized Co-ordinates, Principle of virtual work, D'Alembert's principal. Lagrange's equation from D'Alembert's principle. Application of Lagrange's equation to a particle in a space, Atwood's machine and bead sliding on uniformly rotating wire under force free condition, simple pendulum **2. Variational principles** Hamilton's principle, Deduction of Hamilton's principle from D' Alembert's principle, Deduction of Lagrange's equation from Hamilton's principle. Application of Hamilton's principle: shortest distance between two points in plane, Brachistochrone problem.	
Unit 2	**1. Non-inertial and Rotating co-ordinate system** Inertial and non-inertial framed of reference Fictitious or Pseudo force, centrifugal force, uniformly rotating frame, Motion relative to earth. Application of Coriolis force: 1) Formation of cyclone, 2) Particles in a horizontal plane, 3) Freely falling body at earth's surface **2. Special theory of Relativity** Introduction: Galilean transformation, the Michelson-Morley experiment, Ether hypothesis Postulates of special theory of relativity, Lorentz transformations, Relativistic addition of velocities, Length contraction, Time dilation, Variation of mass with velocity, Mass energy relation.	18

Reference Book:

1) Classical mechanics by Goldstein Herbert.

2) Classical mechanics by Gupta, Kumar & Sharma.

3) Classical mechanics by J.C.Upadhyay

4) Classical mechanics by Takwale R.G. & Puranik P. S.

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR.

B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023

Semester VI

PHYSICS Paper 11

Discipline Specific Elective Course (DSE-1001F3)

Elements of Modern Physics

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks : 50 (Credits: 02)

CO's:

After completion, students are able to

1. understand atomic structure, atomic models and atomic spectra.
2. understand fine structure and Zeeman effect.
3. understand Rotational and Vibrational spectra, Raman Effect and Characteristic properties of Raman lines.
4. understand Milky Way galaxy and origin of solar system.

Unit	Syllabus	Lectures
Unit 1	**1. Atomic Physics** Quantum numbers , spatial quantization, vector atom model, Alkali Spectra, Optical spectral series, Spectral term spectral notation, energy level diagram of sodium, spin orbit interaction Zeeman effect, Explanation of Anomalous Zeeman effect on vector atom model, Anomalous Splitting of D1 and D2 Line 2. Molecular Physics Molecular system, type of bonds, diatomic molecule as a rigid rotator rotational states of diatomic molecule, Raman effect, Experimental study of Raman effect, classical theory of Raman effect, Applications of Raman effect.	18
Unit 2	**1. Laser Physics** Ordinary Light, Laser, Spontaneous and stimulated emission, Populations Inversion, Monochromaticity, directionality , Pumping (optical, electrical) Ruby laser He-Ne laser, Diode laser, Laser applications, (Industrial, medical, nuclear, optical) , Types of lasers **2. Space Science** Cosmology, Big-bang theory, oscillating theory, steady-state theory, Hubble's law, cosmological tests, Milky way galaxy, our solar system, features of sun, interior of sunspots, static characteristics of earth and mars.	18

Reference books:

1. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
2. Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
3. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill
4. Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage LearningModern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill

VIVEKANAND COLLEGE (AUTONOMOUS), KOLHAPUR.

B.Sc. Part III Physics CBCS Syllabus with effect from June, 2023

Semester VI

PHYSICS Paper 12

Discipline Specific Elective Course (DSE-1001F4)

Solid State Physics II

Theory: 36 Hours (45 Lectures of 48 minutes)

Marks : 50 (Credits: 02)

CO's:

After completion, students are able to

1. know about free electron theory, band gap energy, Hall effect
2. know about dielectric properties of material
3. explain concept of X-ray diffraction
4. analyze different materials with the help of x-ray diffraction pattern

Unit	Syllabus	Lectures
Unit 1	**1. Elementary band theory** Introduction of free electron theory (Classical and Quantum mechanical) , Kronig Penny model, Effective mass of an electron, Band Gaps. Conductors,	36

	Semiconductors, and insulators. P and N type semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall voltage and Hall coefficient. **2. Dielectric Properties of Materials** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons. **3. X-Ray Diffraction** Reciprocal lattice and its properties, concept of Brillouin zone , diffraction of X-rays by crystals, Ewald construction, Bragg's law in reciprocal lattice, X-ray diffraction methods: 1) Laue method. 2) Rotating crystal 3) Powder method - Principle, Construction, Working , analysis of cubic crystal by powder crystal method	

Reference Books:

1. Introduction to Solid State Physics-Charles Kittle, 8th Ed.,2004,Wiley India Pvt. Ltd.
2. Elements of Solid State Physics - J.P. Srivastava, 2nd Ed., 2006,Prenice-Hall of India
3. Introduction to Solid - Leonid V.Azaroff,2004,Tata Mc-Graw Hill
4. Solid State Physics - Neil W. Aschroft and N. David Mermin, 1976, Cengage Learning
5. Solid State Physics ,Rita John,2014,Mc-Graw Hill
6. Solid State Physics, Adrianus J. Dekker, Macmillan Publishers India Ltd.
7. Solid State Physics, M.A.Wahab,3rd Ed.,2018,Narosa Publishing House Pvt. Ltd.
8. Solid State Physics, S.O.Pillai,5th Ed., New Age International(P) Ltd., Publishers.
9. Fundamentals of Solid State Physics, Saxena-Gupta- Saxena, (Pragati Prakashan Meerut)
10. Solid State Physics : R. L. Singhal
11. Solid State Physics- C.M. Kachhava (Tata McGraw Hill Publication) 12. Elements of X-ray diffraction – B.D.Cullity and Stock

B.Sc. III Physics Practical

Total marks: 200 Credits: 08

Laboratory Experiments

Group - I (General Physics)

1) Resonance pendulum.
2) S. T. of soap solution.
3) S. T. by Fergusson modified method.
4) Y & η using flat spiral spring.
5) 'Y' by Koenig's method. 6) 'Y' by cornu's method.
7) Measurement of heat capacity of solid.
8) S. T. tension by drop weight method.
9) 9) Young's modulus by vibration using AFG.

Group - II (Optics)

1) Cardinal points by turn table method.
2) Cardinal points by Newton's method.
3) Diffraction at single slit.
4) Diffraction at cylindrical obstacle.
5) Diffraction at straight edge
6) Lloyd's single mirror.
7) Double refracting prism
8) Diameter of lycopodium powder.
9) Spherical aberration.
10) Absorption of spectrum of $KMno_4$ solution.

Group - III (Electricity Magnetism)

1) Self inductance by Owen's bridge.
2) Self inductance by Rayleigh's method.
3) Self inductance by Maxwell bridge.
4) Measurement of B_V, B_H and θ using earth inductor.
5) Hysteresis by magnetometer.
6) e/m of electron by Thomson's method.
7) Measurement of dielectric constant.
8) Resistivity of semiconductor crystal with temperature by four probe method.
9) Calibration of wire using Carey-foster key.

Group - IV (Electronics)

1) UJT as voltage sweep generator.
2) Astable multivibrator by using IC 555 timer.
3) Monostable multivibrator by using IC 555 timer.
4) IV characteristics of P-N diode and LED.
5) Inverting amplifier using op - Amp 741.

6) I - V characteristics of solar cell.
7) Band gap energy of semiconductor using P-N junction.
8) Determination of plank's constant.
9) FET characteristics.
10) FET as VVR.

Group - V (A)

1) Study of divergence of LASER beam.
2) Measurement of wavelength of LASER using grating.
3) Lattice constant using XRD powder.
4) To measure numerical aperture of optical fibre.
5) Obtain interference fringes using Biprism.
6) Thermal expansion of Quartz using LASER. 7) Measurement of refractive index of air.
8) Refractive index of glass by Brewster's law.

Group - V (B)

1) To measure current, voltage, power in D.C, AC, circuits.
2) Assemble of given electronic circuit.
3) Testing of electronic electric component.
4) Resistance of galvanometer by Kelvin method.
5) To verify superposition theorem. 6) To verify millman's theorem.
7) Study of hysteresis using anchor ring and C. R. O.
8) Measurement of active and reactive power in A.C circuit.

Assessment of Annual work of a student

1) Certified laboratory Journal.
2) Study tour / Project report.
3) Seminar report (one seminar per semester)

Practical Examination scheme

1) Practical examination should be annual of total 200 marks.
2) Practical examination duration per batch should be total three days.
3) Every day there should be two sessions of three hours each.
4) Each candidate should perform one experiment in one session from Group - I to Group as V (A) & V (B).
5) There should be a Group VI of 50 marks on certify journal / study tour report / project and seminar report. [Direct viva with Examiner]
6) Seminar report, study tour / project report should be compulsory at the time of Examination.
7) At least eighty percent practical should be complete by the student.

Distribution of Practical Marks
Total = 200 Marks

Groups	Marks
Group - I	30
Group - II	30
Group - III	30
Group - IV	30
Group - V (A)	15
Group - V (B)	15
Group - VI 1) Certified journal 2) Study tour / Project report 3) Seminar report	 20 15 15
Total	200

Skill Enhancement Course (SEC)-III

RENEWABLE ENERGY AND ENERGY HARVESTING

(Credits: 02)

Theory: 30 Lectures

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible

Chapter I: Fossil fuels and Alternate Sources of energy (3 hours) Fossil fuels and Nuclear Energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Chapter II: Solar energy (6 hours)

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.

Chapter III: Wind Energy harvesting (6 hours)

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

Chapter IV: Ocean Energy (5 hours)

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.

Chapter V:Geothermal Energy **(2 hours)**

Geothermal Resources, Geothermal Technologies.

Chapter VI: Hydro Energy **(2 hours)**

Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

Chapter VII: Piezoelectric Energy harvesting (4 hours)

Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modelling piezoelectric generators,

Piezoelectric energy harvesting applications, Human power

Chapter VIII: Electromagnetic Energy Harvesting (2 hours)

Linear generators, physics mathematical models, recent applications

Chapter IX: Carbon captured technologies, cell, batteries, power consumption **(2 hours)**

Chapter X: Environmental issues and Renewable sources of energy, sustainability **(1 hours)**

Demonstrations and Experiments

1. Demonstration of Training modules on Solar energy, wind energy, etc.
2. Conversion of vibration to voltage using piezoelectric materials

3. Conversion of thermal energy into voltage using thermoelectric modules.

Reference Books:

1. Non-conventional energy sources – G.D Rai – Khanna Publishers, New Delhi
2. Solar energy – M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 7.http://en.wikipedia.org/wiki/Renewable energy

Skill Enhancement Course (SEC)-IV
BASIC INSTRUMENTATION SKILLS
(Credits: 02)
(30 Lectures)

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

Basic of Measurement (4 Lectures)

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter: Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

Electronic Voltmeter (4 Lectures)

Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/Multimeter and their significance. AC millivoltmeter: Type of AC millivoltmeters: Amplifier-rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

Cathode Ray Oscilloscope (6 Lectures)

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls, Specifications of a CRO and their significance.

Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working. (3 Lectures)

Signal Generators and Analysis Instruments (4 Lectures)

Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters (3 Lectures)

Block diagram of bridge. working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram& working principles of a Q- Meter. Digital LCR bridges.

Digital Instruments (3 Lectures)

Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter (3 Lectures)

Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/frequency counter, time- base stability, accuracy and resolution.

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages 5.Circuit tracing of Laboratory electronic equipment, 6.Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges **Laboratory Exercises:**

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.

2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/frequency counter.
6. Measurement of rise, fall and delay times using a CRO.
7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

Open Ended Experiments:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

Reference Books:

1) A text book in Electrical Technology - B L Theraja - S Chand and Co.
2) Performance and design of AC machines - M G Say ELBS Edn.
3) Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4) Logic circuit design, Shimon P. Vingron, 2012, Springer.
5) Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6) Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., 2012, Tata McGraw Hill
7) Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
8) Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

- There will be internal evaluation of 15 marks for each paper.
- There will be end semester theory examination of 35 marks for each paper.
- The total marks for each paper will be 50.
- **There will be separate passing for internal evaluation, end semester theory examination, practical examination and Skill Enhancement Courses**

Paper No.	Internal evaluation	End Semester Theory Examination	Total
IX	15	35	50
X	15	35	50
XI	15	35	50
XII	15	35	50
XIII	15	35	50
XIV	15	35	50
XV	15	35	50
XVI	15	35	50

- **There will be separate examination of 100 marks for Skill Enhancement Courses (SEC's) of all three subjects together of B.Sc. III at the end of semester VI (Conducted by College Examination Cell)**

Nature of Question Paper
(End Semester Examination)

Instructions:

1) All the questions are **compulsory**.
2). Figures to the right indicate **full** marks.
3) Draw neat labeled diagrams **wherever** necessary.

Time: 2 hours **Total Marks: 35**

Q:1] Chose correct alternative

A] **FIVE** Multiple Choice Questions 5 Marks

1.

2.

3.

4.

5.

B] **TWO** fill in the blanks 2 Marks

1.
2.

Q:2] Long Answer questions (Attempt any **TWO** out of three) 16 Marks

1.
2.
3.

Q.3] Short Answer questions (Attempt any **THREE** out of five) 12 Marks

1.
2.
3.
4.