SYLLABUS

Under Graduate (UG) Course CBCS

for

Subject- Physics

(Under National Education Policy-2020)

B.Sc. Part I (Semester I & II) for Session 2024-25
B.Sc. Part II (Semester III & IV) for Session 2025-26
B.Sc. Part III (Semester V & VI) for Session 2026-27

DEPARTMENT OF PHYSICS
JAI NARAIN VYAS UNIVERSITY, JODHPUR

Titles of the Courses in B.Sc. (Physics) as per NEP-2020 w.e.f Session 2024-25

	Sem	Course Type	Course code	Course Title	L/W	P/W	H/W	Total Hrs.	Credits	Total Credits	CA	EoSE	M.M.
Level-5 (NHQEF-4.5)	I	DCC	PHY5001T	Mechanics	4	0	4	60	4	6	30	70	100
			PHY5001P	Mechanics Lab	0	2	4	60	2		30	70	100
	II	DCC	PHY5002T	Optics	4	0	4	60	4	6	30	70	100
			PHY5002P	Optics Lab	0	2	4	60	2		30	70	100
Level-6 (NHQEF-5)	III	DCC	PHY6001T	Electromagnetics	4	0	4	60	4	6	30	70	100
			PHY6001P	Electromagnetics Lab	0	2	4	60	2		30	70	100
		SEC	SEC6321T	Application of Software Packages	2	0	2	30	2	2	30	70	100
	IV	DCC	PHY6002T	Thermal & Statistical Physics	4	0	4	60	4	6	30	70	100
			PHY6002P	Thermal & Statistical Lab	0	2	4	60	2		30	70	100
		SEC	SEC6322T	Energy Resources : Harvesting and Storage	2	0	2	30	2	2	30	70	100
Level-7 (NHQEF-5.5)	V	DSE	PHY7101(A)T or PHY7101(B)T*	Electronics or Computer Systems & Networking*	4	0	4	60	4	6	30	70	100
			PHY7101(A)P Or PHY7101(B)P*	Electronics Lab Or Elementary Computer Lab*	0	2	4	60	2		30	70	100
			PHY7102T	Quantum Mechanics & Spectroscopy	4	0	4	60	4	6	30	70	100
			PHY7102P	Advanced Physics Lab	0	2	4	60	2		30	70	100
		SEC	SEC6323T	Ceramic Glasses : Synthesis and Applications	2	0	2	30	2	2	30	70	100
	VI	DSE	PHY7103T	Solid State Physics	4	0	4	60	4	6	30	70	100
			PHY7103P	Solid State Physics Lab	0	2	4	60	2		30	70	
			PHY7104T	Nuclear Physics	4	0	4	60	4	6	30	70	100
			PHY7104P	Modern Physics Lab	0	2	4	60	2		30	70	100
		SEC	SEC6324T	Advances in Nano-materials & Technology	2	0	2	30	2	2	30	70	100

*Only for the students offering Electronics as one of the subject.

DCC – Discipline Centric Core Course; DSE - Discipline Specific Elective Course; L/W – Lecture per week; P/W- Practical per week; H/W – Hours per week, CA – Continuous Assessment; EoSE – End of Semester Examination, M.M. – Maximum marks, NHEQF – National Higher Education Qualification Framework Level

Titles of the Courses in B.Sc. (Physics) First Year as per NEP-2020
Session 2024-25

Level-5 (NHEQF Level -4.5)											
Semester-I											
Course Type	**Course code**	**Course Title**	**L/W**	**P/W**	**H/W**	**Total Hrs.**	**Credits**	**Total Credits**	**CA**	**EoSE**	**M.M.**
DCC	PHY5001T	Mechanics	4	0	4	60	4	6	30	70	100
	PHY5001P	Mechanics Lab	0	2	4	60	2		30	70	100
Semester-II											
DCC	PHY5002T	Optics	4	0	4	60	4	6	30	70	100
	PHY5002P	Optics Lab	0	2	4	60	2		30	70	100

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L/W – Lecture per week; P/W- Practical per week; H/W – Hours per week,
CA – Continuous Assessment; EoSE – End of Semester Examination,
M.M. – Maximum marks, NHEQF – National Higher Education Qualification Framework Level

Semester-I

Course Code- PHY5001T

Mechanics

UNIT-1

Elasticity : Young modulus, Bulk modulus and modulus of rigidity, Poisson ratio, relation between elastic constants, Theory of bending of a beam, cantilever, torsion of a cylinder, experimental determination of Y by loading a beam in the middle, experimental determination of η by static and dynamic methods, experimental determination of Poisson ratio using rubber tube, Searle's two bar experiment.

UNIT-2

Frames of Reference: Inertial frames, Galilean transformations, Non-inertial frames, fictitious forces, Displacement, Velocity and acceleration in rotating coordinate systems and their transformations, Coriolis force, Focault's pendulum, Motion relative to earth. Centre of Mass, Head-on elastic collision of particles in laboratory and C.M. frame.

UNIT-3

Special Theory of Relativity: Invariance of c, Michelson-Morley Experiment, Lorentz transformations, addition of velocities, time dilation and length contraction, conservation of momentum in collision at relativistic speeds and variation of mass with velocity, relativistic energy, mass-energy equivalence, work and energy, transformation equations for momentum, energy and rate of change of momentum.

UNIT-4

Oscillations: Qualitative idea of oscillations in an arbitrary potential well, General differential equation for the harmonic motion, mass on a spring, oscillation of two masses connected by a spring, reduced mass, coupled oscillations, normal modes, normal coordinates of two linear coupled oscillators, damped harmonic motion, Forced oscillations and resonances, Resonance width and quality factor.

UNIT-5

Waves: General differential equation of one dimensional wave motion and its solution, plane progressive harmonic wave, differential calculus methods for speed of transverse waves on a uniform string and for that of longitudinal waves in a fluid, energy density and energy transmission in waves, superposition of waves, group and phase velocity.
Fourier series, Fourier analysis of square and saw-tooth waves.

Books suggested:

Berkeley: Physics Course, Vol. I, Mechanics, Tata McGraw Hill, New Delhi.
Berkeley: Physics Course, Vol. III, Waves and Oscillations, McGraw Hill, New Delhi.
A. P. French: Physics of Vibration and Waves.
R. S. Gambhir: Mechanics, CBS Publishers.
J.C. Upadhyaya: Mechanics, Ram Prasad & Sons, Agra.

Course Code- PHY5001P

Mechanics Lab

1. Determination of Young's modulus by bending of a beam.
2. Determination of Modulus of rigidity by statical method using Barton’s apparatus (horizontal mode).
3. Determination of Modulus of rigidity by statical method using Barton’s apparatus (vertical mode).
4. Determination of Modulus of rigidity by dynamical method using hollow Maxwell needle.
5. Determination of Modulus of rigidity by dynamical method using solid Maxwell needle.
6. Determination of Elastic constants by Searle's method.
7. To determine the Poisson's ratio of a rubber tube.
8. Determination of low resistance by Carey Foster Bridge.
9. Determination of surface tension of water by Jagger's method.

Note: - New experiments may be added on availability of equipments.

Semester-II

Course Code- PHY5002T

Optics

UNIT-1

Geometrical Optics: Axial, Lateral and angular magnifications and their inter-relationship, Abbe's Sine condition for spherical surfaces, Aplanatic points for a spherical refracting surface.

Focal length of two thin lenses separated by a distance, Cardinal points of a co-axial lens system, properties of cardinal points, construction of image using cardinal points, Newton's formula and other relations for a lens system using cardinal points, Ramsden's and Huygen's eye pieces, their cardinal points, and relative merits.

Spherical Aberration in lenses and methods to minimize it. Chromatic Aberration in lenses, Achromatism for two thin lenses in contact and separated by a distance.

UNIT-2

Interference: Division of Amplitude-Interference exhibited by thin film, Production of colours in thin films, Wedge-shaped film, Newton's rings and determination of wavelength and refractive index of a liquid by Newton's rings.

Michelson Interferometer: Measurement of wavelength and difference between two close wavelengths. Fabry-Perot interferometer: Intensity Distribution, Co-efficient of sharpness and half width, measurement of wavelength.

UNIT-3

Lasers: Population inversion, laser as source of coherent radiation, Einstein's coefficients and their inter relations, Basic principles of He-Ne Laser and Ruby Laser

Diffraction: Fresnel's class of diffractions, Zone Plate, Phase reversal Plate, Cylindrical wave front and its effect at an external point and geometrical construction, diffraction at a straight edge; thin wire, rectangular slit and circular aperture.

UNIT-4

Fraunhofer class of diffraction: Amplitude and phase due to a number of SH Motions acting on a particle simultaneously, Diffraction at two slits and intensity distribution, Diffraction at N slits.

Plane Transmission Grating: Theory and formation of spectra, width of principal maxima, absent spectra, overlapping of spectral lines, number of spectra, measurement of wave-length of light, Rayleigh's criterion, Resolving Power of a Prism and plane transmission grating.

UNIT-5

Polarization: Double refraction, production of plane polarized light by double refraction, Nicol Prism, Double refraction in uniaxial crystals, Huygen's explanation of Double Refraction, Plane, circular and elliptically polarized light, Half-wave and quarter-wave plates, production and detection of plane, circularly and elliptically polarized light by Nicol Prism and Quarter-wave plate. Rotatory Polarization, Fresnel's explanation, specific rotation, half shade and Biquartz Polarimeter, determination of specific rotation and strength of sugar solution.

Books suggested:

Jenkins and White: Optics, McGraw Hill.
Ghatak A.K.: Optics, Tata McGraw Hill.
Khandelwal D.P.: Optics and Atomic Physics, Shivlal Agarwal & Co.
Subramanayam and Brijlal: A text book of Optics, S. Chand, New Delhi.

Course Code- PHY5002P

Optics Lab

1. Determination of focal length of combination of two lenses, separated by finite distance using nodal slide assembly and also locate the cardinal points.
2. Determination of dispersive power of the material of a prism using spectrometer.
3. Determination of wavelength of monochromatic light (Sodium/ Laser) by Newton's rings.
4. Determination of wavelength of light by plane transmission grating.
5. Determination of specific rotation of sugar solution by polarimeter.
6. Verification of Malus's law.
7. Determination of resolving power of a plane transmission grating.

Note: - New experiments may be added on availability of equipments.

Titles of the Courses in B.Sc. (Physics) Second Year as per NEP-2020
Session 2025-26

Level-6 (NHEQF Level-5)											
Semester-III											
Course Type	**Course code**	**Course Title**	**L/ W**	**P/ W**	**H/ W**	**Total Hrs.**	**Cre dits**	**Total Credits**	**CA**	**EoSE**	**M.M.**
DCC	PHY6001T	Electromagnetics	4	0	4	60	4	6	30	70	100
	PHY6001P	Electromagnetics Lab	0	2	4	60	2		30	70	100
SEC	SEC6321T	Application of Software Packages	2	0	2	30	2	2	30	70	100
Semester-IV											
DCC	PHY6002T	Thermal & Statistical Physics	4	0	4	60	4	6	30	70	100
	PHY6002P	Thermal & Statistical Lab	0	2	4	60	2		30	70	100
SEC	SEC6322T	Energy Resources : Harvesting and Storage	2	0	2	30	2	2	30	70	100

DCC – Discipline Centric Core Course; DSE - Discipline Specific Elective Course;
L/W – Lecture per week; P/W- Practical per week; H/W – Hours per week,
CA – Continuous Assessment; EoSE – End of Semester Examination,
M.M. – Maximum marks,
NHEQF – National Higher Education Qualification Framework Level

Semester-III

Course Code- PHY6001T

Electromagnetics

Unit 1:
Vector Analysis: Scalar and Vector fields, partial differentiation of vector, gradient of a scalar field, line and surface integral of vector field, flux of a vector field, divergence of vector field and its physical significance, curl of vector field and its physical significance. Gauss law in integral and differential forms, Gauss divergence theorem, Stokes curl theorem and Green's theorem, Poisson's and Laplace equations in Cartesian coordinate, Uniqueness theorem.

Unit 2:
Electrostatics: Potential and field due to an arbitrary charge distribution, concept of multipoles, Electrostatic energy of a uniformly charged sphere. Classical radius of an electron.
Electric field in matter : Boundary condition for electrostatic field at dielectric surface . Atomic and molecular dipoles, polarizability, polarization Vector, electric displacement vector, electrostatic energy of a charge distribution in dielectrics. Lorentz local field and Clausius-Mossotti equation.

Unit 3:
Magnetic field in matter: Magnetization Vector, uniform magnetization and surface current, non-uniform magnetization, B,M,H Vectors and their inter-relations, Magnetic Susceptibility.
Integral and differential form of Faraday's law of electromagnetic induction, Relation between self and mutual inductance, measurement of self-inductance by (i) Rayleigh method (ii) Anderson Bridge, Energy stored in magnetic field.

Unit 4:
Transient response: Rise and decay of current in (i) CR and (ii) LR circuits, time constant, Resonance, Power Dissipation, Quality Factor and Band Width in (i) series LCR circuit and (ii) parallel LCR circuit.
Principle construction and working of ballistic galvanometer, determination of constant of ballistic galvanometer using steady deflection method, determination of high resistance by method of leakage; determination of mutual inductance using B.G.

Unit 5:
Electromagnetic Waves: Displacement current, Maxwell's equations, Electromagnetic wave equation, Poynting theorem, Plane Electromagnetic waves in free space, Plane Electromagnetic waves in non-conducting medium, Interaction of Electromagnetic waves with matter: Normal and anomalous dispersion of light, empirical relations for dispersion (without derivation).

Books suggested:
Berkeley: Physics Course, Vol. II: Electricity and Magnetism, Tata McGraw Hill.
Laud, B.B.: Electro-magnetics, Wiley Eastern.
Ahmed and Lal: Electricity, Magnetism and Electronics.
D.C. Tayal: Electricity and Magnetism, Himalaya Publishing House
A.S. Mahajan A.A. Rangwala: Electricity and Magnetism, Tata McGraw Hill.
Griffiths: Introduction to Electrodynamics, PHI.
S.P. Puri: Electrodynamics, Tata McGraw Hill
J.D. Jackson: Classical Electro-dynamics, John Wisely, New York

Course Code- PHY6001P

Electromagnetics Lab

1. Study of variation of magnetic field along the axis of circular coil and determination of diameter of the coil.
2. Study of charging and discharging of R-C (D.C.) circuit.
3. Study of electro-magnetic induction and verification of Faraday's Laws.
4. Study of phase relationship of L-R circuit.
5. Study of phase relationship of C-R circuit.
6. Study of phase relationship of L-C-R circuit.
7. Determination of ballistic constant of a ballistic galvanometer by steady deflection method.
8. Determination of high resistance by method of leakage.
9. Determination of mutual inductance of a coil.
10. Determination of ballistic constant of a ballistic galvanometer using condenser.
11. Determination of unknown capacitance by De-Sauty's Bridge.
12. Determination of unknown inductance of coil by Anderson's bridge

Note: - New experiments may be added on availability of equipments.

Course Code- SEC6321T

Application of Software Packages

Unit-1

Software packages, system software and application software packages, general purpose application software packages, MS office Package, components of MS office, MS word: word documents, editing tools, font types, font size, other editing tools, inserting tables, figures, graphs, symbols and equations, equation editor, page layout, review tools: spelling, grammar and thesaurus

Unit-2

MS Excel: Excel worksheet, data types and range, calculation using Excel, inserting formulas, using common mathematical functions: Log, Exp, factorial, Random Numbers and sum; analysis of data using statistical functions such as: AVERAGE, MEDIAN, MODE, Standard Deviation and other functions, Normal distribution; linear regression, slope and intercept functions, graphs using Excel

Unit-3

Origin Software Package: Origin Worksheet, different type of graphs in Origin, drawing multiple graphs on single page, style, color and size, formatting axis and scales, tick labels and borders, graph labels and captions, adding error bars to the graphs, saving and printing graphs, exporting graphs, curve fitting in graphs, fitting the user defined function, interpolate data.

Books Suggested

Alexander Mamishev and Murray Sargent, Creating Research and Scientific Documents Using Microsoft Word, Microsoft Press (2013).

Les Kirkup, Data Analysis with Excel: An introduction for Physical Scientists, Cambridge University Press, Cambridge U.K. (2002).

Semester-IV

Course Code- PHY6002T

Thermal & Statistical Physics

Unit-1 :
Elementary Statistics: probability, binomial distribution, distribution of *n* molecules in two halves of a box, distribution corresponding to maximum and minimum probability, standard deviation, fluctuations and their dependence on *n*, thermodynamic probability, macrostate & microstate, principle of *equal a priori* probabilities, phase space and phase cells, accessible and inaccessible states, number of accessible states between an infinitesimally small energy interval E and E+ΔE, elementary concept of ensembles, statistical ensemble, time and ensemble averages;

UNIT-2 :
Thermal interactions, condition of thermal equilibrium between two systems, β parameter and its identity with (1/kT), zeroth law of thermodynamics, internal energy, first law of thermodynamics, probability and entropy, boltzmann entropy relation, entropy of a perfect gas, entropy change in isothermal and adiabatic expansions of an ideal gas.
reversible and irreversible process, carnot's cycle, carnot engine & efficiency, carnot theorem, second law of thermodynamics, kelvin-planck and clausius statements and their equivalence. thermodynamic scale of temperature and its equivalence with the perfect gas scale.

UNIT-3 :
Thermodynamic Potentials: extensive and intensive thermodynamic variables, definitions and properties of enthalpy, helmholtz free energy and gibb's free energy, phase transitions, clausius clapeyron equation and vapor pressure curve, maxwell's thermodynamic equations, their applications in deriving values of c_p-c_v and c_p/c_v.
maxwell's speed and velocity distribution function, experimental verification, mean, rms and most probable values of speed, degrees of freedom, law of equipartition of energy, heat capacities of monatomic and diatomic gases

UNIT-4 :
Quantum statistics: distinguishable and indistinguishable particles, Bose-Einstein distribution law, Calculation of the thermodynamic functions of an ideal Bose gas, derivation of Planck's radiation law, Bose Einstein condensation, properties of liquid He (qualitative description),
Fermi-Dirac distribution law, Thermodynamic functions of a degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Richardson's equation of thermionic a emission.

UNIT-5 :
Production of low temperatures: Cooling by Adiabatic expansion, Joule Thomson porous plug experiment, Joule Thomson coefficient for ideal and real gases, Temperature of inversion, Regenerative cooling, cooling by adiabatic demagnetization, third law of thermodynamics, Nernst Heat Theorem.
Transport Phenomena: Mean free path, collision cross-sections, mean free time, Coefficients of viscosity, thermal conductivity and self-diffusion.

Books suggested:
JP Agrawal & Satya Prakash: Thermodynamics and Statistical Mechanics, Pragati Prakashan
JP Agrawal : Thermal and Statistical Mechanics, Pragati Prakashan
Reif : Statistical Physics, Berkeley, Vol. 5, McGraw Hill.
Reif : Fundamentals of Statistical and Thermal Physics, McGraw Hill.
Lokanathan and Gambhir: Statistical and Thermal Physics, Prentice Hall.

Course Code- PHY6002P

Thermal & Statistical Lab

1. Verification of Rutherford and Soddy's law of radioactive disintegration using dices and statistical board.
2. Experimental verification of the first law of thermodynamics by discharging the condenser through resistance.
3. Determination of temperature coefficient of platinum resistance thermometer using Carey Foster Bridge.
4. Determination of the thermodynamic constant $\gamma = C_p / C_v$ using Clement and Desormes' method.
5. Determine thermal conductivity of a bad conductor by Lee's method.
6. Study of Gaussian distribution law using statistical board and dices.
7. Plot thermo e.m.f. versus temperature and find the neutral temperature and temperature of inversion.

Note: - New experiments may be added on availability of equipments.

Course Code- SEC6322T

Energy Resources, Harvesting and Storage

Unit-1

Energy Resources: Need for sustainable energy sources, environmental impact of fossil fuels, global and Indian energy scenario, Classification of energy sources, primary and secondary energy sources, commercial and non-commercial energy sources, conventional & non-conventional sources, renewable & non-renewable sources.

Unit -2

Energy Harvesting Through Renewable Sources: Wind energy, geothermal energy, hydropower, biomass, tidal energy, solar energy & its advantages, fundamentals of solar cells, photovoltaic parameters, losses in solar cells, types of solar cells: inorganic, organic and hybrid solar cells, materials for photovoltaics.

Unit -3

Energy Storage: Energy Storage: Need of energy storage, different modes of energy storage, electrical and magnetic energy storage: Capacitors, electromagnets; chemical energy storage: Thermo-chemical, photo-chemical, bio-chemical, electro-chemical, fossil fuels and synthetic fuels, Hydrogen for energy storage.

Books Suggested:

1. Non-Conventional Energy Sources: G. D. Rai, Khanna Publishers, New Delhi.
2. Non-Conventional Energy Resources: Shobh Nath Singh, Pearson.
3. Renewable Energy Resources- Basic Principles and Applications: G. N. Tiwari, M. K. Ghosal, Narosa Publications
4. Solar Photovoltaics; Fundamentals, Technologies & Applications: C. S. Solanki, PHI Learning Pvt. Ltd.
5. Science & Technology of Photovoltaics: P. J. Reddy, BS publications.
6. Fundamentals of Energy Storage: J. Jensen and B. Squrensen, John Wiley, NY.
7. Electrochemical Power Sources: Primary and Secondary Batteries: M. Barak, P. Peregrinus,IEE.
8. Hydrogen and Fuel Cells: Emerging Technologies and Applications, B.Sorensen, Academic Press.

Titles of the Courses in B.Sc. (Physics) Final Year as per NEP-2020
Session 2026-27

Level-7 (NHEQF Level-5.5)											
Semester-V											
Course Type	**Course code**	**Course Title**	**L/ W**	**P/ W**	**H/ W**	**Total Hrs.**	**Cre dits**	**Total Credit s**	**CA**	**EoSE**	**M.M.**
DSE	PHY7101(A)T or PHY7101(B)T*	Electronics or Computer Systems & Networking*	4	0	4	60	4	6	30	70	100
	PHY7101(A)P Or PHY7101(B)P*	Electronics Lab Or Elementary Computer Lab*	0	2	4	60	2		30	70	100
DSE	PHY7102T	Quantum Mechanics & Spectroscopy	4	0	4	60	4	6	30	70	100
	PHY7102P	Advance Physics Lab	0	2	4	60	2		30	70	100
SEC	SEC6323T	Ceramic Glasses : Synthesis and Applications	2	0	2	30	2	2	30	70	100
Semester-VI											
DSE	PHY7103T	Solid State Physics	4	0	4	60	4	6	30	70	100
	PHY7103P	Solid State Physics Lab	0	2	4	60	2		30	70	100
DSE	PHY7104T	Nuclear Physics	4	0	4	60	4	6	30	70	100
	PHY7104P	Modern Physics Lab	0	2	4	60	2		30	70	100
SEC	SEC6324T	Advances in Nano-materials & Technology	2	0	2	30	2	2	30	70	100

*Only for the students offering Electronics as one of the subject.

DCC – Discipline Centric Core Course; DSE - Discipline Specific Elective Course;
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M.M. – Maximum marks, NHEQF – National Higher Education Qualification Framework Level

Semester-V

Course Code- PHY7101(A)T

Electronics

Unit-1:
Intrinsic and extrinsic semi-conductors, Fermi levels, mass-action law; carrier injection, recombination, diffusion and diffusion length, drift and diffusion currents, continuity equation; p-n junction, potential barrier, biasing, current-voltage relation, space charge and diffusion capacitances; varactor diode; Zener diode; tunnel diode; photovoltaic effect, solar cell.
Power supplies: Full wave and half wave rectifiers; ripple factor, voltage regulation; filters; Zener regulation.

Unit-2:
Network theorems – Thevenin, Norton, Maximum power transfer and Miller theorems.
Dipolar junction transistors, Ebers-Moll equations; CB, CE and CC configurations, BJT characteristics; biasing and thermal stabilization, self bias; hybrid parameters of a two port network; small signal hybrid equivalent model of a BJT at low frequencies, current, voltage and power gains; input and output impedances; high frequency hybrid pi model, short circuit current gain, f_β and f_α; current gain with resistive load.

Unit-3:
Field effect transistors, JFET, MOSEET, construction and characteristics; FETs as voltage Controlled Devices, small signal model.
Large signal amplifiers, class A, B and C operations and efficiencies; distortions; determination of second harmonic distortion; push-pull amplifiers; impedance matching.

Unit-4:
Negative Feedback: Current and voltage negative feedbacks; effect on stability, input and output impedances, distortion, frequency response; emitter follower.
Oscillators: Positive feedback, Barkhausen criterion; RC phase-shift oscillator; Hartley and Colpitts oscillators, UJT and sweep generators using UJT; Transistor as a switch and Astable multi-vibrator.

Unit-5 :
Operational amplifiers, inverting and non-inverting; differential amplifiers, CMRR; measurement of OP AMP parameters; use of OP AMPs as adder, in analog integration and differentiation.
Digital circuits: Laws of Boolean algebra and De-Morgan's theorem, realization of Boolean Expression using logic gates

Books suggested:
J. Millman and CC Halkias: Integrated Electronics : Analog and Digital Circuits and Systems, Tata McGraw Hill.
A. Mottertshead: Electronic Devices and Circuits – An Introduction, Prentice Hall India.

Course Code- PHY7101(A)P

Electronics Lab

1. Study of the characteristics of a given transistor (PNP/NPN) in common emitter configuration and find the value of parameter of given transistor.
2. Study the characteristics of rectifier junction diode and Zener diode.
3. Study of ripple factor for shunt capacitor, series inductor, L-section and π section filters using full wave rectifier circuit.
4. Study of operational amplifier (OP-AMP).
5. Study of R-C circuits as integrating and differentiating systems with square input.
6. Study of series and parallel L-C-R resonance circuit.
7. Design and voltage study of AND, OR, NOT, NAND and NOR gates circuits using diodes and transistors.
8. Study the characteristics of field effect transistor (FET).
9. Study of frequency response of single stage transistor amplifier (variation of gain with frequency).
10. Study the negative feedback effect on voltage gain, and input and output impedances of the amplifier.
11. Design and study of RC phase shift oscillator.
12. Determination of parameter of transformer.

Course Code- PHY7101(B)T

Computer Systems & Networking

(Only for the students offering Electronics as one of the subject in B.Sc.)

Unit-1
Introduction to computers: Development of computers with electronic devices, brief history of computers, computer generations, IC technology, LSI and VLSI, classification of computers, applications of computers, basic computer organization, basic processor architecture, types of processors, memory, primary memory, cache, RAM and ROM, secondary memory, HDD, CD drive, Pen drive, Power supply, input and output devices, keyboard, pointing device, optical devices, monitor, projector, printers, plotter (only definitions and functions of the devices).

Unit-2
System software: Operating system, need of OS, functions of OS, different types of OS, batch processing OS, multi programming OS, single user OS and multi user OS, time sharing OS, OS for Personal Computer, DOS, Windows OS, features of Windows OS, Unix OS, Open source OS Linux. Low level languages: machine language, Assembly language, assembler, high level languages, features of high level languages, interpreters and compilers .

Unit-3
Application software: Program development in high level languages, algorithm and flow chart, execution of user application programs. Software packages: MS Office package, word processing, MS Word, preparing and printing documents in MS Word, MS Excel; using formulas and functions, plotting graphs, Power point presentation. Computer graphics, graphic software packages, Origin software package, plotting graphs in Origin.

Unit-4
Basic Network Functions: Overview, evolution of computer networks, elements of LAN and WAN, Network architecture, ISO-OSI architecture, hardware elements: modems, multiplexers, concentrators, transmission media, twisted pair, coaxial cable, optical fibre, LAN topologies: bus, ring and star.

Unit-5
Network interconnection issues: Internetworking bridges, routers, communication methods, store and forward techniques, circuit switching, packet switching, introduction to TCP/IP protocol family, issues related to network reliability and security.

Books suggested:
A. Mottershed: Electronic Devices and Circuits, PHI.
V. Rajaraman: Fundamentals of Computers, PHI.
Martin, J.: Networks and Distributed Processing, PHI.
R. Thareja: Fundamentals of Computers, Oxford Press.

Course Code- PHY7101(B)P

Elementary Computer Lab

(Only for the students offering Electronics as one of the subject in B.Sc.)

The following experiments to be performed in BASIC language:

1. To print out all natural even/odd number between given limits.
2. To find maximum, minimum and range of a given set of numbers.
3. To evaluate sum of finite series.
4. To find the product of two matrices.
5. To find the roots of a quadratic equation.
6. To check if triangle exists and the type of the triangle.
7. To find the sum of the Sine and Cosine series and print out the curve.
8. Fitting a straight line or a simple curve in a given data.
9. Find roots of f(x)=0 by using Newton-Raphson Method.
10. Find roots of f(x)=0 by using Secant Method.
11. Integration by Simpson Rule.
12. To find the value of y at a given value of x by Runge-Kutta Method.

Note: - New experiments may be added on availability of equipments.

Course Code- PHY7102T

Quantum Mechanics & Spectroscopy

UNIT-1. :
Development of quantum theory: Blackbody radiation and their characteristics, failure of classical physics to explain spectral distribution of blackbody radiation, Planck's quantum Hypothesis, Average energy of Planck oscillator, Planck's radiation formula, Wien's law, Rayleigh-Jean's Law, Stefan-Boltzmann's Law; Failure of classical physics to explain photo-electric effect and Compton effect, photons as carrier of energy and momentum of electro-magnetic waves.

UNIT-2 :
Wave Mechanics and Schrödinger equation: Phase velocity and group velocity of waves, wave particle duality; De Broglie Hypothesis; De Broglie group and phase velocity, wave packet, Heisenberg uncertainty principle, Statement and its equation from wave-packet in space and time; Application of uncertainty principle such as (i) Non-existence of electron in nucleus, (ii) Ground state of H-atom, (iii) Natural line width of spectral lines, X-ray microscope, Particles passing through (a) single slit and (b) double slit and observed on screen behind, explanation of distribution in terms of probability amplitude and interference of probability amplitude.
Postulates of Quantum Mechanics: Wave functions, Schrödinger superposition principle, operators in Quantum mechanics, Hermitian operators, expectation values, Interpretation of wave-function, symmetric and anti-symmetric wave functions, concept of parity; Probability density, Schrödinger equation, Schrödinger equation for free particle; Arguments in favour of this equation.

UNIT-3 :
Application of Schrödinger equation: Schrödinger equation for particle moving in potential field, Time dependent and time independent Schrödinger equation, Stationary states, Orthogonality of wave functions, Probability current density, Ehrenfest Theorem, Simple solution of Schrodinger equation (Restricted to one dimensional case), Particle in one dimensional infinite well, Particle in one dimensional finite well (one or both sides of well may be non-rigid), Calculation of reflection and transmission coefficient for potential step and potential barrier.

UNIT-4 :
Atomic Spectroscopy: Orbital angular momentum, electron spin and Stern Gerlac experiment, Total angular momentum, Spin-orbit interaction, Vector model of atom and quantum numbers associated with atom, L-S coupling and j-j coupling, Statement of Hund's Rule and Lande Interval Rule (without derivation), Fine structure of spectral lines, spectral terms up to two valence electron system, Pauli's exclusion principle.

UNIT-5 :
Atom in magnetic field: Magnetic moment of atom, contribution from orbital and spin angular momentum, gyro-magnetic ratio; Interaction energy of atom in magnetic field, splitting of energy levels, using good quantum numbers in Normal Zeeman effect, Anomalous Zeeman effect and Paschen-Back effect, Selection rules for dipole transitions.
Molecular spectroscopy: qualitative features of molecular spectra, rigid rotator, rotational and vibrational energy levels of diatomic molecules, rotational-vibrational spectra.

Books suggested:
Alonso and Finn: Fundamental University Physics, Vol. – III.
Beiser: Concepts in Modern Physcis
Waghmare: Quantum Mechanics

Course Code- PHY7102P

Advance Physics Lab

1. Determination of Planck's constant using LED.
2. Determination of specific charge of electron (e/m) by Thomson's method.
3. Verification of Stefan's law (Black Body method).
4. Study of Lissajous patterns.
5. Determination of difference in wavelength of the two line of Sodium light.
6. To determine the velocity of ultrasonic waves in a given liquid and the compressibility of the liquid.

Note: - New experiments may be added on availability of equipments.

Course Code- SEC6323T

Ceramic Glasses : Synthesis and Applications

Unit-I

Ceramic glasses Introduction: History of glasses, types of natural & artificial glasses, selections of chemical composition & Doping materials, Calculation of glass batch composition to raw materials, homogeneity & grinding of glass batch composition, Annealing & polishing

Unit -II

Synthesis Technologies: Melt quenching, Chemical reaction, Thermal evaporation, Sputtering, Gel-desiccation and Electrolyte depositions

Unit -III

Ceramic glasses application: application of ceramic glasses in research laboratory equipment, medical field, commercials, fibers, coloring & discoloring etc.

Reference Books Suggestions

1 Ceramic materials - Roman Pampalls

2 Glass and Glass ceramic - M H Lewis

3 Functional Glasses and glass ceramic; Processing, Properties and applications - Basudeb Karmakar

Semester-VI

Course Code- PHY7103T

Solid State Physics

Unit-1 :
Crystal structure : Different terms of crystal structure, Fundamental types of lattices, Two and three dimensional lattice types; Seven system of crystals, Characteristics of sc, bcc, fcc, hcp; Miller indices, orientation of planes in cubic lattices; Distribution of Atoms in atomic planes of cubic lattices. Distance between successive planes; Von-Laue's equations of diffraction of X-rays, Bragg's Law, scattering from lattice of point-atoms. Scattering factor. Geometrical Scattering factor for sc, bcc, fcc. Reciprocal lattice and its properties.

Unit-2 :
Crystal binding and lattice vibrations : Inter-atomic forces of solids. Crystal of inert gases, cohesive energy and bulk modulus. Ionic crystals, Madelung energy and bulk modulus. Covalent crystals. Hydrogen bonded crystals, Atomic radii. Concept of phonons Vibration of monatomic lattices, lattice with two atoms per primitive cell. Local phonon modes. Density of states in one dimension, three dimensions, lattice heat capacity for Einstein model, Debye model.

Unit-3 :
Free Electron theory of metals : Free electron model, Density of states of electron gas, Fermi-Dirac distribution function, effect of temperature on Fermi-Dirac distribution function, Fermi energy at absolute zero temperature and low temperature. Electron heat capacity. Thermionic emission. Boltzmann transport equation, Sommerfeld theory of electrical conductivity, Thermal conductivity, Wiedmann-Franz Law. Hall effect.

Unit-4 :
Band theory : Formation of bands and origin of energy gap, Bloch theorem, Kronig Penney model, crystal momentum and velocity of an electron. Effective mass of electrons. Electrons and holes. Number of states in a band, insulator, semi-conductor and metal. Construction of Brillouin Zones and Fermi-surfaces. Fermi levels in intrinsic, n- type and p- type semi-conductors, Mass action Law. The static dielectric constants of solids. Local electric field at an atom.

Unit-5 :
Magnetism : Diamagnetism and Larmor precession, classical theory of diamagnetism, Para-magnetism and its classical theory, free electron theory. Molecular theory of ferromagnetism.
Experimental Survey of Superconductivity : Zero resistance, persistent currents, effect of magnetic fields, flux exclusion, Intermediate state, Entropy effect, frequency effects, Gyromagnetic ratio, Isotope effect. Occurrence of superconductivity. Thermoelectric effects, thermal conductivity. High temperature oxide, superconductors and their properties. BCS theory (elementary idea without mathematical derivation), Magnetic levitation.

Books suggested :
Kittel : Introduction to Solid State Physics, Wiley Eastern.
A.J. Dekker : Solid State Physics, McMillian India.

Course Code- PHY7103P

Solid State Physics Lab

1. To determine the energy band gap of a semiconductor using a p-n junction diode.
2. To determine the energy band gap of a semiconductor using four probe method.
3. To study hysteresis loss of transformer by B-H curve using C.R.O.
4. To determine the magnetic field between the pole pieces of an electromagnet using search coil and a ballistic galvanometer.
5. To study the electromagnetic damping of a compound pendulum.
6. To determine the polarizing angle for the glass prism surface and to determine the refractive index of material of prism using Brewster's law.

Note: - New experiments may be added on availability of equipments.

Course Code- PHY7104T

Nuclear Physics

Unit 1
Properties of Nucleus: Rutherford alpha scattering experiment, relation between scattering angle and impact parameter, scattering formula, nuclear mass, size, variation of nuclear radius with mass number A, Hofstadter experiment to estimate charge and nuclear density, parity, isospin, isotopes, isobars, angular momentum, magnetic moment, electric quadrupole moment and its significance.

Unit 2
Nuclear Binding Energy: Constituents of nucleus, absence of electron in nucleus according to uncertainty principle, binding energy, mass defect and packing fraction, variation of binding energy per nucleon with mass number A, nuclear force & its properties, liquid drop model of nucleus, Weizsacker's semi empirical mass formula, nuclear stability, conditions of stability for members of odd & even isobaric family.

Unit 3
Radioactivity: Types of radioactive decay i.e. alpha, beta and gamma decay, law of radioactive decay, decay constant, half life and mean life, activity, statistical nature of radioactivity, radioactive growth and decay, ideal equilibrium, transient and secular equilibrium, radioactive series, radiocarbon dating method.

Elementary Particle Physics: Classification of elementary particles into leptons, mesons and baryons, conservation laws (only qualitative discussion), quantum numbers of elementary particles, elementary idea of quark model.

Unit 4
Nuclear Fission: energy released in fission of uranium ($_{92}U^{235}$), stability limits against spontaneous fission, explanation of nuclear fission on the basis of liquid drop model, chain reaction and condition for self sustaining chain reaction, elementary idea of nuclear reactors.

Nuclear Fusion: energy released in fusion of deuterium ($_1H^2$), fusion in stars, carbon-nitrogen & proton-proton cycles, problems of controlled fusion, distinction between fission and fusion reactions.

Unit 5
Radiation Detectors: General principle of detectors based on ionization of gases, construction, working principle and applications of Proportional counter & Geiger-Muller counter, efficiency, dead time, recovery time, paralysis time and necessity of quenching process.
Particle Accelerators: Linear accelerators, cyclotron and betatron.

Books suggested:
S.N. Ghoshal: Atomic & Nuclear Physics – Vol. II, S. Chand, New Delhi.
Satyapraksh: Nuclear Physics, Pragati Prkashan Meerut
R. R. Roy and B. P. Nigam, Nuclear Physics, New Age Int.(P) Ltd
D.C. Tayal: Nuclear Physics, Himalaya Publishing House.
Jagdish Varma, R.C.Bhandari and D. R. S. Somayajulu, Fundamentals of Nuclear Physics, CBS Publishers & Distributors Pvt. Ltd.

Course Code- PHY7104P

Modern Physics Lab

1. Study of characteristics of a G.M. counter and verification of inverse square law for the same strength of a radioactive source.
2. Determination of specific charge of electron (e/m) by helical method.
3. Determination of separation of plates of Etalon using spectrometer.
4. To study the variation of refractive index of the material of the prism with wavelength and to verify Cauchy's dispersion formula.
5. Determination of refractive index of ordinary and extra ordinary light using Babinet compensator.
6. Determination of self inductance of a Coil using Ballistic galvanometer (Rayleigh method).

Note: - New experiments may be added on availability of equipments.

Course Code- SEC6324T

Advances in Nano-Materials & Technology

Unit-1

Nanoscience and Nanotechnology

General Introduction of Nanoscience and Nanotechnology, History of Nanomaterials, Classification of Nanomaterials, Some typical properties of nanomaterials, present and future applications of nanomaterials.

Unit-2

Synthesis of Nanomaterials

Physical Methods: Ball Milling, Photolithography, Electron-beam Lithography, Physical Vapour Deposition- Thermal Evaporation, E-beam Evaporation, Pulsed Laser Deposition, Chemical Methods: Sol-Gel Process, Solvothermal Synthesis, Hydrothermal Synthesis.

Unit-3

Characterization Techniques of Nanomaterials

X-ray crystallography, Scanning Electron Microscope, Transmission Electron Microscope, Ultraviolet-Visible Spectroscopy, Fourier Transform Infrared Spectroscopy, Raman Spectroscopy, Photoluminescence Spectroscopy, Electrical properties of nanomaterials, Magnetic properties of nanomaterials.

Suggested Books:

1. Nanoscience and nanotechnology, Sundar Singh, PragatiPrakashan, 2019.
2. Nanomaterials, A.K. Bandopadhyay, New Age International Publishers, 2008.
3. Fundamentals and Applications of Nanomaterials, Zhen Guo& Li Tan, ARTECH HOUSE, 2009.
4. Nanotechnology: An Introduction to Synthesis Properties and Applications of Nanomaterials, Thomas Varghese & K.M. Balakrishna, Atlantic Publishers & Distributors Pvt Ltd. 2020.