जननायक चन्द्रशेखर विश्वविद्यालय, बलिया

Jananayak Chandrashekhar University, Ballia

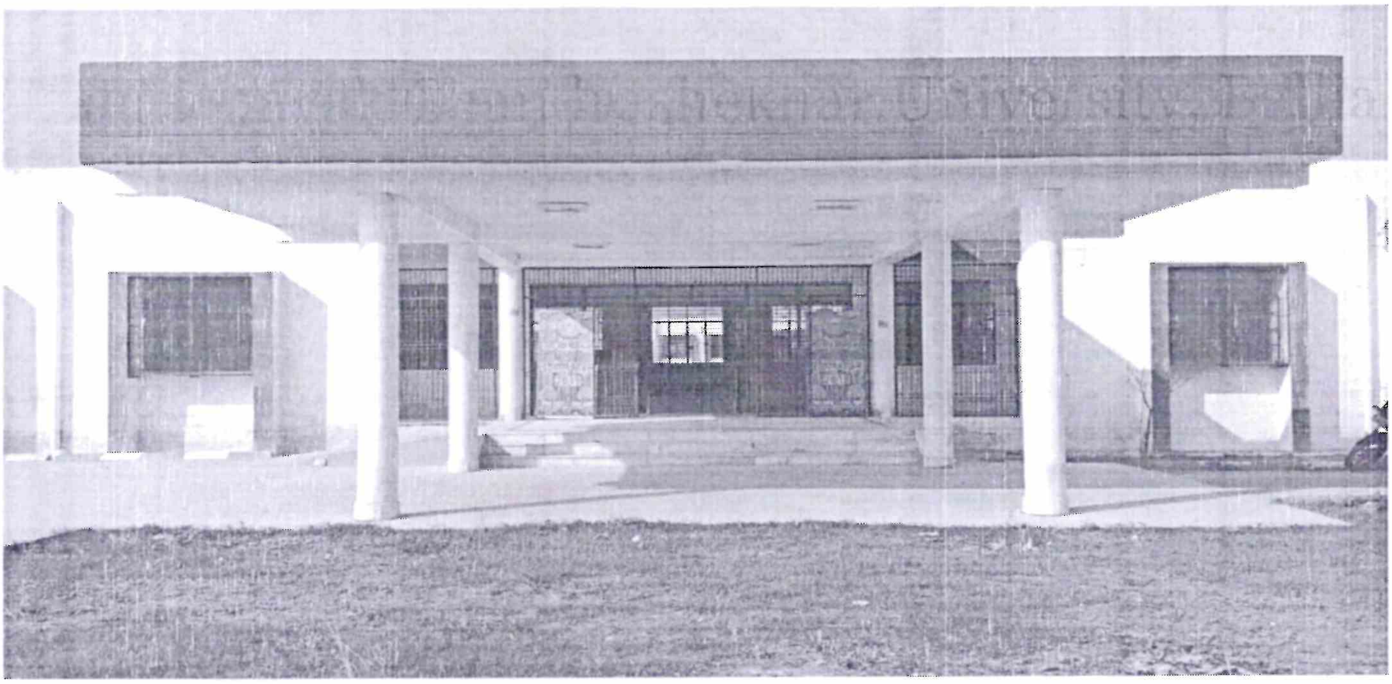
A State University established under Uttar Pradesh State University Act 1973

Curriculum in Accordance to

National Education Policy-2020

Bachelor of Science

Subject:Physics



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Structure for Four Years Undergraduate Programme in accordance with National Education Policy – 2020 and Common Minimum Syllabus

PHYSICS

Semester-wise Title of the Papers

Year	Sem.	Course Code	Paper Title	Theory/ Practical	Credits	Total Credits	Max. Marks
1st	I	B010101T	Mathematical Physics & Newtonian Mechanics	Theory	4	6	75
		B010102P	Mechanical Properties of Matter	Practical	2		25
	II	B010201T	Thermal Physics & Semiconductor Devices	Theory	4	6	75
		B010202P	Thermal Properties of Matter & Electronic Circuits	Practical	2		25
2nd	III	B010301T	Electromagnetic Theory & Modern Optics	Theory	4	6	75
		B010302P	Demonstrative Aspects of Electricity & Magnetism	Practical	2		25
	IV	B010401T	Perspectives of Modern Physics & Basic Electronics	Theory	4	6	75
		B010402P	Basic Electronics Instrumentation	Practical	2		25
3rd	V	B010501T	Classical & Statistical Mechanics	Theory	4	10	75
		B010502T	Quantum Mechanics & Spectroscopy	Theory	4		75
		B010503P	Demonstrative Aspects of Optics & Lasers	Practical	2		50
	VI	B010601T	Solid State & Nuclear Physics	Theory	4	10	75
		B010602T	Analog & Digital Principles & Applications	Theory	4		75
		B010603P	Analog & Digital Circuits	Practical	2		50
Total (3 Years Graduate Programme)					44		800
4th	VII	B010701T	Mathematical Physics	Theory	4	24	75
		B010702T	Classical Mechanics	Theory	4		75
		B010703T	Quantum Mechanics-I	Theory	4		75
		B010704T	Electromagnetic Theory Practical	Theory	4		75
		B010705P	Practical	Practical	4		100
		B010706R	Minor Research Project -I	Project	4		
	VIII	B010801T	Atomic and Molecular Physics	Theory	4	24	75
		B010802T	Condensed Matter Physics	Theory	4		75
		B010803T	Quantum Mechanics-II	Theory	4		75
		B010804T	Electrodynamics and Plasma Physics	Theory	4		75
		B010805P	Practical	Practical	4		100
		B010806R	Minor Research Project -II Project I and project II to be evaluated together	Project	4		100
Total					48		900
Grand Total (4 Years Programme)					92		1700

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Details of Marks Distribution					
Class	Theory (T)		Total/Paper	Practical (P)	Minor Research Project (R) (I & II)
	External/Paper	Internal & Mid Term/Paper			
B.Sc. (Sem. I, II, III & IV)	50	25	75	25	-------
B.Sc. (Sem. V & VI)	50	25	75	50	-------
B.Sc. (Sem. VII & VIII)	50	25	75	100	100

Note:

- The student shall perform only one experiment in practical exam for sem. I, II, III and IV.
- The student shall perform two experiment in practical exam for sem. IV and V.
- The student shall perform two experiment in practical exam for sem. VII and VIII.
- The student shall prepare a Minor Research Project (MRP) in the 5th and 6th Semester (3rd Year) of Graduation. The minor research project will be considered as a major paper during course which will belong to one of the major subject. The MRP shall be submitted and evaluated in the 6th Semester.
- The student shall prepare a Research Project in the 7th and 8th Semesters (4th Year) of Graduation. The MRP shall be submitted and evaluated in the 8th Semester.

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Syllabus
Subject: Physics

Semester	First	
Course Code	B010101T	
Course Title	Mathematical Physics & Newtonian Mechanics	
Credit	4	Maximum Marks :50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:

- Recognize the difference between scalars, vectors, pseudo-scalars and pseudo-vectors.
- Understand the physical interpretation of gradient, divergence and curl.
- Comprehend the difference and connection between Cartesian, spherical and cylindrical coordinate systems.
- Study the origin of pseudo forces in rotating frame.
- Study the response of the classical systems to external forces and their elastic deformation.
- Comprehend the different features of Simple Harmonic Motion (SHM) and wave propagation.

Syllabus

Unit	Course Content
I	**Vector Algebra and Calculus** Coordinate rotation, defining scalars, vectors, pseudoscalars and pseudo-vectors (include physical examples). Geometrical and physical interpretation of dot product, cross product and triple product of vectors. Geometrical and physical interpretation of vector differentiation, Gradient, Divergence and Curl and their significance. Vector integration, Line, Surface (flux) and Volume integrals of vector fields. Gradient theorem, Gauss-divergence theorem, Stoke-curl theorem, Greens theorem. Introduction to Dirac delta function
II	**Coordinate Systems and Tensors** Plane Polar, Spherical and Cylindrical coordinate systems, transformation equations. Expressions for displacement vector, arc length, area element, volume element, gradient, divergence and curl in different coordinate systems. Components of velocity and acceleration in different coordinate systems. Introduction to Tensors, , contravariant, covariant , mixed tensors ,Symmetric and skewsymmetric tensors.
III	**Dynamics of a System of Particles, Rigid Body and Motion of Planets & Satellites** Dynamics of a system of particles centre of mass motion, and conservation laws & their deductions. Rotating frames of reference, general derivation of origin of pseudo forces Coriolis force. Rotational inertia for simple bodies (ring, disk, rod, solid and hollow sphere, solid and hollow cylinder, rectangular lamina). The radius of gyration, theorem of parallel and perpendicular axes, The combined translational and rotational motion of a rigid body on horizontal and inclined planes. Elasticity, relations between elastic constants.

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	Two particle central force problem, reduced mass, relative and centre of mass motion. Kepler's laws of planetary motion and their deductions, geo-stationary satellites.
IV	**Wave Motion** Differential equation of simple harmonic motion and its solution, energy in SHM, use of complex notation, damped and forced oscillations, Quality factor. Lissajous figures. Differential equation of wave motion. Plane progressive waves in fluid media, reflection of waves and phase change, pressure and energy distribution. Stationary waves, phase and group velocity

References:

- Murray Spiegel, Seymour Lipschutz, Dennis Spellman, "Schaum's Outline Series: Vector Analysis", McGraw Hill, 2017,
- A.W. Joshi, "Matrices and Tensors in Physics", New Age International Private Limited, 1995,
- D.S. Mathur, P.S. Hemne, "Mechanics", S. Chand Publishing, 1981,

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Semester	First	
Course Code	B010102P	
Course Title	Mechanical Properties of Matter	
Credit	2	Maximum Marks : 25

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. Experimental physics which has the most striking impact on the industry wherever the instruments are used to study and determine the mechanical properties.

Experiment List

1. Moment of inertia of a flywheel
2. Moment of inertia of an irregular body by inertia table
3. Modulus of rigidity by statistical method (Barton's apparatus)
4. Modulus of rigidity by dynamical method (sphere / disc / Maxwell's needle)
5. Young's modulus by bending of beam
6. Young's modulus and Poisson's ratio by Searle's method
7. Poisson's ratio of rubber by rubber tubing
8. Surface tension of water by capillary rise method
9. Surface tension of water by Jaeger's method
10. Coefficient of viscosity of water by Poiseuille's method
11. Acceleration due to gravity by bar pendulum
12. Frequency of AC mains by Sonometer
13. Height of a building by Sextant
14. Study the wave form of an electrically maintained tuning fork / alternating current source with the help of cathode ray oscilloscope

References:

- R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
- S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014,

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Semester	Second	
Course Code	B010201T	
Course Title	Thermal Physics & Semiconductor Devices	
Credit	4	Maximum Marks : 50

Course Objective:

Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:

- Recognize the difference between reversible and irreversible processes.
- Understand the physical significance of thermodynamical potentials.
- Comprehend the kinetic model of gases w.r.t. various gas laws.
- Study the implementations and limitations of fundamental radiation laws.
- Utility of AC bridges.
- Recognize the basic components of electronic devices.
- Design simple electronic circuits.
- Understand the applications of various electronic instruments.

Syllabus

Unit	Course Content
I	**Law of Thermodynamics** State functions and terminology of thermodynamics. Zeroth law and temperature. First law, internal energy, heat and work done. Work done in Adiabatic and Isothermal thermodynamical processes. Enthalpy, relation between CP and CV. Carnot's engine, efficiency and Carnot's theorem. Refrigerator and its performance. Different statements of second law, Clausius inequality, entropy and its physical significance. Entropy changes in various thermodynamical processes.Third law of thermodynamics ,Thermodynamical potentials, Maxwell's relations, Clausius- Clapeyron equation, Joule-Thompson effect.
II	**Kinetic Theory of Gases and Theory of Radiation** Derivation of Maxwell's law of distribution of velocities and its experimental verification. Degrees of freedom, law of equipartition of energy (no derivation) and its application to specific heat of gases (mono, di and poly atomic). Blackbody radiation, spectral distribution, concept of energy density and pressure of radiation. Derivation of Planck's law, deduction of Wien's distribution law, Rayleigh-Jeans law, StefanBoltzmann law and Wien's displacement law from Planck's law.
III	**DC & AC Circuits and Semiconductors & Diodes** Growth and decay of currents in RL circuit. Charging and discharging of capacitor in RC, Network Analysis - Superposition, Thevenin's and Norton's theorems. AC Bridges – Principle and application-Maxwell's, and Anderson's bridges and Schering's Bridge. P and N type semiconductors, Formation of depletion layer in PN junction diode, field, Qualitative idea of current flow mechanism in forward & reverse biased diode. , PN junction diode and its characteristics, static and dynamic resistance. Principle, characteristics and applications of Zener, Tunnel, Light Emitting, and Photo diodes. Half and Full wave rectifiers, calculation of ripple factor, rectification efficiency and voltage regulation. Basic idea about filter circuits .

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IV	**Transistors and Electronic Instrumentation** Bipolar Junction PNP and NPN transistors. Study of CB & CE configurations w.r.t. active, Cut off & saturation regions; characteristics; current, transistor currents & relations between them. DC Load Line analysis and Q-point. Multimeter (principle and working), Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, electron gun, applications of CRO to study the waveform and measurement of voltage, current, frequency & phase difference.

References:

- M.W. Zemansky, R. Dittman, "Heat and Thermodynamics", McGraw Hill, 1997,
- S. Garg, R. Bansal, C. Ghosh, "Thermal Physics", McGraw Hill, 2012,
- Meghnad Saha, B.N. Srivastava, "A Treatise on Heat", Indian Press, 1973,
- J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015,
- B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015,
- J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975,
- A. Sudhakar, S.S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill, 2015,
- S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016, 43

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Semester	Second
Course Code	B010202P
Course Title	Thermal Properties of Matter & Electronic Circuits
Credit	2 Maximum Marks : 25

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. Experimental physics which has the most striking impact on the industry wherever the instruments are used to study and determine the Thermaland electronic properties.

Experiment List

1. Mechanical Equivalent of Heat by Callender and Barne's method
2. Coefficient of thermal conductivity of copper by Searle's apparatus
3. Coefficient of thermal conductivity of rubber
4. Coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method
5. Value of Stefan's constant
6. Verification of Stefan's law
7. Variation of thermo-emf across two junctions of a thermocouple with temperature
8. Temperature coefficient of resistance by Platinum resistance thermometer
9. Charging and discharging in RC and RCL circuits
10. A.C. Bridges: Various experiments based on measurement of L and C
11. Resonance in series and parallel RCL circuit
12. Characteristics of PN Junction, Zener, Tunnel, Light Emitting and Photo diode
13. Characteristics of a transistor (PNP and NPN) in CE, CB and CC configurations
14. Half wave & full wave rectifiers and Filter circuits
15. Unregulated and Regulated power supply
16. Various measurements with Cathode Ray Oscilloscope (CRO)

References:

- R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut,
- S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut,

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Semester	Third	
Course Code	B010301T	
Course Title	**Electromagnetic Theory & Modern Optics**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
1. understand electrical and magnetic phenomenon in daily life.
2. Study the fundamental physics behind reflection and refraction of light (electromagnetic waves).
3. Study the working and applications of Michelson and Fabry-Perot interferometers.
4. Recognize the difference between Fresnel's and Fraunhofer's class of diffraction.
5. Comprehend the use of Polarimeters.
6. Study the characteristics and uses of lasers.

Syllabus

Unit	Course Content
I	**Electrostatics &Magnetostatics** Electric charge & charge densities, Coulomb law, electric field and potential, E due to Electric dipole (end on position & broad side on position), Eletric potential due to charge distribution for hollow and solid sphere ,Gauss law and its applications (charged wire, hollow and solid sphere), Electric polarization of Dielectric and Vector D & P. Magnetic field due to steady current, Biot Savart Law, Magnetic field due to finite and infinite current carrying wire, current loop and solenoid, Magnetic force between two current elements. Ampere'scircuital law (applications included). Magnetic dipole and its strength, Magnetisation, auxiliary field **H**, magnetic susceptibility andpermeability.
II	**Time Varying Electromagnetic Fields** Faraday's laws of electromagnetic induction and Lenz's law. Displacement current, equation of continuity and Maxwell-Ampere's circuital law. Self and mutual induction (applications included).Derivation and physical significance of Maxwell's equations. Electromagnetic energy density and Poynting vector. Plane electromagnetic waves in vacuum linear infinite dielectrics,
III	**Interference& Diffraction** Conditions for interference and spatial & temporal coherence. Division of Wavefront - Fresnel's Biprism. Division of Amplitude - Parallel thin film, and Newton's Ring experiment. Interferometer - Michelson and Fabry-Perot. Distinction between interference and diffraction. Fresnel's and Fraunhofer's class of diffraction.Fresnel's Half Period Zones and Zone plate. Fraunhofer diffraction at a single slit, and Plane Diffracting Grating. Resolving Power of Optical Instruments - Rayleigh's criterion and resolving power of telescope& grating.
IV	**Polarisation & Lasers** Polarisation by dichronic crystals, Nicol prism, retardation plates,Analysis of polarized light. Optical Rotation - Fresnel's explanation of optical, rotation and Half Shade & Biquartz polarimeters. Characteristics and uses of Lasers. Conditions for Laser action and Einstein's coefficients. Ruby Laser and He-Ne Laser

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References:

1. D.J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India Private Limited, 2002,
2. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 2",Pearson Education Limited, 2012
3. D.C. Tayal, "Electricity and Magnetism", Himalaya Publishing House Pvt. Ltd., 2019,
4.Francis A. Jenkins, Harvey E. White, "Fundamentals of Optics", McGraw Hill, 2017,
5. Samuel Tolansky, "An Introduction to Interferometry", John Wiley & Sons Inc., 1973,
6. A. Ghatak, "Optics", McGraw Hill, 2017,

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Semester	Third
Course Code	B010302P
Course Title	**Demonstrative Aspects of Electricity & Magnetism**
Credit	2 Maximum Marks : 25

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. This expertise is especially crucial in experimental physics which has the most striking impact on the industry wherever the instruments are used to study and determine the mechanical properties.

Experiment List

1. Variation of magnetic field along the axis of single coil
2. Variation of magnetic field along the axis of Helmholtz coil
3. Ballistic Galvanometer: Ballistic constant, current sensitivity and voltage sensitivity
4. Ballistic Galvanometer: High resistance by Leakage method
5. Ballistic Galvanometer: Low resistance by Kelvin's double bridge method
6. Ballistic Galvanometer: Self inductance of a coil by Rayleigh's method
7. Ballistic Galvanometer: Comparison of capacitances
8. Carey Foster Bridge: Resistance per unit length and low resistance
9. Deflection and Vibration Magnetometer: Magnetic moment of a magnet and horizontal component of earth's magnetic field
10. Earth Inductor: Horizontal component of earth's magnetic field

References:

- R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut,
- S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut,

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Semester	Fourth	
Course Code	B010401T	
Course Title	**Perspectives of Modern Physics & Basic Electronics**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:

1. Recognize the difference between the structure of space & time in Newtonian & Relativistic mechanics.
2. Understand the physical significance of consequences of Lorentz transformation equations.
3. Comprehend the wave-particle duality.
4. Develop an understanding of the foundational aspects of Quantum Mechanics.
5. Study the comparison between various biasing techniques.
6. Study the classification of amplifiers.
7. Comprehend the use of feedback and oscillators.
8. Comprehend the theory and working of optical fibers along with its applications.

Syllabus

Unit	Course Content
I	**Relativity-Experimental Background and Relativity-Relativistic Kinematics** Inertial & non-inertial frames, Newtonian relativity, Galilean transformation. Attempts to locate the Absolute Frame: Michelson-Morley experiment and significance of the null result.Einstein's postulates of special theory of relativity.Lorentz transformation equations, Consequences of Lorentz Transformation Equations(derivations & examples included): Relativity of simultaneity Length contraction ,Time dilationRelativistic velocity addition, Transformation of Acceleration; Variation of mass with velocity, Einstein's mass & energy relation, Energy & Momentum.
II	**Inadequacies of Classical Mechanics and Introduction to Quantum Mechanics** Particle Properties of Waves: Spectrum of Black Body radiation, Photoelectric effect, Compton effect and their explanations based on Max Planck's Quantum hypothesis.Wave Properties of Particles: Louis de Broglie's hypothesis of matter waves and their experimentalverification by Davisson-Germer's experiment.Matter Waves: Mathematical representation, Wavelength, Concept of Wave group, Group (particle)velocity, Phase (wave) velocity and relation between Group & Phase velocities. Postulates of Quantum mechanics, Wave Function: Functional form, Normalisation of wave function, Orthogonal & Orthonormal wave functions and Probabilistic interpretation of wave function.
III	**Transistor Biasing and Amplifiers** Faithful amplification & need for biasing. Stability Factors and its calculation for transistor biasing circuits for CE configuration: Fixed Bias (Base Resistor Method), Collector to Base Bias (Base Bias with Collector Feedback) &, Voltage Divider Bias. Classification of amplifiers based on Mode of operation (Class A, B, AB, C & D), Stages (single & multi stage), Coupling methods (RC, Transformer, Direct & LCcouplings), Nature of amplification (Voltage & Power amplification) Theory & working of RC coupled voltage amplifier (Uses of various resistors & capacitors, andFrequency response)

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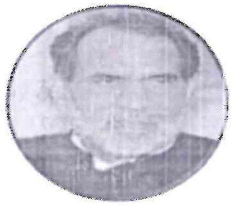

IV	**Feedback & Oscillator Circuits and Introduction to Fiber Optics** Feedback Circuits: Effects of positive and negative feedback(Advantages and disadvantages) Estimation of Input Impedance, Output Impedance, Gain, Stability, Distortion, Noise and Band Width for Voltage Series negative feedback. Oscillator Circuits: Use of positive feedback for oscillator operation. Barkhausen criterion for self sustained oscillations, Qualitative discussion of Reactive Network feedback oscillators (Tunedoscillator circuits): Hartley & Colpitt oscillators. Basics principles of Fiber Optics, step index fiber, graded index fiber, light propagation through an opticalfiber, acceptance angle & numerical aperture, qualitative discussion of fiber losses and applicationsof optical fibers.

References:

1. A. Beiser, Shobhit Mahajan, "Concepts of Modern Physics: Special Indian Edition", McGraw Hill, 2009,
2. R.A. Serway, C.J. Moses, and C.A. Moyer, "Modern Physics", Cengage Learning India Pvt. Ltd, 2004, 3e
3. R. Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019,
4. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015, 4e
5. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015, 7e
6. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975,
7. John M. Senior, "Optical Fiber Communications: Principles and Practice", Pearson Education Limited, 2010,
8. John Wilson, John Hawkes, "Optoelectronics: Principles and Practice", Pearson Education Limited, 2018,
9. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016,

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Semester	Fourth	
Course Code	B010402P	
Course Title	**Basic Electronics Instrumentation**	
Credit	2	Maximum Marks : 25

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. This expertise is especially crucial in experimental physics which has the most striking impact on the industry wherever the instruments are used to study the basic electronics instrumentation.

Experiment List

1. Transistor Bias Stability
2. Comparative Study of CE, CB and CC amplifier
3. Clippers and Clampers
4. Study of Emitter Follower
5. Frequency response of single stage RC coupled amplifier
6. Frequency response of single stage Transformer coupled amplifier
7. Effect of negative feedback on frequency response of RC coupled amplifier
8. Study of Schmitt Trigger
9. Study of Hartley oscillator
10. Study of Wein Bridge oscillator

References:

- R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut,
- S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut,

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Semester	Fifth	
Course Code	B010501T	
Course Title	**Classical & Statistical Mechanics**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
1. Understand the concepts of generalized coordinates and D'Alembert's principle.
2. Understand the Lagrangian dynamics and the importance of cyclic coordinates.
3. Comprehend the difference between Lagrangian and Hamiltonian dynamics.
4. Study the important features of central force and its application in Kepler's problem.
5. Recognize the difference between macrostate and microstate.
6. Comprehend the concept of ensembles.
7. Understand the classical and quantum statistical distribution laws.
8. Study the applications of statistical distribution laws.

Syllabus

Unit	Course Content
I	**Constrained Motion and Lagrangian Formalism** Constraints - Definition, Classification and Examples. Degrees of Freedom and Configurationspace. Constrained system, Forces of constraint and Constrained motion. Generalised coordinates,Transformation equations and Generalised notations & relations. Principle of Virtual work and D'Alembert's principle. Lagrangian for conservative & non-conservative systems, Lagrange's equation of motion (no derivation), Cyclic coordinates, and Conservation laws (with proofs and properties of kinetic energy function included). Lagrangian formulation for S.H.M. and free falling particle
II	**Hamiltonian Formalism and Central Force** Phase space, Hamiltonian for conservative, Physical significance of Hamiltonian, Hamilton's equation of motion (no derivation), Construction of Hamiltonian from Lagrangian.Hamiltonian formulation for compound pendulum and linear harmonic oscillator. Definition and properties (with prove) of central force. Equation of motion and differential equation of orbit. Bound & unbound orbits, stable & non-stable orbits, Motion under inverse square law of force and derivation of Kepler's laws.
III	**Macrostate & Microstate and Concept of Ensemble** Macrostate, Microstate, Number of accessible microstates and Postulate of equal a priori. Phase space, Phase trajectory, Volume element in phase space, Quantisation of phase space and number ofaccessible microstates for free particle in 1D & harmonic oscillator in 1D. Problem with time average, concept of ensemble, postulate of ensemble average Micro Canonical, Canonical & Grand Canonical ensembles Thermodynamic Probability, Postulate of Equilibrium and Boltzmann Entropy relation
IV	**Distribution Laws and Applications of Statistical Distribution Laws** Statistical Distribution Laws: Expressions for number of accessible microstates, probability &number of particles in ith state at equilibrium for Maxwell-Boltzmann, Bose-Einstein & Fermi-Dirac statistics. Comparison of statistical distribution laws and their physical significance.Canonical Distribution Law: Boltzmann's Canonical Distribution Law, Boltzmann's Partition Function, relation between Partition function and Thermodynamic potentials.

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	Application of Bose-Einstein Distribution Law: Photons in a black body cavity and derivation ofPlanck's Distribution Law.Application of Fermi-Dirac Distribution Law: Free electrons in a metal, Definition of Fermi energy,Determination of Fermi energy at absolute zero, Kinetic energy of Fermi gas at absolute zero

References:

1. Herbert Goldstein, Charles P. Poole, John L. Safko, "Classical Mechanics", Pearson Education, India, 2011.
2. N.C. Rana, P.S. Joag, "Classical Mechanics", McGraw Hill, 2017
3. R.G. Takwale, P.S. Puranik, "Introduction to Classical Mechanics", McGraw Hill, 2017
4. F. Reif, "Statistical Physics (In SI Units): Berkeley Physics Course Vol 5", McGraw Hill, 2017.
5. B.B. Laud, "Fundamentals of Statistical Mechanics", New Age International Private Limited, 2020.
6. B.K. Agarwal, M. Eisner, "Statistical Mechanics", New Age International Private Limited, 2007.

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Semester	Fifth	
Course Code	B010502T	
Course Title	**Quantum Mechanics & Spectroscopy**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
1. Understand the significance of operator formalism in Quantum mechanics.
2. Study the eigen and expectation value methods.
3. Understand the basis and interpretation of Uncertainty principle.
4. Develop the technique of solving Schrodinger equation for 1D.
5. Comprehend the success of Vector atomic model in the theory of Atomic spectra.
6. Study the different aspects of spectra of Group I & II elements.
7. Study the production and applications of X-rays.
8. Develop an understanding of the fundamental aspects of Molecular spectra.

Syllabus

Unit	Course Content
I	**Operator Formalism and Eigen & Expectation Values** Operators: definition of an operator, Hermitian Operators: Definition, properties and applications parity operator, operator algebraand operators corresponding to various physical-dynamical variables.Commutators: Definition, commutator algebra and commutation relations among position, linearmomentum & angular momentum and energy & time. Eigen & Expectation Values: Eigen equation for an operator, eigen state (value) and eigenfunctions. Linear superposition of eigen functions and Non-degenerate & Degenerate eigen states.Expectation value pertaining to an operator and its physical interpretation.
II	**Uncertainty Principle & Schrodinger Equation and Applications of Schrodinger Equation** Uncertainty Principle: statemment, derivation, physical significance and applicationsSchrodinger Equation: Derivation of time independent & time dependent forms, Schrodingerequation as an eigen equation, Deviation & interpretation of equation of continuity in Schrodinger representation, and Equation of motion of an operator in Schrodinger representation. Ehrenfest theorem. Application to 1D Problems: Infinite Square well potential (Particle in 1D box), Finite Square well potential, Potential step, Rectangular potential barrier and 1D Harmonic oscillator.
III	**Vector Atomic Model and Spectra of Alkali & Alkaline Elements** Inadequacies of Bohr and Bohr-Sommerfeld atomic models w.r.t. spectrum of Hydrogen atom (fine structure of H-alpha line). Modification due to finite mass of nucleus Vector atomic model (Stern-Gerlach experiment) and physical & geometrical interpretations of various quantum numbers for single & many valence electron systems. LS & jj couplings, spectroscopic notation for energy states, selection rules for transition of electrons Spectra of alkali elements: Screening constants for s, p, d & f orbitals; sharp, principle, diffuse &fundamental series; doublet structure of spectra and fine structure of Sodium D line.Spectra of alkaline elements: Singlet and triplet structure of spectra.

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IV	**X-Rays & X-Ray Spectra and Molecular Spectra** Nature & production, Continuous X-ray spectrum & Duane-Hunt's law, Characteristic X-rayspectrum & Mosley's law, Discrete set of energies of a molecule, electronic, vibrational and rotational energies. Quantizationof vibrational energies, transition rules and pure vibrational spectra. Quantization of rotationalenergies, transition rules, pure rotational spectra and determination of inter nuclear distance.Rotational-Vibrational spectra; transition rules; fundamental band & hot band; O, P, Q, R, Sbranches.

References:

1. D.J. Griffiths, "Introduction to Quantum Mechanics", Pearson Education, India, 2004.
2. E. Wichmann, "Quantum Physics (In SI Units): Berkeley Physics Course Vol 4", McGraw Hill, 2017.
3. Richard P. Feynman, Robert B. Leighton, Matthew Sands, "The Feynman Lectures on Physics - Vol. 3", Pearson Education Limited, 2012.
4. R Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019.
5. H.E. White, "Introduction to Atomic Spectra", McGraw Hill, 1934.
6. C.N. Banwell, E.M. McCash, "Fundamentals of Molecular Spectroscopy", McGraw Hill, 2017.
7. R Murugeshan, Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publishing, 2019.
8. S.L. Gupta, V. Kumar, R.C. Sharma, "Elements of Spectroscopy", Pragati Prakashan, Meerut, 2015.

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Semester	Fifth	
Course Code	B010503P	
Course Title	**Demonstrative Aspects of Optics & Lasers**	
Credit	2	Maximum Marks : 25

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. This expertise is especially crucial in experimental physics which has the most striking impact on the industry wherever the instruments are used to study and determine the optical properties.

Experiment List

1. Fresnel Biprism: Wavelength of sodium light
2. Fresnel Biprism: Thickness of mica sheet)
3. Newton's Rings: Wavelength of sodium light
4. Newton's Rings: Refractive index of liquid
5. Plane Diffraction Grating: Resolving power
6. Plane Diffraction Grating: Spectrum of mercury light
7. Spectrometer: Refractive index of the material of a prism using sodium light
8. Spectrometer: Dispersive power of the material of a prism using mercury light
9. Polarimeter: Specific rotation of sugar solution
10. Wavelength of Laser light using diffraction by single slit

References:

1.B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
3. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014.

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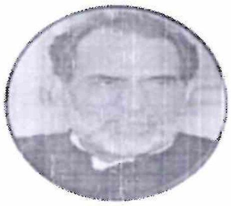

Semester	Sixth	
Course Code	B010601T	
Course Title	**Solid State & Nuclear Physics**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
1.Understand the crystal geometry w.r.t. symmetry operations.
2. Comprehend the power of X-ray diffraction and the concept of reciprocal lattice.
3. Study various properties based on crystal bindings.
4. Recognize the importance of Free Electron & Band theories in understanding the crystal properties.
5. Study the salient features of nuclear forces & radioactive decays.
6. Understand the importance of nuclear models & nuclear reactions.
7. Comprehend the working and applications of nuclear accelerators and detectors.
8. Understand the classification and properties of basic building blocks of nature.

Syllabus

Unit	Course Content
I	**Crystal Structure and Crystal Diffraction** Lattice, Basis & Crystal structure. Lattice translation vectors, Primitive & non-primitive cells. 3D Bravais lattice. Parameters of cubic lattices. Lattice planes and Miller indices. Simple crystal structures - HCP & FCC, Diamond, and Sodium Chloride. X-ray diffraction and Bragg's law. Experimental diffraction methods - Laue, Rotating crystal. Reciprocal lattice, Reciprocal lattice vectors and relation between Direct & Reciprocal lattice. Ewald's methodand Brillouin zones. Reciprocal lattice to SC, BCC & FCC lattices.
II	**Crystal Bindings and Lattice Vibrations** Classification of Crystals on the Basis of Bonding - Ionic, Covalent, Metallic, van der Waals(Molecular) and Hydrogen bonded. Cohesive energy, Madelung energy and evaluationof Madelung constant.Lattice Vibrations: Lattice vibrations for linear mono & di atomic chains, Dispersion relations andAcoustical & Optical branches (qualitative treatment). Lattice heat capacity, Einstein's theory of lattice heat capacity. Free Electron Theory: Fermi energy, Density of states, Hall effect in metals.Band Theory: Origin of band theory, Qualitative idea of Bloch theorem, Kronig-Penney model.
III	**Nuclear Forces & Radioactive Decays and Nuclear Models & Nuclear Reactions** General Properties of Nucleus: Mass, binding energy, radii, density, angular momentum, magnetic dipole moment vector. Nuclear Forces: General characteristic of nuclear force, Radioactive Decays: Nuclear stability, basic ideas about beta minus decay, beta plus decay, alphadecay, gamma decay & electron capture, fundamental laws of radioactive disintegration andradioactive series. Nuclear Models: Liquid drop model and Bethe-Weizsacker mass formula. Single particle shellmodel (the level scheme in the context of reproduction of magic numbers included). Nuclear Reactions: Bethe's notation, types of nuclear reaction, Conservation laws, Theory of

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	nuclear fission (qualitative), Nuclear reactors and Nuclear fusion.
IV	**Accelerators & Detectors and Elementary Particles** Accelerators: Theory, working and applications of Van de Graaff accelerator, Cyclotron andSynchrotron.Detectors: Theory, working and applications of GM counter, Semiconductor detector, Scintillationcounter. Classification ofelementary particles based on intrinsic-spin, mass, interaction & lifetime. Families of Leptons,Mesons, Baryons & Baryon Resonances. Conservation laws for mass-energy, linear momentum,angular momentum, electric charge, baryonic charge, leptonic charge, isospin & strangeness.Concept of Quark model.

References:

1.Charles Kittel, "Introduction to Solid State Physics", Wiley India Private Limited, 2012, 8e
2. A.J. Dekker, "Solid State Physics", Macmillan India Limited, 1993
3. R.K. Puri, V.K. Babbar, "Solid State Physics", S. Chand Publishing, 2015
4. Kenneth S. Krane, "Introductory Nuclear Physics", Wiley India Private Limited, 2008
5. Bernard L. Cohen, "Concepts of Nuclear Physics", McGraw Hill, 2017
6. S.N. Ghoshal, "Nuclear Physics", S. Chand Publishing, 2019

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Semester	Sixth	
Course Code	B010602T	
Course Title	**Analog & Digital Principles & Applications**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
1.Study the drift and diffusion of charge carriers in a semiconductor.
2. Understand the Two-Port model of a transistor.
3. Study the working, properties and uses of FETs.
4. Comprehend the design and operations of SCRs and UJTs.
5. Understand various number systems and binary codes.
6. Familiarize with binary arithmetic.
7. Study the working and properties of various logic gates.
8. Comprehend the design of combinational and sequential circuits.

Syllabus

Unit	Course Content
I	**Semiconductor Junction and Transistor Modeling** Expressions for Fermi energy, Electron density in conduction band, Hole density in valence band,Drift of charge carriers (mobility & conductivity), Diffusion of charge carries and Life time ofcharge carries in a semiconductor. Expressions for Barrier potential, Barrier width and Junction capacitance (diffusion & transition)for depletion layer in a PN junction. Expressions for Current (diode equation). Transistor as Two-Port Network. Notation for dc & ac components of voltage & current. H-parameters for CB, CE & CC configurations. Analysis of transistor amplifier using the hybridequivalent model and estimation of Input Impedance, Output Impedance and Gain (current, voltage& power).
II	**Field Effect Transistors and Other Devices** JFET: Construction (N channel & P channel); Operation in differentregions (Ohmic or Linear, Saturated or Active or Pinch off & Break down); Important Terms(Shorted Gate Drain Current, Pinch Off Voltage & Gate Source Cut-Off Voltage); Characteristics of FET and its parameter. MOSFET: Construction and Working of DE-MOSFET (N channel & P channel) and E-MOSFET(N channel & P channel); Characteristics (Drain & Transfer) of DE-MOSFET and E-MOSFET; Comparison of JFFET and MOSFET. SCR: Construction; Equivalent Circuits Working (Off state & On state); Characteristics; UJT: Construction; Equivalent Circuit; Working Characteristics (Peak & Valley points);
III	**Number System and Binary Arithmetic** Number Systems: Binary, Octal, Decimal & Hexadecimal number systems and their interconversion. Binary Addition, Decimal Subtraction using 9's & 10's complement, Binary Subtraction using 1's& 2's compliment, Multiplication and Division.

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IV	**Logic Gates and Combinational & Sequential Circuits** Truth Table, Symbolic Representation and Properties of OR, AND, NOT, NOR, NAND, EX-OR &EX-NOR Gates. Implementation of OR, AND & NOT gates (realization using diodes & transistor).De Morgan's theorems. NOR & NAND gates as Universal Gates. Application of EX-OR & EXNORgates as pairty checker. Boolean Algebra. Karnaugh Map. Combinational Circuits: Half Adder, Full Adder, Half Substractor, Full Substractor.Data Processing Circuits: Multiplexer, Demultiplexer,. Sequential Circuits: SR & JK Flip-Flops.

References:

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015.
2. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015.
3. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015.
4. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975.
5. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016.
6. D. Leach, A. Malvino, Goutam Saha, "Digital Principles and Applications", McGraw Hill, 2010.
7. William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice", Prentice-Hall of IndiaPrivate Limited, 1982.
8. R.P. Jain, "Modern Digital Electronics", McGraw Hill, 2009.

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Semester	Sixth	
Course Code	B010603P	
Course Title	**Analog & Digital Circuits**	
Credit	2	Maximum Marks : 25

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. This expertise is especially crucial in experimental physics which has the most striking impact on the industry wherever the instruments are used to study and determine the analog & digital circuits.

Experiment List

1. Energy band gap of semiconductor by reverse saturation current method
2. Energy band gap of semiconductor by four probe method
3. Hybrid parameters of transistor
4. Characteristics of FET, MOSFET, SCR, UJT
5. FET Conventional Amplifier
6. FET as VVR and VCA
7. Study and Verification of AND gate using TTL IC 7408
8. Study and Verification of OR gate using TTL IC 7432
9. Study and Verification of NAND gate and use as Universal gate using TTL IC 7400
10. Study and Verification of NOR gate and use as Universal gate using TTL IC 7402
11. Study and Verification of NOT gate using TTL IC 7404
12. Study and Verification of Ex-OR gate using TTL IC 7486

References:

1. R.L. Boylestad, L. Nashelsky, "Electronic Devices and Circuit Theory", Prentice-Hall of India Pvt. Ltd., 2015.
2. J. Millman, C.C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", McGraw Hill, 2015.
3. B.G. Streetman, S.K. Banerjee, "Solid State Electronic Devices", Pearson Education India, 2015.
4. J.D. Ryder, "Electronic Fundamentals and Applications", Prentice-Hall of India Private Limited, 1975.
5. S.L. Gupta, V. Kumar, "Hand Book of Electronics", Pragati Prakashan, Meerut, 2016.
6. D. Leach, A. Malvino, Goutam Saha, "Digital Principles and Applications", McGraw Hill, 2010.
7. William H. Gothmann, "Digital Electronics: An Introduction to Theory and Practice", Prentice-Hall of India Private Limited, 1982.
8. R.P. Jain, "Modern Digital Electronics", McGraw Hill, 2009.

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Semester	Seventh	
Course Code	B010701T	
Course Title	**MATHEMATICAL PHYSICS**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Understand the methods of mathematical physics to develop skills in the area of matrix analysis, complex variables, Tensors, Fourier polynomials, transformation equation, to solve problems in theoretical physics.

Syllabus

Unit	Course Content
I	**Matrix** Analysis Definition and types of matrix, conjugate of a matrix, algebraic operation on matrices, Hermitian and anti- Hermitian matrices, determinant of a equation, transformation matrices, square-matrix, inverse of a matrix, solution of linear rank and diagonalization of matrix.
II	**Complex Variables** Definition of complex number, analyticity of Cauchy's Integral theorem and complex function, Cauchy-Riemann condition, formula, Zeroes, poles and singular points. Contour Integration, Residue theorem.)
III	**Tensors** Definition of a tensor in three dimensions and four dimensional multiplication, contraction of space, rank of tensor addition, Symmetry and tensors, Covariant and contra variant tensors. Pseudo tensors. Anti-symmetric properties of tensor, tensors densities.
IV	**Fourier Transformation & Polynomials** Fourier Transformation: Definition, Fourier series, FS for transform, Application of arbitrary period, Fourier Sine and Cosine Fourier-Transform. Polynomials: Bessel and Legendre functions and polynomials, Rodrigue's formula for polynomial Orthonormality and other Legendre properties of Legendre, Associated Laguerre and Associated Legendre, Hermit, Laguerre polynomial.

References:

1. Mathematical methods for Physicist: G. Atken
2. Matrices and Tencer in physics by A.WJoshi
3. Elements of Complex variable: Churchill

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Semester	Seventh	
Course Code	B010702T	
Course Title	**CLASSICAL MECHANICS**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Understandthe Classical Mechanicsto learn how complex classical systems could be formulated solved using the Hamiltonian by observing symmetries of the system and/or through advanced co-ordinate transformation techniques such as canonical transformations of various kinds and action-angle variable technique.

Syllabus

Unit	Course Content
I	Mechanics of a Lagrangian system of particles, Generalized Coordinates, D Alembert's principle. The formulation and formulation equations of motion (with full derivation). The Hamiltonian and equations of motion (with full derivation)
II	Calculus of variations and its application and - Hamilton's principle. The modified Hamilton's principle principle of least action, the rigid body motion - Euler angles, Motion of Unit-III symmetrical top.
III	Canonical transformations, Poisson brackets, Equations of motion and infinitesimal canonical transformations in the Poisson bracket formulation, Liouville's theorem.
IV	Hamilton - Jacobi equations, Action angle variables, the connection between Hamilton Jacobi and theory geometrical optics, Theory of small oscillations - Free vibrations of linear tri- atomic molecule.

References:

1. Classical Mechanics: N C Rana& P S Joag, TMH 1991.
2. Classical Mechanics: H Goldstein, Addison Wasley, 1980.

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Semester	Seventh	
Course Code	B010703T	
Course Title	**QUANTUM MECHANICS-I**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Acquire working knowledge of the Non-relativistic Quantum Mechanics and apply mathematical formulation developed for the quantum mechanical systems on the physical systems.

Syllabus

Unit	Course Content
I	FundamentalsUncertainty normalization, probability current density, expectation values, Ehrenfest theorem, energy eigen function and eigen values, separation of time dependent wave and equation, stationary states, boundary continuity conditions, dynamical variables as operators, Hermitian operators and their properties, Orthonormality, free particle solution. One dimensional step potential (finite and infinite) particle in one dimensional square potential well (finite and infinite) parity, linear harmonic oscillator, zero point energy, rectangular potential barrier. principle and applications, Schrodinger wave equation)
II	Three Dimensional SystemParticle in three dimensional box, Dirac delta functions, orbital angular momentum, commutation relations, central force problems, solution of Schrodinger equation for spherical symmetric potentials, Hydrogen atom- reduced mass, wave levels, function, energy degeneracy, Energy Eigen function and Eigen values of three dimensional harmonic oscillator, and rigid rotator.
III	Matrix, formulation of quantum theory, linear vector space, vector and matrix operators and their representation, bra and ket notations, projection operator, unitary transformation, matrix theory of linear harmonic oscillator, raising and lowering operators eigen values and eigen functions of L2 and Lx, spin, Pauli spin matrices, and their algebra, matrices for J2 and Jx, addition of two angular momenta, (elementary discussion).
IV	Time independent perturbation theory for non degenerate case, formulation up to second order, perturbation of linear harmonic oscillator- (i) estimation of correction up to second order for perturbation term depending on x and x2 (ii) first order correction to energy by x3 and x4 type terms, Ground state of Helium atom, Stark effect of a plane rigid rotator.

References:

1. Quantum Mechanics: L I Schifr, TMH
2. Quantum Mechanics: S gasioriwiez, Wiley
3. Quantum Mechanics by P.A.M.Dirac
4. Quantum Mechanics: Mathews and Ventesan

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Semester	Seventh	
Course Code	B010704T	
Course Title	**ELECTROMAGNETIC THEORY**	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Gain an understanding of Maxwell's equations and apply them to explain the behaviour of electromagnetic wave propagation in different media, phenomenon of refraction, reflection, scattering, interference, diffraction and polarization.

Syllabus

Unit	Course Content
I	**Maxwell's Equations** Maxwell's Equations in vacuum and matter, Maxwell's correction to Ampere's currents and law for non steady Conservation of concept of Displacement current; Boundary conditions, Poynting's theorem, Energy and momentum for a system of charged particles and electromagnetic field.
II	**Electromagnetic Potentials and Transformation Equations** Vector and scalar potentials, Maxwell's Equations in terms of Electromagnetic Potentials, Electromagnetic wave equation, Non-uniqueness of Potentials Electromagnetic Function for and the Concept Wave of Gauge. Gauge Transformations: Coulomb and Lorentz Gauge; Green's Equation; Transformation Properties of under Rotation, Electromagnetic Fields and Sources Spatial Reflection and Time- Reversal.
III	**Kinematics & Dynamics of Electromagnetic Waves** Propagation of Medium and Plasma; Electromagnetic Reflection, Plane Refraction Waves in Vacuum, Non-conducting Medium, Conducting and Polarization of Parameters; Electromagnetic Waves, Stokes Anomalous Frequency Dispersion Characteristics of Dielectrics and Conductors; Normal and Dispersion, Spreading of Pulse in Dispersive Media, Kramer-Kronig Relations.
IV	**Propagation of Electromagnetic Waves** Propagation of Electromagnetic Waves in Rectangular Waveguides, TE and TM Modes, Cut off frequency, Energy Flow and Attenuation. Modal Analysis of guided modes in a waveguide. Field and Radiation cylindrical due to an Oscillating Electric Dipole. Magnetic dipole and electric quadrupole fields

References:

1. Electromagnetic Theory by Julius Adams Stratt
2. Electromagnetic Field Theory by V.A.Bakshi, A.V.Bakshi

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Semester	Seventh	
Course Code	B010705P	
Course Title	**Experimental Devices-I**	
Credit	4	Maximum Marks 100

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. This expertise is especially crucial in experimental physics which has the most striking impact on the industry wherever the instruments are used to develop various experimental techniques.

Experiment List

1. Hysteresis Curve (a) by Ballistic method and (b) by Oscillograph
2. FET/MOSFET
3. Ultrasonic Diffraction
4. Michelson Interferometer
5. Elastic constant by Newton's Ring
6. Hall Effect
7. Use of constant deviation spectrograph
8. Q of coil

References:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
3. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014.

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Semester	Eighth	
Course Code	B010801T	
Course Title	ATOMIC AND MOLECULAR PHYSICS	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Develop basic theoretical knowledge in Atomic, Molecular Spectra and Diatomic spectra Physics.

Syllabus

Unit	Course Content
I	**Atomic Physics** Quantum states of one-electron atoms, atomic orbital, hydrogen spectrum, Pauli's principle, spectra of alkali elements, spin orbit interaction and fine structure in alkali spectra- equivalent, non- equivalent electrons.
II	**Atomic Spectra** Normal and anomalous Zeeman effect, Paschen Back effect, stark effect, two electron system, interaction energy in LS and JJ coupling, hyperfine structure (qualitative).
III	**Diatomic-Molecular Spectra** Rotational spectra of diatomic molecules as a rigid rotator, Energy levels and spectra of nonrigid rotator, Intensity of spectral lines.
IV	**Energy of Molecules** Vibrational energy of diatomic molecules, diatomic molecules as a simple harmonic oscillator, Energy level and spectrum, Mores potential energy curve, Molecules as vibrating rotator, vibrational spectrum of diatomic molecules, PQR branches.

References:

1. Introduction to atomic spectra, H E White (T)
2. Fundamental of molecular spectroscopy, C W Banwell (T)
3. Introduction to molecular spectroscopy, G M Barrow
4. Spectra of diatomic molecules, Herzberg

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Semester	Eighth	
Course Code	B010802T	
Course Title	CONDENSED MATTER PHYSICS	
Credit	4	Maximum Marks : 50

Course Objective:

Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:

Know the concepts of symmetry operations, crystal defects, bandgap in semiconductors, magnetism, reciprocal lattice and phenomenon of superconductivity.

Syllabus

Unit	Course Content
I	**Crystal Physics** Crystalline solids, unit cell and direct lattice, Miller indices of planes and dimensional Bravais axes, two and three lattices, closed packed structures, Braggs law, techniques, construction of experimental diffraction reciprocal lattice, reciprocal lattice vector, Brillouin zone and atomic
II	**Point Defect and Imperfection** Point Imperfection defect, line defect and planer stacking fault, the role of dislocation in crystal growth, the observation of plastic deformation and imperfection in techniques. crystal, X-ray and electron microscopic.
III	**Electronic Energy Bands** Electrons in periodic lattice, Bloch theorem, Band theory, classification of solids, effective mass, tight binding, cellular and pseudopotential method.
IV	**Superconductivity** Superconductivity: Critical temperature, persistent current, Meissner effect, type I and type II superconductors, heat capacity, energy gap, isotopic effect, London's equation, coherent length.

References:

1. Verma and Shrivastava: Crystallography for Solid State
2. Aschroff physics and Mermin: Solid State physics
3. Kittel: Solid State physics

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Semester	Eighth	
Course Code	B010803T	
Course Title	QUANTUM MECHANICS II	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Possess a foundational knowledge thatequips students to delve into research within theoretical physics in general and to the fields of nuclear physics, particle physics and astrophysics in particular.

Syllabus

Unit	Course Content
I	Variational method, Wentzel Kramer Brillouin perturbation (WKB) approximation, Time-dependent theory, Harmonic perturbation, Fermi's golden rule, Adiabatic and sudden approximation.
II	Collision in 3-D and scattering, Laboratory and CM reference differential frames, scattering amplitude, scattering cross section and total symmetric potentials, scattering cross section, scattering by spherically partial waves and Phase square well shifts, scattering by perfectly rigid sphere and by potential and absorption. Born approximation for potential.
III	Identical particles, symmetric and antisymmetric wave functions, Collision of identical Spin angular momentum, particles, Spin function for a many electron system.
IV	Semi classical theory of radiation, Quantum Theory of radiation, Relativistic theory, The Klein-garden equation, The Dirac equation, covariance of Dirac equation, energy hole level of hydrogen atoms, theory and positrons.

References:

1. LI Schiff, Quantum Mechanics (Me Graw Hill)
2. B Craseman and JD Powell, Quantum Mechanics (Addison Western)
3. JJ Sakurai, Modern Quantum Mechanics
4. Mathews and Venktesan, Quantum Mechanics

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Semester	Eighth	
Course Code	B010804T	
Course Title	ELECTRODYNAMICS AND PLASMA PHYSICS	
Credit	4	Maximum Marks : 50

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Understand Quantum Electrodynamics (QED) that describes how light and matter interacts. QED represents the quantum counterpart of classical electromagnetism giving a complete account of matter and light interaction and also basic knowledge of Plasma Physics.

Syllabus

Unit	Course Content
I	**Retarded Potentials** Retarded potential and Lienard-Wiechert potential, electric and magnetic fields due to a uniformly moving charge and an accelerated charge, Linear and circular acceleration and angular distribution of power radiated Bremssahlung, synchrotron radiation and cerenkov radiation, reaction force of radiation..
II	**Motion of Charged Particles** Motion of charged particles in electromagnetic field: Uniform E and B fields, non- uniform magnetic fields, diffusion across magnetic field, time varying E and B fields, adiabatic invariants: first, second and third adiabatic invariants.
III	**Basics of Plasma** Elementary concepts: Devation of moment equations from Boltzmann equation, plasma oscillations Debye shielding, plasma parameters, magnetoplasma, plasma confinement, hydro dynamical description of plasma, fundamental equations, hydromagnetic waves, magnetosonic and Alfven waves.
IV	**Wave Propagation** Wave phenomena in magneto plasma: Polarization, phase velocity, group velocity, cutoffs resonance for electromagnetic wave propagating parallel and perpendicular to the magnetic field, Appleton-Hanree formula.

References:

1. Bittencourt: Plasma Physics
2. Chen: Plasma Physics
3. Jackson:Classicalelectrodynamics

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Semester	Seventh	
Course Code	B010805P	
Course Title	**Experimental Devices -II**	
Credit	4	Maximum Marks 100

Course Objective:
Introduction to Indian ancient Physics and contribution of Indian Physicists, in context with the holistic development of modern science and technology, should be included under Continuous Internal Evaluation (CIE).

Learning Outcomes: After successful completion of the syllabus, learners will be able to:
Achieve measurement precision and perfection through Lab Experiments. This expertise is especially crucial in experimental physics which has the most striking impact on the industry wherever the instruments are used to develop various experimental techniques.

Experiment List

1. Planck's constant
2. Richardson Equation
3. GM Counter
4. Energy band gap of semiconductor
5. Fourier analysis by CRO
6. Wavelength of Laser light and thickness of wire
7. Excitation energy and wavelength by Frank Hertz
8. Study of Hall effect

References:

1. B.L. Worsnop, H.T. Flint, "Advanced Practical Physics for Students", Methuen & Co., Ltd., London, 1962.
2. S. Panigrahi, B. Mallick, "Engineering Practical Physics", Cengage Learning India Pvt. Ltd., 2015.
3. R.K. Agrawal, G. Jain, R. Sharma, "Practical Physics", Krishna Prakashan Media (Pvt.) Ltd., Meerut, 2019
4. S.L. Gupta, V. Kumar, "Practical Physics", Pragati Prakashan, Meerut, 2014.

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