Structure for M. Sc.
Department of Physics
NEP 2020
Pratap (Autonomous) College
M.Sc. Physics Sem I + Sem II
Credit distribution structure for Two Years/One Year PG Degree

Year(2 YrPG)	Sem	Major(Core)Subjects		RM	OJT/FP	RP	Cumulative Credits	Degree
		Mandatory(DSC)	Elective(DSE)					
I	Sem-I	DSC-25(4)(T): PHY 111- Mathematical Methods for Physics DSC-26 (2)(T):PHY 112- Quantum Mechanics-A DSC-27(4)(T):PHY 113-Classical Mechanics DSC-28-A (2)(P):PHY 114A General Laboratory-I A DSC-28-B (2)(P):PHY 114B General Laboratory-I B	DSE-5(4)(T): PHY 115A Applied Electronics **OR** PHY 115B Solar Thermal and Photovoltaic systems	RM(4):PHY -116 Research Methodology	---	---	22	PG Diploma (After3-Yr Degree)
	Sem-II	DSC-29(4)(T): PHY 121- Statistical Mechanics DSC-30(2)(T): PHY 122- Quantum Mechanics-B DSC-31(4)(T):PHY 123- Electrodynamics DSC-32 A(2)(P):PHY 124A General Laboratory-IIA DSC-32 B(2)(P):PHY 124B General Laboratory-IIB	DSE-6 (4) (T) PHY 125A Sensors and Instrumentation **OR** PHY 125B Physics of Semiconductor devices	---	OJT/Int(4): PHY 126 On Job training and Internship	---	22	
Cum. Cr. For PG Diploma		28	8	4	4	---	44	

Abbreviations: Yr.: Year; Sem.: Semester; OJT: On Job Training: Internship/ Apprenticeship; FP: Field projects; RM: Research Methodology; Research Project: RP; Cumulative Credits: Cum. Cr., CW: Course work, T-Theory Course, P–Practical course, DSC-Discipline Specific Core Course, DSE-Discipline Specific Elective Course.

M.Sc. Physics Sem - I

Sr No	Course Category	Name of the course (Title of the Paper)		Total Credit	Hours/Semester	Teaching Scheme (hrs / week)		Evaluation Scheme		
						Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
						T	P			
1	DSC	DSC-25	PHY 111-Mathemetical Methods for Physics	4	60	T	-	40	60	03
		DSC-26	PHY 112-QuantumMechanics-A	2	30	T	-	40	60	03
		DSC-27	PHY 113-ClassicalMechanics	4	60	T	-	40	60	03
		DSC-28 A	PHY 114 A General Laboratory-I A	2	30		P	20	30	03
		DSC-28 B	PHY 114 B General Laboratory-I B	2	30	-	P	20	30	03
2	DSE	DSE-5	PHY 115A Applied Electronics **OR** PHY 115B Solar Thermal and Photovoltaic systems	4	60	T	-	40	60	03
3	Research	RM	PHY 116Research Methodology	4	60	T	-	40	60	03
			Total	22						

BOS in Physics (Members)

Chairman in Physics

Dean
(Faculty of Science)

M.Sc. Physics Sem - II

Sr No	Course Category	Name of the course (Title of the Paper)		Total Credit	Hours/Semester	Teaching Scheme (hrs / week)		Evaluation Scheme		
						Theory	Practical	Continuous Internal Evaluation (CIE)(CA)	End Semester Evaluation (ESE)(UA)	Duration of Examination (Hrs)
						T	P			
1	DSC	DSC-29	PHY 121-Statistical Mechanics	04	60	T	--	40	60	03
		DSC-30	PHY 122-Quantum Mechanics-B	02	30	T	--	40	60	03
		DSC-31	PHY 123-Electrodynamics	04	60	T	--	40	60	03
		DSC-32 A	PHY 124 A General Laboratory-II A	02	30	--	P	20	30	03
		DSC-32 B	PHY 124 B General Laboratory-II B	02	30	--	P	20	30	03
2	DSE	DSE-6	PHY 125-A Sensors and Instrumentation **OR** PHY 125B Physics of Semiconductor devices	04	60	T	--	40	60	03
3	FP/OJT, RP	OJT	PHY 126 On Job training and Internship	04	60	--	P	40	60	03
			Total	22						

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NEP 2020 (W. E. F. 2023-24)
M. Sc.Physics (Sem I & II)
SemesterI

DSC 25 / PHY-111:Mathematical Methodsfor Physics (Credits 4)	
Course description:This course is aimed at introducing the concepts of Mathematical physics to the students. **Course objectives**: 1. To impart knowledge of basic concepts in Mathematical physics. 2. To provide the knowledge and methodology necessary for solving problems in Physics. 3. The course also involves the related experiments based on the theory.	
Unit 1	**Vector Space**:Revision of vector space,Subspaces,Linear combinations of vectors, Linear span, Linear dependence and independence, Basis and dimensions, Linear transformations, Linear operator, Matrix representation of linear operator. Inner product space –Definition of innerproduct space,Properties(Conjugate symmetry, linearity, non-negativity), Norm of a vector, Schwarz's inequality, Triangle in equality,Cauchy's inequality,Law of Parallelogram,Orthogonally,Orthonormalset, Orthonormalbasis,Gram-Schmidt Orthogonalization Process. **(H-6,M-8)**
Unit 2	**MatrixAlgebra**: Types of matrices(Symmetric, Skewsymmetric, Hermitian,Skew Hermitian, Adjugate, Unitary and Orthogonal), Eigen values and Eigen vectors of a matrix, Diagonalization of matrix, Caley-Hamilton theorem. **(H-6,M-6)**
Unit 3	**Fourier Series:** Definition, Determination of Fourier coefficient, Dirichlet theorem, Extension of interval, Half range Fourier sine and cosine series, Complex form of Fourier series,Parseval's identity, Fourier integrals. **(H-10,M-8)**
Unit 4	**Integral Transforms:** Definition of Laplace Transform,Properties(Linearity, Shifting, Change of Scale), Laplace Transform of derivative, Laplace transform of integrals, Derivative of Laplace transform, initial and final values theorems, Multiplication by power of t, division by t, Inverse Laplace transform- Definition, Proofs of Linearity, I^{st} & II^{nd} shifting theorem, Convolution theorem(Statement only),Applications to solution of differential equations. Definition of Fourier transformation, Fourier cosine transforms. **(H-18,M-18)**
Unit 5	**Special Functions**: Legendre, Hermit, & Laguerre Functions (Generating functions, Recurrence relations, Orthogonally, Rodrigue's Formula), Associated Legendre equation, Associated Legendre function, Properties of Associated Legendre function, Recurrence formulae for Associated Legendre function, Laguerre polynomials, Associated Laguerre Polynomials, Orthogonality of associated Laguerre polynomials, Recurrence formulae for Associated Lageurre polynomials. Generating function for Jn(x), Integral representation for Jn(x), Reccurence relation for Jn(x), Bessel's Function of half odd order (J+1/2(x), J-1/2(x), J+3/2(x), J-3/2(x)), Integral formula of Laguerre polynomials Orthogonally of Bessel's equations. (**H-15,M-15)**
Unit 6	**Complex Analysis:** Complex number, Conjugate complex numbers, Function of Complex variable, Analytic function, Cauchy- Riemann condition, Cauchy'stheorem, Cauchy's integral formula, Derivative of analytic function, Taylors theorem,Lorentz's theorem, Cauchy's residue theorem,Evaluation of definite integrals (integration round the unit circle). **(H-5,M-5)**

Suggestedreadings/References:-

1. LinearalgebraBySeymourLipschutz,Schaumoutlineseries.
2. Theory&ProblemsofMatricesbyFrankAyres.
3. MathematicalMethodforPhysicsbyArfken.
4. MathematicalMethodinPhysicsbyB.D. Gupta.
5. MMPbyH.K.Das(S.ChandPublication).
6. Mathematical Physics by B. S. Rajput.
7. FourierseriesbySeymourLipschutz,Schaumoutlineseries.
8. LaplaceTransformsbySeymourLipschutz,Schaumoutlineseries.
9. ComplexVariables&ApplicationsbyJ.W.Brown.
10. MathematicsforphysicalsciencebyMaryBoas.

DSC 27 / PHY-113:Classical Mechanics (Credits 4)	
Coursedescription:Thiscourseisaimedatintroducingthefundamentalsof Classical Mechanics to Post Graduate students. **Course Objectives**:: 1. To impart knowledge of basic concepts in Classical 2. Mechanics. 3. To provide the knowledge and methodology necessary for solving problems in Physics. 4. The course also involves the related experiments based on the theory.	
Unit 1	**Mechanics of System of particles:** Conservation of linear and angular momentum of system of particles, Relation between about any point and about Centre of mass,Discuss similar relations for kinetic energy also. Scattering of Particles: Elastic and inelastic collision, Lab. and C.M. system of coordinates, Differential and total cross section, Impact parameter,Rutherford'sscattering,Relationofcross-sectionbetweenC.M.andLab Frame. **(H-14,M-14)**
Unit 2	**Lagrangian Formulation:** Types of constraints, degrees of freedom, Generalized coordinates, Concept of virtual displacement and virtual work, D'Alemberts principle, Lagrange's equation from D'Alemberts principle, Properties of Lagrange's equation, Applications of Lagrange's equation (simple pendulum, linear simple harmonic oscillator, compound pendulum and Atwood's machine). **(H-10,M-10)**
Unit 3	**Hamilton's equation of motion**: Introduction, Legendre's dual transformation, Hamilton's function and Hamilton's equations of Motion, Properties of the Hamiltonian and of Hamilton's equations of motion, Routhian, Configuration space, Phase space and State space, Lagrangian and Hamiltonian of relativistic particles and light rays. **(H-12,M-12)**
Unit 4	**Principle of Least Action and Hamilton's principle:** Introduction, Principle of least action, Hamilton's principle, Comparison between Fermat's principle of least action in optics & Maupertuis' principle of least action in mechanics, Derivation of Euler-Lagrange equations of motion from Hamilton's principle, Derivation of Hamilton's equations of motion for holonomic systems from Hamilton'sprinciple,Invariance of Hamilton's principle under generalized coordinate transformation. **(H-14,M-14)**
Unit 5	**Canonical transformations and Hamilton-Jacobi theory**: Gauge transformation, Canonical transformation, Condition for transformation to be canonical, Poisson brackets, Canonical equations in terms of Poisson bracket notation, Infinitesimal transformation,Relation between infinite simaltransformations and Poissonbrackets, The Hamilton-Jacobi equations,Solution of harmonic oscillator. **(H-10,M-10)**

Suggestedreadings/ReferenceBooks:

1. IntroductiontoClassicalMechanics:R.G.TakwaleandP.S.Puranik.
2. ClassicalMechanics:N.C.RanaandP.S.Joag,TataMcGraw-HillPublishingCo.Ltd.
3. ClassicalMechanics:P.V.Panat,NarosaPublishingHouse.2008
4. ClassicalMechanics:Gupta,KumarandSharma,PragatiPublication
5. ClassicalMechanics:HerbertGoldstein,NarosaPublishingHouse.
6. ClassicalMechanics:J.C.Upadhyaya,HimalayaPublishingHouse.
7. ClassicalMechanics:G.Aruldhas,PHIPublication.

DSC 26 / PHY-112:Quantum Mechanics-A (Credits 2)(30 Hours, 50 Marks)

Course Objectives:

1. To understand the basics principles of quantum mechanics.
2. To understand the basic terms in quantum mechanics.
3. To understand the Schrodinger wave equation, the wave function, its statistical interpretation, and time evolution of solutions.
4. To understand the perturbation theory and its application for finding solutions to real quantum mechanical systems.

Unit-1 **[12Hour, 20 Marks]**

Foundations and Application of Schrodinger equation for 1-D problems

Problem of blackbody radiation and its solution using quantum concept;Postulates of quantum mechanics; Formulation of time dependent and time independent Schrödinger wave equation, Physical significance of wave function,normalized and orthogonal wave functions, requirements of wave function;Finite square barrier and well potential Find R and T for each case, concept of zero-point energy. Square potential barrier application in alpha particle emission, introduction to other problems and solution using Schrodinger wave equation.

Unit-2

Time independent Perturbation theory **[10Hour, 17 Marks]**

Basic theory; Non-degenerate and degenerate cases(upto2nd order);Applications: anharmonic oscillator,Zeeman effect,Stark effect;Numerical based on the above topics.

Unit-3

Time dependentPerturbation theory **[08Hour, 13 Marks]**

Introduction;First order perturbation;Harmonic perturbation;Transition to continuum states, Absorption and emission of radiation, Einstein’s coefficients, Fermi’s golden rule; Numerical based on the above topics.

Reference Books:

1. Advanced Quantum Mechanics by Satya Prakash, Kedar Nath Ram Nath, Meerut Delhi.
2. Quantum Mechanics: Concept and Applications by Nouredine Zettili, A John Wiley and Sons, Ltd., Publication
3. Quantum Mechanics by Leonard I Schiff, McGraw-Hill Book Company Inc.
4. Quantum Mechanics by Chatwal, Anand, Himalaya Publishing House.
5. Quantum Mechanics: Theory and Applications by Ajoy K. Ghatak, S. Lokanathan, Macmillan Publishers India Ltd.
6. Quantum Mechanics: Powell and Crasemann, Addison-Wesley Pub. Co.

Course Outcomes

Oncompletion of this course,thestudentwillbeableto:

No.	Course Outcomes	Cognitive level
1	Student will be able to understand foundations of Quantum Mechanics.	
2	Student will be able to solve 1-D problems by using Schrodinger’s equation.	
3	Student will be able to solve real system problems by time independent and dependent approximation theory.	
4	Student will be able to solve ideal and real physical problems by using Quantum Mechanics.	

DSC 28 A/ PHY-114A:General Laboratory–IA (Credits 2)

Coursedescription: Thiscourseisaimedatintroducingthefundamentalsof BasicLaboratory Physics to students.

Courseobjectives:

1. To impart knowledge of basic concepts in Laboratory Physics and Mechanics.
2. To provide the knowledge and methodology necessary for Practical in Physics.
3. The course involves the related experiments based on the Practicals.

Group A

Note:Atleast 4 experiments from each group and minimum,10experiments should be performed

1	Λ by Michelson Interferometer.
2	Febry-Perot Interferometer.Determination of wavelength of monochromatic source.
3	To determine ultrasonic velocity and to obtain compressibility of a given liquid.
4	Magnetic susceptibility of paramagnetic material by Quincke’smethod.
5	“e/m”byMillikan oil drop method
6	Diffraction at single and double slits using laser source.
7	Surface tension by ripples method.
8	Determination of elastic constants by Cornu’smethod.
9	Determination of thickness of thin transparent sheet like mica using Michelson interferometer.
10	Determination of Rydberg constant using Hydrogen discharge tube.
11	To find the values of Cauchy’sconstants for the material of the given prism using Hg.

DSC 28 B/ PHY-114B:General Laboratory–IB (Credits 2)

Course description: This course is aimed at introducing the fundamentals of Basic Laboratory Physics to students.

Course objectives:

1. To impart knowledge of basic concepts in Laboratory Physics and Mechanics.
2. To provide the knowledge and methodology necessary for Practical in Physics.
3. The course involves the related experiments based on the Practicals.

Group B

Note:Atleast 4 experiments from each group and minimum, 10experiments should be performed

1	Design and build ERPS using IC723 and study its line and load regulation.
2	Design,build and test the phase shift oscillator using IC-741.
3	Design,build and test Schmitt trigger circuit using741.
4	To study the characteristics of LDR,Photodiode and Phototransistor.
5	Design,build and test first order lowpass filter using IC 741.
6	Design,build and test first order highpass filter using IC 741.
7	Design,build and test precision rectifier using IC 741.
8	Design,build and test Astable/monostable multivibrator using IC741/IC 555.
9	Design,build and test voltage to frequency converter.
10	Design,build and test the temperature to frequency converter.
11	Design,build and test transformerless class-Bpush pull amplifier.

DSE 5 / PHY 115 A Applied Electronics

Unit 1 Signal representation & generation

Revision of Monostable, Astable and Bistable multivibrators using IC-555,Block diagram and pin configuration of IC-555 Voltage regulation, Voltage regulation using Zener, IC-723 as a Voltage Regulator, IC 78XX and IC 79XX as a dual power supply Periodic signals, periodic signals, modulated signals (A.M., F.M., P.M.), sampled data pulse Modulation (PWM, PAM, PPM), definition and their graphical representation. Generation of sine, Square, triangular, linear ramp & saw tooth waveforms. **(H-15, M-15)**

Unit 2 Basic OP-AMP Applications

Introduction to OP-AMP, Block diagram of Op-amp, Schematic symbol and Pin diagram of IC 741, Characteristics of OP-AMP, Concept of virtual ground, inverting and non-inverting amplifier with gain expressions, off-set null, Applications: Adder, Subtractor, Integrator, Differentiator, Comparator, Schmitt trigger, Instrumentation amplifier, Precision rectifier (full-wave). **(H-15, M-15)**

Unit 3 Filters

Introduction, types of filters, First order Passive filters (Low-pass, high-pass, bandpass, notch), First order Active filters (Low-pass, high-pass, band-pass, band-reject, notch), **(H-8, M-8)**

Unit 4 Sinusoidal Oscillators

Introduction, Frequency of oscillatory circuit, frequency stability of an oscillator, Barkhausen Criteria, tuned circuit oscillators, transistor-based Hartley oscillator, Colpitts oscillator, Wien-Bridge oscillator, Phase shift oscillator, and Crystal Oscillators. **(H-10, M-10)**

Unit 5 Bio-electric Signals and Electrodes:

Basic Physics of membrane potential, resting membrane potential of nerves, nerve action potential, origin of bio-electric signals,recording electrodes, polarization, skin contact impedance, electrodes for ECG, electrodes for EEG, electrical conductivity of electrodes jellies and creams, microelectrodes. **(H-12, M-12)**

Reference Books:

1. A Text book of Applied Electronics - Dr. R. S. Sedha, S. Chand Publication
2. Basic Electronics Solid State – B. L. Theraja, S. Chand Publication
3. Op-Amps and Linear Integrated Circuits - R G Gaikwad, Prentice Hall Publication.
4. Electronic devices and circuits An Introduction - Allen Mottershead, Prentice Hall Publication.
5. Integrated Circuits – K. R. Botkar, Khanna Publishers.
6. Operational Amplifier – G. B. Clayton
7. Principles of Electronics by V. K. Mehta.

PHY-116 RM- Research Methodology (Credits 4)

Hours :60 Marks 60

Course description:
This course is aimed at introducing the fundamentals of research methodology to the students.
Course objectives:

1. To impart knowledge of basic concepts in research methodology to physics students.
2. To provide the knowledge and methodology necessary for solving problems in Physics.

Unit-1: Research Methodology: A general View **15 Hours 15M**

Research methodology and research methods, methodology–selecting a topic, hypothesis, experiment, analysis and results; non-experimental or theoretical research, critical thinking, investigation, survey, ab initio, semi-empirical, empirical search; Inquiry, Quest, Exploration, innovation (innovative ideas), Discovery and Invention in science; knowledge and creativity.

A flow-chart of research leading to degree, Literature survey through web and other related resources, scientific report/paper writing, documentation in Latex,

Quality of research, quantitative measurement by Impact factor, h-index, Scientometry,etc.

Unit-2: Data Analysis **15 Hours 15M**

Uncertainties in Measurements: Measuring Errors, Uncertainties, Parent and Sample Distributions, Mean and Standard Deviation of Distributions, Binomial Distributions, Poisson Distribution, Gaussian or Normal Error Distribution, Lorentzian Distribution; Approximation and Errors in Computing: Significant Digits, Numerical Errors, Modelling errors, Conditioning and Stability, Convergence of Iterative Processes.

Error Analysis: Instrumental and Statistical Uncertainties, Propagation of Errors, Application of Error Equations, method of Least squares, Statistical Fluctuations, Probability Tests, chi-square Test of a distribution

Unit-3: Graphical Representation of Data **15 Hours 15M**

Curve fitting (Regression Analysis); Least square Fit to a Straight line, error estimation ofthefittedparameters,limitationsoftheleastsquaremethod,Leastsquaresfittoapolynomial,polynomial curve fitting, Introduction to Excel/Origin/Mathematica, numerical calculations and Built-in functions, Basic algebraic operations on Expressions, Defining and evaluating Functions, Graphs of two dimension and Three dimension.

Unit-4: Computational Skills for Research **15 Hours 15M**

Basics of computer languages, Basics of C-language, Programming in C, Arrays, functions, conditional statements, Applications in few numerical methods

Suggested Reading:

1. TheScientificEndeavor-MethodologyandPerspectivesOfSciences byJeffreyALee; Pearson Education India.
2. ResearchMethodsforScienceby M.P.Marder,CambridgeUniversityPress
3. ResearchMethodologyTechniquesandTrendsBy Y.K.SinghandR.B.Bajpai,APHPublishingCorporationHouse.
4. DataReductionandErrorAnalysisforthePhysicalSciencesbyPhilipRBevington&DKeithRobinson,McGraw Hill
5. NumericalMethodsbyBalagurusamy,TataMcGrawHill
6. LATEXforEngineersandScientistsbyDavidJBuerger,McGrawHill Pub.Co.,NY,1990.

Semester II

DSC 29 / PHY–121:Statistical Mechanics (Credits 4)	
Course Description: This course is aimed at introducing the fundamentals of Statistical Mechanics to the students. **Course objectives:** 1. To impart knowledge of basic concepts in Statistical Mechanics. 2. To provide the knowledge and methodology necessary for solving problems inPhysics. 3. The course also involves related experiments based on the theory	
Unit 1	**Phase Space and Ensembles:**Phase space, Types of Ensembles, Partition function, Liouville's theorem, Principles of conservation of density and extension in phase space, Grand canonical ensemble, Physical interpretation of α, Chemical potential in the equilibrium state, Fluctuations innumber of particles of a system in grand canonical ensemble, Partition function of Classical ideal gas and calculation of thermodynamic quantities, Entropy of mixing and Gibb's paradox, Sackur-Tetrode equation. **(H-14,M-14)**
Unit 2	**Classical and Quantum Statistical Mechanics:**Brief outline of classical and Quantumstatistics, Symmetry of wave functions, The quantum distribution functions, MaxwellBoltzmann statistics, Bose Einstein. Statistics, Photon statistics, Fermi Dirac statistics,The Boltzmann limit of Boson and Fermions gases, Evaluation of partition function forquantummonatomicgas,Partitionfunctionfordiatomicmolecules,Equationofstate Foranidealgas.**(H-12,M-12)**
Unit 3	**Ideal Bose Systems:** Photon gas: Black body radiation, radiation properties such aspressure, density, emissivity and equilibrium number of photons in a cavity. Einstein'sderivationofPlanck'slaw,BoseEinsteincondensation,Specificheatfromlattice vibrations,Debye'smodelofsolids:Phonongas. **(H-12,M-12)**
Unit 4	**IdealFermiSystems:**Fermienergy,Meanenergyoffermionsatabsolutezerotemperature, Fermi energy as a function of temperature, Electronic specific heat, WhiteDwarfs,CompressibilityofFermigas,Pauliparamagnetism,Relativisticdegenerategas. **(H-12,M-12)**
Unit 5	**Phasetransition**:Phasetransitions,Istorderphasetransition,IIndorderPhasetransition,Isingmodel, introduction to non equilibrium processes- Distribution function, Boltzmann transport equation, relaxation approximation, electrical conductivity from relaxation approximation.**(H-10,M-10)**

SuggestedReadings:/ReferenceBooks:

1. Fundamentals of StatisticalMechanics:B.B.Laud,NewAgeInt.lPublishers(2003)
2. Introduction of StatisticalMechanics:S.K.Sinha,NarosaPublication,NewDelhi(2007).
3. FundamentalsofStatistical&ThermalPhysics:F.Reif,McgrawHillCompany,(1965).
4. StatisticalMechanics:R.K.Patharia,Butterworth-Heinemann(Elsevier)(2/eReprint2004).
5. StatisticalPhysics:HarveyGouldandJanTobochnik..

DSC 30 / PHY 122 Quantum Mechanics B (Credits 2)) (30 Hours, 50 Marks)

Course Objectives:

1. To impart knowledge of basic concepts and application of Quantum Mechanics.
2. To provide the knowledge and methodology necessary for solving problems in microscopic and atomic Physics.
3. The course also involves how to use quantum mechanics for real systems of physics problem.

Unit 1

Many Electrons Atoms **[14Hour, 23 Marks]**

Indistinguishableparticles;PauliPrinciple;Inclusionofspin,Spinfunctionsfortwoand threeelectrons;Exampleofhydrogenatom;Centralfieldapproximation;Thomas-Fermimodeloftheatom;IntroductiontoHarteeequationandHartee-Fockequation.Differential and total scattering cross sections, Born Approximation, condition for validity of Born Approximation, scattering by square well potential and perfectly rigid sphere. Numericalbased on theabovetopics.

Unit 2

Variational Method **[09Hour, 15 Marks]**

Variationalmethod:Basicprinciplesandapplicationstoparticleinbox,simple harmonicoscillator,hydrogen atom.Numericalbased on theabovetopics.

Unit 3

WKBApproximation **[**07Hour, 12 Marks]

TheWKBmethod;Connectionformulas;ValidityofWKBapproximation,Barrier penetration;applicationstoα-particlefieldemission;Boundstatesinpotentialwell; Numericalbased on theabovetopics.

Reference Books:

7. Advanced Quantum Mechanics by Satya Prakash, Kedar Nath Ram Nath, Meerut Delhi.
8. Quantum Mechanics: Concept and Applications by Nouredine Zettili, A John Wiley and Sons, Ltd., Publication
9. Quantum Mechanics by Leonard I Schiff, McGraw-Hill Book Company Inc.
10. Quantum Mechanics by Chatwal, Anand, Himalaya Publishing House.
11. Quantum Mechanics: Theory and Applications by Ajoy K. Ghatak, S. Lokanathan, Macmillan Publishers India Ltd.
12. Quantum Mechanics: Powell and Crasemann, Addison-Wesley Pub. C

Course Outcomes

On completion of this course ,the student will be able to:

No.	Course Outcomes	Cognitive level
1	Student will be able to understand spin-orbit interaction.	
2	Student will be able to quantum mechanical scattering by nucleons and electrons.	
3	Student will be able to solve real system problems by variational method.	
4	Student will be able to solve physical system by WKB approximation method.	

DSC 31 / PHY 123 Electrodynamics

Course Objectives:

. To understand the basics of electrostatics, magnetostatics, electrodynamics and the potential formulation of basic laws.

. To understand how to apply basic theories in electromagnetic waves and radiation.

To understand the propagation of electromagnetic waves through the bounded and unbounded regions.

Unit.1 Electrostatics and Magnetostatics 12Hours

The electricfield,continuous charge distribution,divergence and curl of electrostatic fields,Gauss's law and applications,electricpotentials,Poison's equations and Laplace equation,the potential of localized charge distribution,electrostatic boundary condition, work and energy in electrostatics. Biot-Savart'slaws,divergence and curls of B,Amperes law and its applications,magnetic vector potential:the vector potential, magnetostatic boundary conditions, multipole expansion of the scalar and vector potential.

Unit.2

Electromagnetic Waves 12Hours

Introduction, Maxwell equations, Energy in Electromagnetic field (Poynting Theorem), Poynting vector, Energy and momentum in electromagnetic waves, Plane Electromagnetic waves in matter, Plane Electromagnetic waves in anisotropic media, Polarization of Electromagnetic waves

Unit.3

Reflection, Refraction and Scattering 12Hours

Boundary conditions for the electromagnetic field vectors B, E, D and H at interface between two media, Reflection and Refraction at the boundary of two non-conducting media, Fresnel's equations-Incident wave polarized with its vectors E normal and parallel to the plane of incidence, The coefficients of reflection and transmission at the interface between two dielectrics, Brewster angle and degree of polarization, Rectangular wave guide, Basic concept about scattering, scattering by free electron (Thomson scattering)

Unit.4

Electromagnetic Fields and Radiating systems: 12Hours

Electrodynamics potentials, Non uniqueness of Electrodynamics potentials and Gauge transformations Lienard-Wiechart Potentials, Electric and magnetic fields of charge in uniform rectilinear motion, Radiation due to non-relativistic charges and relativistic charges, Radiating systems, Radiation due to an oscillating electric dipole, Radiation due to a small current element,

Unit.5

Relativistic Electrodynamics: 12Hours

Introductions, Lorentz variance and invariance of ∇, ∇^2 *and* □ operators, Four vectors in electrodynamics. Four vectors of charge and potential: Covariance of Continuity equation and Lorentz condition, Maxwell's electromagnetic field tensor covariance of field equation, covariant form of electric and magnetic field-Electromagnetic field tensor.

Suggested readings:

1. Introduction to Electrodynamics byD.J.Griffith,PrenticeHall Of India.
2. ElectromagneticField TheoryFundamentals byGuru And Hiziroglu,CambridgeUniversity Press.
3. Introduction To Electromagnetic Fields by PaulAnd Nasar.McGraw Hill CompanyPvt.Ltd.
4. ClassicalElectrodynamics byJ.D.Jackson,WileyIndia PvtLtd
5. ElectricityAnd Magnetism byEdward Purcell,TataMcGraw Hill Publication Pvt.Ltd

6. Fundamentals OfApplied Electromagnetics
byFawwazUlaby, PrenticeHall ofIndiaPvt.Ltd.
7. Electrodyanims
by S. L. Gupta, S. P. Singh, V. Kumar, Pragati Prakashan Meerut.
8. Electromagnetics
by B. B. Laud, New Age International Publishers.
9. Classical Electromagnetic Radiation by Jerry B. Marion, Academic Press.
10. Introduction to Electrodynamics
by A. Z. Capri & P. V. Panat, Narosa Publishing House Pvt Ltd.
11. Classical Electricity & Magnetism
by Panofsky Phillips, Addison-Wesley Publishing Company
12. Electromagnetic theory & Electrodynamics
by Satyaprakash, Kedarnath Ram Nath.

Course Outcomes

Oncompletion of this course,thestudentwillbeableto:

No.	Course Out comes	Cognitive level
	interpret the basic theories governing the electricity and magnetism	
	apply the basic the ories in electromagnetic waves and radiation	
	applythe basictheoriesto realproblems	

DSC 32A / PHY-124A:General Laboratory–IIA

Course description: This course is aimed at introducing the fundamentals of Basic Physics Laboratory to Under the students.

Course objectives:

1. To impart knowledge of basic concepts in Basic Physics and Mechanics etc.
2. To provide the knowledge and methodology necessary for Practical problems in Physics.
3. The course involves the related experiments based on the Practices.

Important note: Atleast 4 experiments from each group and minimum,10 experiments should be performed.

GroupA

1	Determination of Brewster's angle & estimation of refractive index of a given transparent Material by using spectrometer and sodium lamp.
2	Study of normal Zeeman effect using LG plate.
3	Construction & study of Pb-Sn binary phase diagram from direct cooling curve of a particular Composition and the given transition temperature data.
4	Determination of ionic conductivity & activation energy of NaCl / KCl solidspecimen.
5	Halleffect: Determination of Hallcoefficient, mobility and type of charge carriers.
6	To investigate the characteristics of radiation emitted by bodies at elevated temperatures (Black Body radiation)and determine various constants.
7	Study of magneto resistance in semiconductors.
8	Determination of dielectric constant at highfrequency by Lecherwire.
9	Todetermine Young'smodulus of ametallic rod by Searle's optical interference method (Newton'sRings).
10	.Audiometry of human using an audiometer.
11	.Magnetic susceptibility by Guoy method..
12	.Measurement of electrical conductivity of silicon/germanium material at different Temperatures by Four Probe method

DSC 32B / PHY-124B:General Laboratory–IIB

Course description: This course is aimed at introducing the fundamentals of Basic Physics Laboratory to Under the students.

Course objectives:

1. To impart knowledge of basic concepts in Basic Physics and Mechanics etc.
2. To provide the knowledge and methodology necessary for Practical problems in Physics.
3. The course involves the related experiments based on the Practices.

Important note:Atleast 4 experiments from each group and minimum,10 experiments should be performed.

Group B

1	.Design,build&test square,triangular and sinewave generator using IC-741.
2	Build & test dual power supply using three pin regulators:78XXand79XXseries
3	Instrumentation amplifier with thermocouple transducer AD-590.
4	Capacitance measurement using IC555.
5	Design,Build and test Inductance simulation circuit using IC741.
6	Design,build and test the DC to DC converter circuit.
7	Design,build& test NotchfilterusingIC-741
8	Study of voltage control oscillator using IC566.
9	Study of optocoupler MCT2E and their applications.
10	.Active filters for bio-signals :design&testing.
11	.Build and test temperature controller using Solid State Relay(SSR)andPT-100.

DSE 6 / PHY- 125: Sensors and Instrumentation (Credits 4)

Course Objectives:

1. To understand sensors: fundamentals, characteristics. Sensors for measurement of different physical parameters, working principle,
2. To understand details of processing of signal from sensors,
3. To learn about Programmable Logic Controllers and actuators

Course Outcomes:

1. Explain the conversion of physical quantity into electrical forms and science behind it
2. Select proper sensor for specific application
3. Explain the signal processing steps involved
4. Design and build simple PLC based system

Unit 1 Sensor fundamentals and characteristics **5 hours 5M**

Sensor classification, characteristics, performance parameters, Criteria for selection of a sensor,

Unit 2 Sensor Sensors for measurements **15 hours 15M**

Temperature sensors: Thermistors, RTD, thermocouples, Pressure sensors: High pressure sensors, Low pressure sensors, Optical Sensors: Pyrometer, Magnetic field sensors, Flow sensors, Displacement sensors

Unit 3 Sensor Signal processing **10 hours 10M**

Sample and hold, Filtering: Need, methods, Amplification: Impedance matching, Differential Amplifier, Instrumentation amplifier, ADC: Methods, quantization, sampling frequency, resolution

Unit 4 Sensor Introduction to PLC **20 hours 20M**

Introduction to PLC, advantages of PLC, architecture pf PLC, Functions of various blocks that make PLC, working principle of PLC, types of PLC, different types of input/outputs (analog and digital), programing methods, programming devices, basic instructions NO and NC contacts, Boolean gates-symbols and truth tables, Ladder logic.

Unit 5 Sensor Control actuators: **10 hours 10M**

Working principal of electromechanical actuators, Hydraulic actuators, pneumatic actuators, solenoid valves.

Suggested readings:

1. Modern Electronic and Measurement TechniquesBy A.D.Helfrick,W.D.Kooper, Prentice Hall Of India Pvt. Ltd.
2. Instrumentation: Devices and SystemsBy Rangan, Mani, Sharma, Tata McGraw Hill Publication Pvt. Ltd.
3. Introduction To Instrumentation and ControlBy A.K.Ghosh, Prentice Hall Of India Pvt. Ltd.
4. Programmable Logic Controllers By W. Bolton, Fourth Edition, ELSEVIER

OJT/INT4 PHY-126 On Job Training & Internship(Credits 4)