B.Sc. PHYSICS (Hons/Major) & Minor Syllabus Under CHOICE BASED CREDIT SYSTEM

B.Sc. Physics Hons. Course Structure

Year-1

Semester-I

		Subject	Mark	Credit
Paper-1(Gen)	**G101**	Communicative English-I	50	3
Paper-2 (Major)	**PHHT101**	Math. Method	50	3
Paper-3 (Major)	**PHHT102**	Mechanics & Prop. of Matter	50	3
Paper-4(Major)	**PHHP103**	PHY. Lab-I (Prop. of Matter)	50	3
Paper-5(Minor1)	**CHMT101**	Chemistry (Theory)-I	50	3
Paper-6(Minor2)	**MATHM101**	Mathematics-I	50	3

300 18

Semester-II

		Subject	Mark	Credit
Paper-7(Gen)	**G201**	Computer Language	50	3
Paper-8 (Major)	**PHHT201**	Thermal Physics	50	3
Paper-9 (Major)	**PHHT202**	Complex fn; Wave & Osc.	50	3
Paper-10(Major)	**PHHP203**	PHY Lab-II (Heat, Sound, Magnetism)	50	3
Paper-11(Minor1)	**CHMT201**	Chemistry (Theory)-II	50	3
Paper-12(Minor1)	**CHMP202**	Chemistry (Lab)-I	50	3
Paper-13(Minor2)	**MATHM201**	Mathematics-II	50	3

350 21

Year-2

Semester-III

		Subject	Mark	Credit
Paper-14(Gen)	**G301**	Comm. English-II	50	3
Paper-15 (Major)	**PHHT301**	Electricity & Magnetism	50	3
Paper-16 (Major)	**PHHT302**	Optics	50	3

Paper-17(Major)	**PHHP303**	PHY Lab-III (Optics & Electricity)	50	3
Paper-18(Minor1)	**CHMT301**	Chemistry (Theory)-III	50	3
Paper-19(Minor2)	**MATHM301**	Mathematics-III	50	3
Paper-20(Minor2)	**MATHM302**	Mathematics-IV	50	3

350 21

Semester-IV Subject
Mark Credit

Paper-21(Gen)	**G401**	Statistical Methods	50	3
Paper-22(Gen)	**G402**	Elective: Entp. Dev./ Basic Financial Institution &market/ Basic Indian History	50	3
Paper-23 (Major)	**PHHT401**	Quantum Mech.-I	50	3
Paper-24 (Major)	**PHHT402**	Electronics	50	3
Paper-25(Major)	**PHHP403**	PHY Lab-IV (Electronics)	50	3
Paper-26(Minor1)	**CHMP401**	Chemistry (Lab)-II	50	3
Paper-27(Minor2)	**MATHM401**	Mathematics-V	50	3

350 21

Year-3

Semester-V Subject
Mark Credit

Paper-28(Gen)	**G501**	Indian Society and Culture (Gen. Core)	50	3
Paper-29(Gen)	**G502**	Biology for Phys. Sci./ Maths for Life Sciences/Science for everyday life (Gen. Elect)	50	3
Paper-30 (Major)	**PHHT501**	Quant. Mech.-II & Stat. Mech.	50	3
Paper-31 (Major)	**PHHT502**	Electrodynamics & Relativity	50	3

Paper-32(Major)	**PHHP503**	PHY Lab-V (Group 1 or Group 2)	50	3
Paper-33(Minor1)	**CHMT501**	Chemistry (Theory)-IV	50	3
Paper-34(Minor2)	**MATHM501**	Mathematics-VI	50	3

350 21

Semester-VI Subject
Mark Credit

Paper-35(Gen)	**G601**	Environmental Studies	50	3
Paper-36 (Major)	**PHHT601a**	a. Solid State Physics & Laser OR	50	3
	PHHT601b	b. Material Science		
Paper-37 (Major)	**PHHT602**	Atomic and Nuclear Physics	50	3
Paper-38(Major)	**PHHP603**	PHY Lab-VI (Group 1 or Group 2)	50	3
Paper-39	**PHHPS604**	Project Report Project Seminar	75 25	6 2

300 20

PHHT: Physics Hons. Theory; PHHP: Physics Hons. Practical; PHHPS: Physics Hons. Project and Seminar; CHMT: Chemistry Minor Theory; CHMP: Chemistry Minor Practical; MATHM: Mathematics Minor

Total Mark=300+350+350+350+350+300=2000

Total Credit=18+21+21+21+21+20=122

B.Sc. Physics Hons. Syllabus (Utkal University)

Choice Based Credit System

DISTRIBUTION OF COURSE, CREDITS AND MARKS							
	1st sem	2nd sem	3rd sem	4th sem	5th sem	6th sem	M
Gen.core & Gen. Elect	Comm. Eng.-I 3 credits (Gen.core)	Computer Language 3 credits (Gen.core)	Com.Eng.-II 3 credits (Gen.core)	1.Statistical Methods 3 credits (Gen.core) 2. Gen.Elect: Entp.Dev./ Basic Financial Institution &market/ Basic Indian History 3 credits	1. Indian Society and Culture 3 credits (Gen.core) 2. Gen.Elect: Biology for Phys.Sci./ Math. for Life Sc./ Sci. for everyday life 3 credits	Env. Studies 3 credits (Gen.core)	5 4 2 cr
Major	Phys.(Th)-1 3 credits	Phys.(Th)-3 3 credits	Phys.(Th)-5 3 credits	Phys.(Th)-7 3 credits	Phys.(Th)-9 3 credits	Phys.(Th)-11 3 credits	

	Phys.(Th)-2 3 credits	Phys.(Th)-4 3 credits	Phys.(Th)-6 3 credits	Phys.(Th)-8 3 credits	Phys.(Th)-10 3 credits	Phys.(Th)-12 3 credits	
	Phys.(Lab)-1 3 credits	Phys.(Lab)-2 3 credits	Phys.(Lab)-3 3credits	Phys.(Lab)-4 3credits	Phys.(Lab)-5 3credits	Phys.(Lab)-6 3credits Project Report (75 Marks 6credits) Project Seminar (25 Marks 2 credits)	1 5 cr
Minor1	Chem.(Th)-I 3 credits	Chem.(Th)-II 3 credits	Chem.(Th)-III 3 credits	Chem.(Lab)-II 3 credits	Chem.(Th)-IV 3 credits		3
		Chem.(Lab)-I 3 credits					1 cr
Minor2	Math-I 3 credits	Math-II 3 credits	Math-III 3 credits Math-IV 3 credits	Math-V 3 credits	Math-VI 3 credits		3 1 cr
credits	6 papers 18 credits	7 papers 21 credits	7 papers 21 credits	7 papers 21 credits	7 papers 21 credits	6 papers 20 credits	2 T 1 cr

Mark and Credit Distribution

Semester	***Credit***	***Marks***
1st	18	300
2nd	21	350
3rd	21	350
4th	21	350
5th	21	350
6th	20	300
Total	**122**	**2000**

MAJOR
SEMESTER- I
PHY-1.1 –MATHEMATICAL METHODS

Unit 1:Vectors and Coordinate systems

Rotation of coordinate axes in two and three dimensions, Rotation Matrix, Orthogonality property, Definition of vector and scalars, polar and axial vector Product of vectors, Triple scalar product, Triple vector product ,Quadruple product of vectors. Differentiation of vectors .Gradient of a scalar, Divergence and curl of vector and their physical significance. The Laplacian. Line, surface and volume integral of vectors . Gauss divergence theorem Stoke's Theorem. Green's Theorem.

General Orthogonal Curvilinear Coordinate systems .Plane polar ,cylindrical and spherical polar coordinate systems .Relation of their basis vectors with those of the Cartesian system .Expression of grad, div, curl, Laplacian, in those systems .Expression for velocity ,Kinetic energy and acceleration in those system.

Unit 2 –Differential Equations

Linear Second Order differential equation with variable coefficients ,singularities of differential equations ,and their classification , Power Series Method and Frobenius (extended Power Series) method of solving the differential equations, Hermite Differential Equation, singularities, Power Series Solution, Hermite Polynomial generating Function ,Recurrence Relations, Rodrigues Formula, orthogonality relation, simple integrals involving Hermite Polynomials, Legendre Differential Equation, singularities, Power Series solution, Legendre Polynomials generating function, Recurrence Relation, Rodrigue's Formula, Orthogonality Relation, Associated Legendre polynomials, Recurrence Relation, Orthonormality relation, Spherical Harmonics, orthonormality, values of spherical harmonics for l=0,1,2.

Unit 3:Integral Transforms

Fourier Series, Fourier Cosine and Sine Series, complex form of fourier series, Fourier Integral, Fourier Transform Cosine and Sine Transform ,Transform of Derivatives, the convolution Theorem, Parseval's Relation, Laplace Transform ,Inverse Laplace Transform ,Laplace transform of elementary functions and derivatives, application to Linear Harmonic Oscillator equation, Gamma Function, Beta Function, Their interrelation, properties ,simple integrals using gamma and beta functions. Dirac Delta function

Books:

1.Mathematical Methods for Physics -----G.B. Arfken, Academic Press.
2.Mathematical Physics and Special Relativity Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan)
3.Mathematical Physics ----B. S. Rajput ---Pragati Prakashan
4.Mathematical Physics –C. Harper ,Prentice Hall India.

Suggested reading

Advanced Engineering Mathematics, E. Kreyszig (New Age)

PHY 1.2. MECHANICS AND PROPERTIES OF MATTER

Unit 1:Mechanics

Kinematics of Rigid Body Motion, Moment of inertia-parallel axis theorem and perpendicular axis theorem. M.I of a solid cylinder and solid sphere Rotational kinetic energy of a rigid body about a fixed axis ,Rotating frames of Reference, inertial forces, coriolis force.

Gravitational field and Potential due to a solid sphere and spherical shell. Compound Pendulum, Kater's Pendulum. Central force motion ,reduction of two body central force motion into equivalent one body motion .General features of Central force motion differential equation of orbit, Kepler's Laws of Planetary motion, Virial Theorem .

Unit 2:Lagrangian and Hamiltonial Formulation :

Conservation of linear momentum , angular momentum and total energy of a system of particles, Lagrangian formulation ,constraints, degrees of freedom, generalized coordinates ,and velocities, principle of virtual work, D Alembert's Principle, Derivation of Lagrange's equation of motion from calculus of variation, Hamilton's Principle of least action ,derivation of Hamilton's equation of motion and Lagrange's equation of motion from Hamilton's Principle, Hamiltonian of a system, cyclic coordinates ,symmetry and conservation theorems.

Unit 3:Properties of Matter :

Elastic constants of homogeneous isotropic solid and their inter relations .Torsion of a right circular cylinder , Bending of beams, bending moment ,Cantilever, beam supported at both ends and loaded at the middle .

Kinematics of moving ideal fluid ,equation of continuity ,Euler's Equation for ideal fluid ,Bernoullie's Theorem ,Viscous Fluids, Laminar flow through narrow tubes, Pouiseullie's formula. Searle's Viscometer, Surface Tension and Surface Energy, Pressure difference across a curved liquid surface ,gravity waves and ripples .

Books:

1.Mechanics---Classical Mechanics –H.Goldstein ,Pearson Education ,India)
2.Properties of matter - D.S. Mathur (S.Chand)
3.Classical Mechanics - M.Das,P.K.Jena,M. Bhuyan , R.N.Mishra (Sri Krishna Publication)
4. Mechanics ---- K.R.Symon, Addison Wesley
5.Properties of Matter –Newmann and Searle, Eward Arnold Publication .
6.Introduction to Classical mechanics-R. K. Takwale, S.Puranik-Tata Mc Graw Hill
7. *Properties of Matter*, F.H. Newman and V.H.L. Searle (Edward Arnold Publication)
8. *Intr.to Classical Mechanics*, R.K.Takwale, S.Puranik (Tata McGraw-Hill)

Suggested Preliminary Reading:

Feynman Lectures in Physics Vol. 1, R. P. Feynman (Narosa)
Mechanics, Berkeley Course in Physics- 1, C.Kittel (Tata McGraw Hill)
Mechanics, J. C. Slater and N. H. Frank (McGraw-Hill)

Reference Books:

(i) Mechanics, (ii) Fluid Mechanics, (iii) Theory of Elasticity, L. Landau (Elsevier India)

PHY 1.3 PROPERTIES OF MATTER (PRACTICAL)

A student has to perform at least 10 experiments in a semester.
A student has to perform one Experiment during Exam.

1.Determinatin of g by bar pendulum .
2.Determination of g by Kater's Pendulum .
3.Determination of coefficient of rigidity of a wire statically.
4. Determination of coefficient of rigidity of a wire dynamically.
5.Determination of surface Tension of water by rise in a capillary tube .

6.Determination of viscosity of water by capillary flow method .
7.Determination of Y of a wire by Searle's method .
8..Detremination of Y of rubber .
9.Determination of surface Tension of soap solution .
10.Determination of coefficient of viscosity by Stoke's method .
11.Determination of Y by bending of beams .
12.Determination of Y from period of vibration of a loaded cantilever.
13.Determination of viscosity by oscillating disk method.
14.Determination of surface tension and angle of contact of mercury by Quinck's method .
15.Acceleration due to gravity by bar pendulum and study the effect of amplitude on the time period .

Reference Books:

Advanced Practical Physics, B. L. Worsnop and H.T. Flint (Asia Publishing)
Practical Physics, M. Nelkon and J. Ogborn (Heinemann)
A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal (Vani)

SEMESTER- II

PHY 2.1. THERMAL PHYSICS

Unit 1: Kinetic theory of Gas and Conduction

Ideal Gas Review of the Kinetic model of an ideal Gas ,interpretation of Temperature,

Equipartition of Enegy; Real Gases, Vander Waal' Equation of State, critical constants, reduced Equation of State
Mean Free Path; Clausius formula. Brownian Motion, Einstein's Formula, Determination of Avogadro's number.
Joule-Thomson Expansion; constancy of U+pV, Cooling in J-T Expansion ;Adiabatic Expansion of an ideal Gas., Thermal Conductivity, differential equation of heat flow in one dimension ,its solution, Ingen Hausz method of determination of thermal conductivity, radial flow of heat in spherical and cylindrical bodies, relation between thermal conductivity and electrical conductivity. Wiedman and Franz Law.

Unit 2:Thermodynamics
Internal Energy, Carnot Cycle and its Efficiency ,Carnot Theorem, the Second Law of Thermodynamics, Clausius and Kelvin- Planck Statements and their Equivalence,. Entropy as a Thermodynamic variable, Reversible and Irreversible Processes, Principle of Increase of Entropy; Thermodynamic scale of Temperature, its equivalence with the ideal gas scale. Impossibility of attaining absolute zero(third Law)
Thermodynamic functions, Internal Energy, Enthalpy, Helmoholtz free Energy, Gibb's Function, Maxwell Thermodynamic equations and its applications. Clausius Clapeyron Eq^n and Joule –Thomson Effect, First order Phase transition ,TdS Equations, effect of Pressure on Melting and Boiling Point .

Unit 3 Radiation
Black Body Radiation, its characteristics, Stefan Boltzman Law ,spectral Distribution in black body Radiation, Wien's Displacement Law, Wien's Formula ,Rayleigh Jeans Formula ,Ultra Violet Catastrophe, Planck's hypothesis; Mean Energy of an Oscillator and Planck's Law
Einstein's Theory and Debye's Theory of Specific heat of solids .

Books
1. 1.Heat and Thermodynamics----M.W. Zeemansky, R.H.Dittman , Mc Graw Hill
2.A Treaties on Heat-----M. N. Saha and B.N. Srivastav , The Indian Press Pvt.Ltd
3.Thermal and Statistical Physics ---M. Das ,P. K. Jena and others (Sri Krishna Prakashan)
4.Heat and Thermodynamics –A.B. Gupta and H. Ray ,Books and Allied Publishers .
5. Advanced Text Book of Heat-----P.K. Chakravarty, Hindustan Pub Co.

Suggested Preliminary Reading:
Feynman Lectures in Physics Vol. 1, R. P. Feynman (Narosa)

PHY 2.2-COMPLEX FUNCTIONS, OSCILLATIONS AND WAVES

Unit 1: Complex functions

Complex Numbers and Complex variables, functions of complex variables, Analytic function, Cauchy Riemann Condition, Harmonic Functions, line integral of complex function, Cauchy Integral Theorem, Cauchy Integral formula, Taylor Series and Laurent Series expansion, singularities of complex functions, simple poles, Residue Theorem, Evaluation of simple Contour Integrals,(around unit circle and semi circular contour)

Unit 2: Oscillations

Free oscillations of simple systems :Equilibrium ;concept of potential well; small oscillations approximation ;solutions; linear and transverse oscillations of mass between two springs ;diatomic molecule ;reduced mass concept .

Damped oscillations ;critical damping ; Q of an oscillator ;forced oscillator with one degree of freedom; Transient and steady state oscillations; resonance energy absorption; low and high frequency responses .

Two dimensional oscillator; normal modes; longitudinal and transverse oscillation of coupled masses, energy transfer between modes, coupled pendulum .

Unit 3: Waves.

Wave equation in a medium, velocity of longitudinal wave in a elastic medium , and that of transverse wave in a stretched string. composition of SHM Lissajous Figure for superposition of two orthogonal SHM vibrations with frequency in the ratio 1:1 and 2:1. Intensity and loudness of Sound, bel and decibels ,

Theory of plucked, struck and bowed string .

Ultrasonics, Production ,detection ,properties and uses .

Books :

1.A Text Book of Sound –M.Ghosh S.Chand
2.Classical Mechanics –M.Das ,P.K.Jena and others (Srikrishna Prakashan)
3.Mathematical Physics and Relativity –M.Das and others (Srikrishna Prakashan)

Suggested Preliminary Reading:

Feynman Lectures in Physics Vol. 1, R. P. Feynman (Narosa)
Waves, Berkeley Course in Physics 3 , F.S. Crawford (Tata McGraw Hill)
Advanced Engineering Mathematics, E. Kreyszig (New Age)

PHY 2.3- HEAT AND SOUND AND MAGNETISM (PRACTICAL)

A student has to perform at least 10 experiments in a semester.
A student has to perform one Experiment during Exam.

1.Specific heat of liquid by method of cooling .
2.Verification of Newton's Law of cooling .
3. .Determination of mechanical equivalent of heat by Joule's Calorimeter .
4. Determination of specific heat of a solid applying radiation correction .
5. Determination of unknown frequency of tuning fork using sonometer .
6.Verification of Laws of transverse vibrations of string using Sonometer.

7.Frequency of tuning fork using Melde's apparatus .
8.Thermal conductivity of rubber tube by radiation correction .
9.Determinationof Latent heat of steam applying radiation correction.
10. Thermal conductivity of a bad conductor by Lee's Method .
11.Deterimine the reduction factor of given tangent Galvanometer.
11Determination of Angle of Dip using Dip Circle .
13..Determination of magnetic moment of a magnet and H using deflection and vibration magnetometer.
14.Proof of Inverse Square Law in magnetism using Deflection Magnetometer.
15.Study of Oscillation of a mass under different combination of springs .
16. Determination of mechanical equivalent of heat using Calendar Barnes continuous flow calorimeter .

Reference Books:

Advanced Practical Physics, B. L. Worsnop and H.T. Flint (Asia Publishing)
Practical Physics, M. Nelkon and J. Ogborn (Heinemann)
A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal (Vani)

SEMESTER III

PHY 3.1.ELECTRICITY AND MAGNETISM

Unit 1: Electrostatics

Electric field at a point due to (a) electric dipole (b) continuous distribution of charge, Gauss's Law of electrostatics and applications- Field due to linear, spherical and plane charge distribution. Conservative nature of Electrostatic force ,

Electrostatic Potential. Relation between field and potential. Potential due to discrete and continuous charge distribution ,electrostatic boundary conditions, Laplace equation ,Poisson 's Equation ,Solution of Laplace Equation in spherical polar coordinates ,Conducting Sphere in uniform Electrostatic field.

Unit 2: Dielectric Polarization

Dielectric Polarization, Field inside a Dielectric ,Gauss Law in dielectric the Potential at a point due to a plane polarized dielectric, Gauss law in dielectric medium, Linear dielectrics ,susceptibility, permeability, dielectric constant .Potential energy of a point charge distribution in a dielectric medium. Boundary conditions on the displacement vector D ,dielectric sphere in an external uniform electric field, force on a point charge embedded in a dielectric, molecular field in Dielectric, Clausius Mossoti relation, energy in a dielectric medium.

Unit 3: Magnetism

Electric current ,current density ,electromotive force, steady current in media without sources of emf. Equation of continuity, Ohm's Law .

Magnetic Induction B ,Lorentz force Law, force on a straight conductor in a uniform magnetic field, the Law of Biot-Savart, magnetic induction due to a straight conductor, on the axis of circular coil and solenoid carrying current .

Magnetic field due to a distant circuit, Magnetic Scalar and vector Potentials. Torque on a current loop placed in external uniform magnetic field, moving coil and Ballistic Galvanometer.

Magnetic Properties of matter, Magnetization ,field of a magnetized object, Ampere's Law in magnetized medium, magnetic intensity magnetic susceptibility ,and permeability Hysteresis , Langevin's Theory of Diamagnetism, paramagnetism, Weiss theory of Ferromagnetism **.**

Books :

1.Introduction to Electrodynamics –D.J.Griffith Prentice Hall of India
2.Electricity and Magnetism –Chattopadhyay and Rakshit
3.Foundation of Electromagnetic Theory---Reitz and Millford
4.Electricity and Magnetism ---D C Tayal Himalay Pub
5.Electromagnetic Theory ----Satya Prakash.

Suggested Preliminary Reading:
Electricity and Magnetism, Berkeley Course in Physics Vol.2 , E. D. Purcell (Tata McGraw-Hill)
Feynman Lectures in Physics Vol. 2, R. P. Feynman (Narosa)
Reference Book:
Classical Electrodynamics, J. D. Jackson (John Wiley)

PHY 3.2. OPTICS

Unit 1 : Geometrical optics

Fermat's principle, reflection and refraction at plane interface ,Matrix formulation in geometrical Optics ,Cardinal points of co axial system ,Cardinal points of combination of two thin lenses and a thick lens ,

Monochromatic Aberrations ,spherical aberration and its minimization ,elementary ideas about Coma ,astigmatism ,curvature ,distortion ,and their remedies ,Chromatic Aberration ,Achromatic combination ,removal of chromatic aberration in a separated doublet, Ramsden and Huygen 's Eyepieces

Dispersion ,Theory of formation of primary and secondary rainbow .

Unit 2:Interference

Wave theory of Light, Huygen's Principle ,Electromagnetic nature of light ,condition of interference ,coherent sources ,division of wave front, Biprism, interference by plane parallel thin film illuminated by a point source. Interference by wedge shaped thin film. Colour of thin films, Newton's rings Michelson Interferometer, determination of wavelength of monochromatic light and wavelength difference by it. Fabry Perot Interferometer ,its Resolving Power, Determination of wavelength by it .

Unit 3: Diffraction and Polarization of light

Diffraction of light, Fresnel's and Fraunohofer diffraction, Fresnel's half period zones .Zone plate, its analogy with converging lens. Diffraction at straight edge , Fraunhoffer diffraction by a single slit, double slit ,plane transmission grating, Resolving power of telescope and microscope. Rayleigh Scattering ,Raman Effect .

Polarized and un polarized light, plane, circularly and elliptically polarized light, polarization by reflection and refraction, Brewster's Law, Malus Law, double refraction, ordinary and extra ordinary rays ,nicol prism and its construction ,working and use as a polarizer and analyzer. Half wave plate and quarter wave plate. Babinet's compensator and Laurent Polarimeter.

Books

1.Optics- P.K. Chakravarty
2.Physical Optics ---A.K. Ghatak
3.Principles of Optics ---B.K. Mathur
4.Physics for Degree students ---Das and others (Sri Krishna Prakashan)
5.Fundamentals of Optics-Jenkins and White.
6.Geometrical and Physical Optics –Longhurst

PHY 3.3. OPTICS & ELECTRICITY (PRACTICAL)

A student has to perform at least 10 experiments in a semester.

A student has to perform one Experiment during Exam.

1.Drawing I-D curve and determination of refractive index of the material of the prism using spectrometer.
2.Determinationof Cauchy's constants of a material of a prism using spectrometer.
3.Determination of dispersive power of a prism using a spectrometer .
4.Determination of thickness of a narrow wire using optical bench .
5. Determinationof Resolving Power of a telescope
6.Determination of wavelength of monochromatic light by using plane diffraction grating .
7. Determination of wavelength of monochromatic light by using Newton's rings .
8 .Comparison of capacitances by De Sauty Bridge .
9.Determinationof resistance of a suspended coil Galvanometer by (a)half deflection method (b)Kelvin's method .
10.Comparison of two emfs using stretched wire potentiometer and pointer galvanometer .
11.Determination of radius of curvature of a concave mirror –Kohlaruch Method .
12.Figure of Merit of a moving coil Galvanometer
13.Determination of resistance of a voltmeter
14.Study of variation of Field on the axis of a circular current carrying coil.
15.Comparison of two nearly equal resistances by Carey Foster bridge method and Pointer Galvanometer.
16. Determination of E.C.E. of copper.

Reference Books:

Advanced Practical Physics, B. L. Worsnop and H.T. Flint (Asia Publishing)
Advanced Level Practical Physics, M.Nelkon and J. Ogborn (Heinemann)
A Laboratory Manual of Physics for Undergraduate Classes, D. P. Khandelwal (Vani)

SEMESTER IV

PHY4.1. QUANTUM MECHANICS

Unit 1: Atomic Spectra and Models

Inadequacy of classical physics, Brief Review of Black body Radiation , Photoelectric effect ,Compton effect, dual nature of radiation ,wave nature of particles, Atomic spectra, Line spectra of hydrogen atom, Ritz Rydberg combination principle ,Alpha Particle Scattering ,Rutherford Scattering Formula , Rutherford Model of atom and its limitations ,Bohr's model of H atom .explanation of atomic spectra, correction for finite mass of the nucleus ,Bohr correspondence principle ,limitations of Bohr model ,discrete energy exchange by atom, Frank Hertz Expt. Sommerfeld Modification of Bohr's Theory .

Unit 2: Wave Particle Duality

De-broglie hypothesis , Experimental confirmation of matter wave ,Davisson Germer Experiment, ,velocity of de Broglie wave , wave particle duality ,Complementarity. superposition of two waves ,phase velocity and group velocity ,wave packet ,Gaussian Wave Packet ,spatial distribution of wave packet ,Localization of wave packet in time.

Time development of a wave Packet ;Wave Particle Duality ,Complementarity .

Heisenberg Uncertainty Principle ,Illustration of the Principle through thought Experiments of Gamma ray microscope and electron diffraction through a slit. Estimation of ground state energy of harmonic oscillator and hydrogen atom, non existence of electron in the nucleus .Uncertainty and Complementarity.

Unit 3: Schrodinger Equation and Operators

Time dependent Schrodinger equation in one and three dimension ,the wave function , Normalization of wave function, eq^{n} of continuity ,probability density and probability current density, Expectation value of an observable, Ehrenfest Theorem .

Operators associated with dynamic variables in Quantum Mechanics ,representation of position, linear momentum, and energy operators in co-ordinate and momentum space ,Schrodinger Equation in Momentum space, Linear operator s, Algebra of Linear Operators ,

commutation relation among components of position and momentum , commutator algebra , Adjoint of an operator. Hermitian operators. Eigen values and Eigenfunctions of an Operator Degeneracy, Orthogonality of Eigenfunctions, Linear dependence ,Schmidt Orthogonalization procedure for degenerate Eigenfunctions. Eigenfunctions Expansion ,Completeness and Closure Relation compatibility ,Proof of the Uncertainty Relation $\Delta x.\Delta p_x > \hbar/2$,Minimum Uncertainty Wave Packet, Time Energy Uncertainty Relation .

Books:

1.QuantumPhysics----S.Gasiorwiz (John Wiley)
2.Quantum Mechanics -J.L. Powell and B.Craseman (Addison Wesley)
3.Introduction to Quantum Mechanics- M.Das,P.K.Jena,(SriKrishna Prakashan
4.Basic Quantum Mechanics –A.Ghatak
5. Introduction to Quantum Mechanics – R. Dicke and J. Wittke

Suggested Preliminary Reading:
Feynman Lectures in Physics Vol. 2, R. P. Feynman (Narosa)
Reference Book: *Quantum Mechanics*, L. I. Schiff (McGraw-Hill)

PHY 4.2. ELECTRONICS

Unit 1:Electronic devices:

pn junction as a rectifier, half wave and full wave rectifier(center tap and bridge type) efficiency ,ripple factor ,use of RC and LC filters, Zener Diode as a Voltage Regulator .

Bipolar Junction Transistor : pnp and npn transistor ,active and saturation regions, characteristics of BJT, input and output characteristics in CE and CB configuration ,Beta parameter Relation with alpha, Transistor as a four port device, , hybrid h parameter, equivalent circuit for transistors . load line concept ; Biasing methods .stability factor ,low frequency model .

Field Effect Transistor :classification of various types of FETs, constructional details of JEFT, drain characteristic of JEFT ,biasing of JEFT ,operating Regions ,pinch off voltage ,idea of MOSFET.

Silicon controlled rectifier, I-V Characteristics, phase controlled rectifier. Unijunction transistor, I-V Characteristics ,

Unit 2 : Analog Circuits:

Hybrid parameter model of transistor, analysis of transistor amplifier (with and without R_S and R_L) using h- parameters, simplified hybrid model, brief idea about hybrid π model.

Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier, Feedback in amplifiers, positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits.

Barkhausen criterion of oscillations, tuned collector oscillator, Hartley / Colpitt oscillator, phase shift oscillator.

Need and types of modulation, amplitude modulation, analysis of A.M. wave, modulator and demodulator circuits.

Operational Amplifiers :Differential Amplifiers ,principles of Op Amplifier Properties of a practical OP-Amp and applications .

Unit 3 : Digital Circuits:
Integrated circuits, advantages, fabrication of monolithic ICs.
Boolean algebra, logic gates, AND, OR ,NOT,NAND ,NOR gates truth table ,DTL , TTL circuits. NAND and NOR gates as universal gates. Simplification of Boolean expressions using K- maps. Half and full adders and subtractors.
Multiplexer and Demultiplexer, Encoder and Decoder .

Books:
1.Basic Electronics :D.C.Tayal , Himalay Pub
2.Electronic Fundamentasl and Applications :Integrated and Discrete Systems. J.D.Ryder—Prentice Hall
3.Electronic devices :circuits and Applications :W.D.Stanley Prentice Hall
4.Electronic Circuits :L.Schilling and Velove :3rd Ed Mc Graw Hill

OR

PHY 4.2 Electronic Devices (Elective for Major)

Unit 1:Diodes and BJT
Pn junction, I-V characteristics, Shockley model ;application in rectifier; clippers and limiters; Zener diode and its applications; optoelectronic diodes: LED; photodiodes, optocouplers .
BJT: npn and pnp structures; active and saturation region characteristics of BJT ;CE configuration, input output characteristics, Beta parameter, CB configuration, input output characteristics, Two port analysis of a transistor ,definition of h parameter, load line concept ,emitter follower, Biasing methods ,stability factor, low frequency model .

Unit 2 :Field Effect Transistor and Amplifiers
Classification of various types of FET, constructional details of junction field effect transistor ,drain characteristic of JFET, biasing of JFET ,operating regions ,pinch off voltage ,idea of metal oxide FET .
Frequency Response of Amplifiers, LC, and RC response, bandwidth and rise time, pass band, ac equivalent circuit with and without input and output loading, cascade connections, decibel power, gain and loss conversion to voltage and current gain, Bode's plots .

Unit 3:Oscillators and waveform generators
Positive feedback, barkhausen criterian, RC oscillator Wien Bridge Oscillator ,Phase Shift

Oscillator, Colpitt's Oscillator ,Hartley Oscillator, Operational Amplifier ,Square Wave Generator, 555timer for a stable operation, Calculation of frequency and amplitude of Oscillator ,Uni-junction Oscillator .

Digital Devices: Logic gates- OR, AND, NOT, NOR, NAND, XOR: truth tables. Implementation of logic gates using DTL, RTL, TTL. NMOS, CMOS.

Books:

1.Electronic Fundamentals and Applications ,Integrated and discrete systems –J.D. Ryder ,5th Ed Prentice Hall
2.Electronic Devices and Applications ,Circuits and applications ,W.D. Stanley ;Prentice Hall
3.Electronic Circuit ,L. Schilling and Velove-3rd Ed Mc Graw Hill

PHY 4.3 Electronics PRACTICAL

A student has to perform at least 10 experiments in a semester.
A student has to perform one Experiment during Exam.

1.Comparing static characteristics of two diode valves.
2.Comparing static characteristic of a p-n junction and a Zener diode.
3.Study of Zener diode as a Voltage Regulator.
4. Study of static characteristic of triode valve and determination of amplification factor .
5.Study of efficiency and ripple factor of a half wave rectifier.
6. Study of efficiency and ripple factor of a full wave rectifier.
7.Study of bridge rectifier with and without filter.
8.Study of static characteristic of a transistor and calculation of input ,output resistances and amplification factor in CB mode .
9. Study of static characteristic of a transistor and calculation of input , output resistances and amplification factor in CE mode .
10.Study of charging and discharging of a capacitor through a resistor .
11.Study of R-C coupled amplifier.
12.Study of Hartley oscillator.
13.Study of a Colpitt's Oscillator .
14.Verification of Truth Tables of AND ,OR and NAND logic gates .
15.Charactristics of FET.

Reference Books:

Basic Electronics (A Text-Lab Manual, P. B. Zbar and B. Malvino (Tata McGraw-Hill)
Advanced Practical Physics, B. L.Worsnop and H.T. Flint (Asia Publishing)

SEMESTER V

PHY 5.1 QUANTUM MECHANICS II AND STATISTICAL PHYSICS

Unit 1 :Angular momentum

Angular Momentum in Quantum Mechanics ; Central forces, orbital angular momentum ,operators for its Cartesian components ,commutation relations mutually as well as with L^2,operators and L+ and L-, their interpretation as step operators, Eigen values of half integral values for quantum numbers. Angular Momentum Operators in Spherical Polar Coordinates , Evaluation of their Eigen functions explicitly in terms of the coordinates ,their degeneracy, Schrodinger Equation for Hydrogen Atom in Spherical Polar Coordinates ,Separation into radial and angular variables ,Qualitative discussion of Spherical Harmonics .

Unit 2 :One Dimensional Problems

Time Independent Schrodinger equation :Stationary States ,Constants of motion in Quantum Mechanics Ehrenfest Theorem(Operator Method) The Quantum Virial Theorem ,Solution of time Independent Schrodinger equation in one dimension. Boundary and Continuity condition, symmetry and Anti Symmetry of Wave Functions ,Parity Operator And its Properties .

General features of the solutions of one dimensional problems. Free and Bound States ,Non degenerate Energy Levels in one dimensional problem ,The Free Particle , finite square well potential, potential barrier ,solution of one dimensional time independent Schrodinger Equation in the above problems. one dimensional linear harmonic oscillator, Energy Eigen values and Energy Eigen functions. Particle in a three dimensional Box .

Unit 3: -Statistical Physics

Equilibrium distribution in a statistical system, probability and entropy, Boltzmann –entropy relation , ensembles, micro canonical, Canonical ,and Grand Canonical ensembles. Partition function for Canonical ensembles, Maxwell Boltzmann Distribution function, Partition function for ideal mono atomic gas, entropy of a mono atomic gas, Gibb's paradox, Maxwell Boltzmann distribution of molecular speeds in an ideal gas, derivation of mean ,rms ,most probable speeds ,degrees of freedom, law of Equipartition of Energy.

Books:

1.QuantumPhysics----S.Gasiorwiz (John Wiley)
2.Quantum Mechanics -J.L. Powell and B.Craseman (Addison Wesley)
3.Introduction to Quantum Mechanics M.Das,P.K.Jena ,(SriKrishna Prakashan)
4.Statistical Thermodynamics -----M.C.Gupta ,Wiley Eastern
5. .Heat and Thermodynamics----M.W.Zeemansky,R.H.Dittman,Mc Graw Hill
6.Statistical physics ---B.B laud –
7. Statistical physics ------K Huang, Wiley Eastern

PHY 5.2 ELECTRODYNAMICS,ELECTROMAGNETIC WAVES AND RELATIVITY

Unit 1: Electromagnetism

Motional emf ,Faraday 's Laws of Electromagnetic induction in integral and differential form ,induced electric field due to an infinite long wire carrying a slowly varying current ,self and mutual inductance ,self inductance of a solenoid ,and of a straight conductor ,energy stored in an inductor in an electromagnetic field ,

Transient currents –growth and decay of current in series RC,RL LC and LCR circuits ,AC-sinusoidal voltages applied to series RC,RL,LC ,and LCR circuits ,Power in AC ,series and parallel resonant circuits ,sharpness of resonance ,Q factor .

Unit 2:--Maxwell's Equations

Displacement current and its physical significance ,Maxwell's electromagnetic equations in free space ,and in medium ,boundary conditions ,scalar potential and vector potential ,Gauge transformations ,Coulomb gauge and Lorentz gauge ,Electromagnetic waves, Poynting Theorem ,Energy and momentum of Electromagnetic wave ,electromagnetic waves in non conducting media ,Propagation of waves in Vacuum and linear media ,Reflection.

Transmission of wave at a conducting surface (Normal Incidence)

Unit 3:Relativity
Galilean Transformations, Newtonian Relativity and its limitations, Michelson Morley Expt. and its consequences, Postulates of special Theory of Relativity, Lorentz Transformation, length contraction, simultaneity ,time dilation, relativistic addition of velocities ,four vectors ,position and Velocity four vector ,Energy momentum four vector , relativistic mass and momentum ,mass energy Relation, Relativistic Doppler Effect.

Books:
1:Introduction to Electrodynamics –D.J.Griffith Prentice Hall of India
2.Electricity and Magnetism –Chattopadhyay and Rakshit
3.Foundation of Electromagnetic Theory---Reitz and Millford
4.Electricity and Magnetism ---D C Tayal Himalay Pub
5.Electromagnetic Theory ----Satya Prakash.
6.Mathematical Physics and Sp.Relativity –M.Das ,P.K.Jena ,B.K.Dash (Srikrishna Prakashan)
7.Relativity –R.Resnick

Suggested Preliminary Reading:
Feynman Lectures in Physics Vol. 2, R. P. Feynman (Narosa)
Reference Books :
Optics, M. Born and E. Wolf (Pergamon)
Classical Electrodynamics, J. D. Jackson (Wiley)
Classical Theory of Fields, L. Landau (Elsevier India)

PHY 5.3. PRACTICAL

50% students have to perform experiments from Group 1 and the remaining students will do that from Group 2. Each student has to perform at least 8 experiments.
A student has to perform one Experiment during Exam.

Group 1
1. Calibration of a spectrometer and determination of unknown wavelength.
2.Wavelength of monochromatic light using biprism .
3. Resolving Power of a prism spectroscope .
4.Resolving Power of a plane transmission grating .
5. Rotativity of sugar solution .
6..Determination of internal resistance of a cell using Potentiometer.
7..Comparison of resistances using a potentiometer .
8..Measurement of resistance by meter bridge applying end correction
9..Study of variation of magnetic field on the axis of a circular coil carrying current

10.Study of single slit diffraction pattern.
11. Vapour Density of a volatile liquid by Victor Meyer method
12.Study of a Cathode Ray Oscilloscope.
13. Measurement of energy band gap of Si using a p-n junction diode
14. Phase shift between the current and the applied voltage in (a) C.R., (b) L.R. (c) L.C.R. circuits using a CRO and an oscillator.
15. To draw B-H curve and study hysterisis loss .
16. Study of the characteristics of SCR

Group 2
1.Determination of Ballistic constant.
2.Measurement of high resistance using mega-ohm box .
3. Study of frequency response curve of a LCR circuit .
4.Calibration of thermocouple thermometer .
5.Calibration of Meter bridge .
6.Calibration of a milliammeter.
7.Determination of viscocity by Searle's Viscometer.
8.Caibration of a set of weights .
9. Calibration of platinum resistance thermometer and determination of melting point of wax.
10. Computer program (Fortran or C or C++) to print out all natural even/odd numbers in a list.
11. Computer program to find the greatest of a set of numbers.
12.Computer program to find sum of a given series .
13.Refractive index of liquid by Newton's Rings .
14.Study of ripple factor and efficiency of a rectifier
15.Verification of Brewster's Law.
16.Study of the characteristics of UJT.
17. Determination of M.I. of a fly wheel about its own axis of rotation.

Reference Books: as for previous semesters, and
Schaum's Outline of Programming with C++, J. R. Hubbard (Tata McGraw-Hill)

SEMESTER VI

PHY6.1. SOLID STATE PHYSICS AND LASERS

Unit 1-Crystal Geometry and Crystallography
Crystalline and Amorphous solids, crystal structure Lattice and Basis Types of Lattices Unit cell ,primitive cell ,Winger-Seitz Cell ,simple cubic ,body centered cubic ,face centered cubic hexagonal close packed structure ,Directions and Planes in Crystal ,Miller indices of planes .
Crystal structure determination by X rays diffraction ,use of electron and neutrons in crystal structure determination ,Laue's condition of X ray Diffraction ,Bragg's Law from Laue condition ,Concept of Reciprocal lattice Vectors ,Atomic form factor ,geometrical structure factor.

Unit2:Crystal Binding and Conduction in metals

Crystal Binding ,ionic crystal ,electrostatic energy, Madelunge Constant Inert gas crystals ,Van Der Waal's-London Interaction ,Cohesive energy ,covalent binding ,metallic bonding ,hydrogen bonded crystals

Conduction in metals, Drude's Theory of electrical conduction ,density of states, Fermi Level ,Hall Effect, Thermal conductivity of metals, Superconductivity, History of Superconductivity, Zero Resistivity, Meisnner's Effect. Type I and Type II Superconductors.

Unit-3 Lasers

Concept of coherence, Temporal coherence, Spatial coherence ,line width, Purity of spectral lines, visibility of fringes, degree of coherence and directionability, Einstein A and B coefficients spontaneous and induced emission, condition for laser action population inversion ,properties of a laser beam He –Ne Laser ,Ruby Laser, Carbon Dioxide Laser ,Practical uses of Laser.

Books:

1.Solid State Physics------C.Kittel (Wiley eastern)
2.Solid State Physucs ----Srivastav
3Solid State Physics – S O Pillai New Age Publication
4.Lasers and Non linear Optics –B.B.Laud-Wiley Eastern.

OR

PHY6.1. MATERIAL SCIENCE

Unit-1-Crystal Physics

Crystalline and Non Crystalline materials, Bravais Lattices, Crystal Systems, Symmetry Elements, Simple Crystal structures like simple cubic ,body centered cubic ,face centered cubic and hexagonal close packed ,Packing factor for sc, bcc, fcc, hcp, structures, Miller Indices .Imperfactions in Crystals Bragg's Law and X ray diffraction methods to study crystal structures.

Unit-2-Electric and electronic Materials

Classical free electron Theory of metals ,Electrical conductivity of Al. Drawbacks of classical theory ,Quantum free electron Theory of Metals ,and its importance . Density of states ,Fermi –Dirac statistics , electrical conduction ,Classification of semiconductor Materials ,Materials and Technology for Integrated circuits ,Photonic materials ,superconductivity and special super conducting materials . Ferrites ,Quartz Crystal ,Dielectric materials ,Piezoelectric and Ferro-electric materials, Electromechanical Materials. Mechanism of polarization and its measurement.

Unit-3-Magnetic Materials and Optical Materials:

Different types of Magnetic materials, and their properties, Domain Theory of Ferro magnetism , Heisenberg Criteria ,Hysteresis, Energy product of a magnetic material ,Ferrites and their applications Magnetic Recording Materials metallic glasses.

Optical properties of metals, insulators and semiconductors, Phosphorescence and Florescence, Excitons, traps and colour centres and their importance. Different phosphors used in CRO screens. Liquid Crystal as display, LED materials, Working of LED, Plasma Displays, Thermography and its applications. Photoconductivity and Photoconducting materials .

Books:

1.Material Sc for Engg- Rajendran ,Marikeni
2. Material Sc for Engg ----Vijaya and Rajendran
3. Material Sc and Engg --Raghavan ,PHI,New Delhi ,1993.

PHY 6.2. MODERN PHYSICS

Unit 1 :Atomic Physics I, Characteristic and Continuous X Rays spectra ,Mosley Law .Absorption of X Rays .
Orbital Angular Momentum of the electron ,Bohr Magneton , Space Quantization , Electron spin, Vector model of Atom ,Coupling of Angular Momenta; Spectroscopic notations ,Stern Gerlach Experiment
,Electron Spin orbit interaction and fine structure , separation due to Spin orbit interaction (p,d,f levels), Normal and Anomalous Zeeman Effect.
,Two electron Atom , J-J coupling , S-S coupling , L-S coupling, Pauli exclusion priniciple.

Unit 2: Nucleus, Radioactivity, Nuclear Reaction
Structure of the atomic nucleus, Basic properties - charge, mass, size, spin, magnetic moment, quadrupole moment parity Nuclear force –its characteristics, mass defect ,binding energy and binding fraction, **S**tability of Nucleus ,liquid drop model, semi empirical mass formula ,explanation of fission. Magic numbers .
Radioactivity, Law of Radioactive Decay, Gamow's Theory of Alpha Decay, Activity, radioactive series, displacement Law, successive disintegration, radioactive equilibrium ,Geiger Nuttal Law .
Nuclear Reaction–Conservation Laws ,Q value , nucleus cross section, Nuclear transmutation induced by proton ,neutron ,deuteron, and alpha particle. Radio Isotopes fission and Fusion reactions . Nuclear Reactors.

Unit 3 :Particle Physics
Detector of charged particles–cloud chamber, bubble chamber, GM counter, Particle Accelerator –linear Accelerator ,Cyclotron .
Cosmic Rays discovery and origin , primary and secondary cosmic rays ,cosmic ray showers, soft and hard components ,discovery of positrons, muon and pion, Elementary particles ,fundamental forces, classification, Leptons Hadrons, Mesons ,Baryons ,internal quantum number, Baryon number, Isospin, Strangeness, hypercharge, parity their conservation ,Elementary ideas of Quarks.

Books:

1.Concept of Modern physics –A .Beiser
2. Nuclear Physics – S.N .Ghosal. S.Chand
3.Concept of Nuclear physics –Cohen
4.Atomic and Nuclear Physics -A.B.Gupta,Dipak Ghosh.,Books and Allied Publishers .
4.Modern Physics ------H.S. Mani and G.K. Mehta
5.Modern Physics ---Murugesan and Sivaprasad –S.Chand

PHY 6.3. PRACTICAL

A student has to perform at least 8 experiments.
The students who have performed experiments from Group 1 in Semester V, shall perform experiments from Group 2 and vice-versa.
A student has to perform one Experiment during Exam.

Group 1

1. Calibration of a spectrometer and determination of unknown wavelength.
2.Wavelength of monochromatic light using biprism .
3. Resolving Power of a prism spectroscope .
4.Resolving Power of a plane transmission grating .
5. Rotativity of sugar solution .
6..Determination of internal resistance of a cell using Potentiometer.
7..Comparison of resistances using a potentiometer .
8..Measurement of resistance by meter bridge applying end correction
9..Study of variation of magnetic field on the axis of a circular coil carrying current
10.Study of single slit diffraction pattern.
11. Vapour Density of a volatile liquid by Victor Meyer method
12.Study of a Cathode Ray Oscilloscope.
13. Measurement of energy band gap of Si using a p-n junction diode
14. Phase shift between the current and the applied voltage in (a) C.R., (b) L.R. (c) L.C.R. circuits using a CRO and an oscillator.
15. To draw B-H curve and study hysterisis loss .
16. Study of the characteristics of SCR

Group 2

1.Determination of Ballistic constant.
2.Measurement of high resistance using mega-ohm box .
3. Study of frequency response curve of a LCR circuit .
4.Calibration of thermocouple thermometer .
5.Calibration of Meter bridge .
6.Calibration of a milliammeter.
7.Determination of viscocity by Searle's Viscometer.
8.Caibration of a set of weights .
9. Calibration of platinum resistance thermometer and determination of melting point of wax.
10. Computer program (Fortran/C/C++) to print all natural even/odd numbers in a list.
11. Computer program to find the greatest of a set of numbers.
12.Computer program to find sum of a given series .
13.Refractive index of liquid by Newton's Rings .
14.Study of ripple factor and efficiency of a rectifier
15.Verification of Brewster's Law.
16.Study of the characteristics of UJT.
17. Determination of M.I. of a fly wheel about its own axis of rotation.

MINOR

SEMESTER I

PHY 1.4. Mechanics, Properties of matter, Oscillations and Thermal Physics

Unit 1: Mechanics

Moment of inertia-parallel axis and perpendicular axis theorem. M.I of a solid cylinder and solid sphere, Rotational kinetic energy of a rigid body, compound pendulum .Central force motion, conservation of energy and angular momentum ,reduction of two body central force problem to one body problem , Kepler's Laws of planetary motion.

Gravitational force, field, potential energy and potential. Gravitational potential and field due to thin spherical shell and solid sphere

Unit2: Properties of Matter and Oscillations

Relation among elastic constants. Bending of beams , bending moment ,depression at the free end of a light cantilever, depression at the midpoint of a loaded heavy beam supported at the ends. Torsion of a right circular cylinder. Surface Tension , pressure difference across a curved membrane.Viscous flow of liquid , Pouiseullie's formula.

Simple harmonic motion , damped harmonic motion, power loss, Q factor, under damped and over damped and critically damped motion .Forced vibration resonance, sharpness of resonance.

Wave equation in a medium, velocity of longitudinal wave in a elastic medium , and that of transverse wave in a stretched string. composition of SHM Lissajous Figure for superposition of two orthogonal SHM vibrations with frequency in the ratio 1:1 and 2:1.

Unit 3:Thermal Physics

Carnot engine and its efficiency ,carnot theorem ,Second law of thermodynamics ,Kelvin-Planck and Clausius formulations .and their equivalence. Thermodynamical scale of temperature, **E**ntropy, Change in entropy ,T-S diagram. Thermodynamic coordinates, P,V,T,S .Maxwell Thermodynamic relations and its applications . T-dS equations. Heat capacity equation. Clausius Clapeyron Eqn, Effect of pressure on melting and boiling point.

Maxwell Boltzmann formula for distribution of molecular speeds, rms speed,average speed,most probable speed(statement and discussion only), equipartition of energy Van der Waal's eqn of state, for real gases. critical constants, Reduced eqn of state.

Black body radiation- only statement and discussion of i. Stefan's law and energy distribution in the black body spectrum, ii. Wien's displacement law and Wien's formula and iii. Rayleigh Jeans Formula and iv. Planck's formula.

Books: 1.Properties of matter -D.S. Mathur (S.Chand)

2..Heat and Thermodynamics-A.B.Gupta,G.B. Ray(Books & Allied Publishers)

3.Sound –M.Ghosh-----(S.Chand)

4.Physics for Degree students –M.Das,P.K.Jena,M. Bhuyan ,D.K. Rout (Sri Krishna Publication)

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PHY 1.5. PRACTICAL

(From 2013-14 Batch and Onwards)
A student is expected to perform at least 12 experiments in a semester.
A student will be examined for one Experiment during Semester End Exam.

1.Gauss method of weighing by Physical Balance.
2.Acceleration due to gravity by bar pendulum.
3.Young's modulus of rubber tube using travelling microscope.
4.Young's modulus of wire by Searle's Method.
5.Rigidity Modulus by static method.
6.Rigidity modulus by Dynamic method.
7.Surface Tension of Water by capillary rise method.
8.Viscocity of water by capillary flow method.
9.Comparison of specific heats of liquids by method of cooling .
10.Refractive Index of material of glass slab using travelling microscope .
11.Refractive index of transparent liquid using travlling microscope.
12.Focal length of Convex/Concave mirror using Kohlarush Method .
13. Variation of Magnetic field along the axis of a circular coil carrying steady current.
14. Horizontal component of Earth's magnetic field and Magnetic moment of a bar magnet using Deflection Magnetometer and Oscillation magnetometer.
15.Reduction factor of Tangent Galvanometer.
16.Electrochemical equivalent of Copper.
17.Figure of Merit of Moving coil Galvanometer.
18. Resistance of a Galvanometer by Kelvin's Method .
19. Determination of Resistance by Meter Bridge using end correction (pointer Galvanometer)

SEMESTER II

PHY 2.4 (Vectors, Electrostatics, Magnetism, Electronics)

Unit-1:Vectors and Electrostatics

Product of vectors, Triple scalar product ,Triple vector product,. Differentiation of vectors Gradient of a scalar ,Divergence and curl of vector and their physical significance.,the Laplacian .Line, surface and volume integral of vectors .Statements of Gauss divergence theorem and Stoke's Theorem.

Gauss's Law of electrostatics and applications. Electrostatic Potential. Electrostatic Potential energy .

Dielectrics Polarization,Potential at a point due to a plane polarized dielectric ,Gauss law in dielectric medium, displacement vector D, Gauss Law in its differential form ,Linear dielectrics ,susceptibility, permeability, dielectric constant .Potential energy of a point charge distribution in a dielectric medium.

Unit 2: Magnetism

Magnetic Induction B ,Lorentz force Law ,force on a straight conductor in a uniform magnetic field, Torque on a current loop ,the Law of Biot-Savart ,magnetic induction due to a straight conductor, on the axis of circular coil and solenoid carrying current . Ampere's Circuital law, its differential form. Magnetic induction on the axis of a solenoid carrying current.

The laws of electromagnetic induction ,its integral and differential form. displacement current, Maxwell's electromagnetic equations- statements and their physical significance, Electromagnetic wave equation, properties of E.M. wave , Statement of Poynting Theorem.

Unit 3: Transients, AC, Electronics

Growth and decay of currents in a RC, LR circuits ,Time constant ,AC through series RC, LR, LCR circuits, phase diagram, impedance , average power ,power factor.RLC series resonant circuit ,sharpness of resonance, bandwidth, Q factor.

p-n junction as a rectifier ,half wave and full wave rectifier(center tap and bridge type)efficiency ,ripple factor ,use of RC and LC filters, working of pnp and npn transistor ,static characteristics of transistors in CE and CB configuration .relation between alpha and beta, load line, operating point. positive and negative feedback ,criteria for sustained oscillation .Hartley and Colpitts Oscillator, principle ,circuit operation ,theory and use. Modulation and demodulation.AM and FM modulation ,Modulation index ,and its significance

Books:

1. .Physics for Degree Students –B.Bhuyan S.Mishra etal (Sri Krishna Publications)
2.Electricity and Magnetism-----Rakshit and Chattopadhyay
3.Fondation of Electronics--- Rakshit , Chattopadhyay,Saha and Purkait
4.Principles of Electronics ---B.B.Swain –(Kitab Mahal)

SEMESTER III

PHY 3.4 (Optics, Relativity and Nuclear Physics)

Unit: 1 Geometrical Optics and Interference

Fermat's Principle ,reflection and refraction at plane interface, cardinal points of a coaxial system ,cardinal points of (i) combination of two thin lenses,(ii) thick lens. Elementary idea of monochromatic aberration and their minimization. chromatic aberration , achromatic combination ,removal of chromatic aberration in a separated doublet ,Ramsden and Huygen's eyepiece ,theory of formation of primary and secondary rainbow.

Wave theory of Light , Huygen' s Principle ,condition of interference ,coherent sources ,division of wave front , Biprism ,interference by plane parallel thin film illuminated by a point source. Interference by wedge shaped thin film . colour of thin films ,Newton's rings .

Unit: 2 Diffraction and Polarization of light

Diffraction of light, Fresnel's and Fraunohofer diffraction, Fresnel's half period zones .Zone plate ,its analogy with converging lens. Diffraction at straight edge , Fraunhoffer diffraction by a single slit ,double slit ,plane transmission grating ,Resolving power of telescope and microscope.

Electromagnetic nature of light, polarized and un polarized light, plane, circularly and elliptically polarized light, polarization by reflection and refraction, Brewster's Law ,Malus Law, double refraction, ordinary and extra ordinary rays ,nicol prism and its construction, working and use as a polarizer and analyzer.

Unit: 3 Relativity and Nuclear Physics I

Galilean Transformations, Newtonian Relativity and its limitations, Michelson Morley Expt and its consequences, Postulates of special Theory of Relativity, Lorentz Transformation, length contraction, simultaneity ,time dilation, relativistic addition of velocities, relativistic mass and momentum ,mass energy Relation,

Properties of nucleus, charge ,size, spin, magnetic moment ,mass ,mass defect ,binding energy and binding fraction, Nuclear force-its characteristic features,. Radioactive Decay law, half life average life, nuclear fission, nuclear fusion, linear accelerator ,cyclotron .

Books:

1.Optics- P.K. Chakravarty
2.A Text Book of Optics –Brij Lal and Subramanyam . –S. Chand
2.Physical Optics ---A.K. Ghatak
3.Principles of Optics ---B.K. Mathur
4.Relativity-----R.Resnick
5.Physics for Degree students ---Das and others (Sri Krishna Prakashan)
6.Physics for Degree Students –C.L.Arora and Hemne –S.Chand .

PHY 3.5 PRACTICAL

(From 2013-14 Batch and Onwards)

A student is expected to perform at least 10 experiments in a semester.
A student will be examined for one Experiment during Semester End Exam.

1.Young's Modulus of Wood/steel by bending of beams .
2.Moment of Inertia of Flywheel.
3.Coefficient of viscocity by Stoke's method.
4. Coefficient of viscocity by Searle's Viscometer.
5.Surface Tension of soap solution .
6..Mechanical Equivalent of heat using Joule's calorimeter.
7.Thermal conductivity of rubber tube .
8.Verification of Laws of vibration of strings using sonometer.
9. Frequency of tuning fork using Melde's apparatus .
10. Magnifying Power of telescope .
11.Determination of high resistance with Megohm box.
121.Comparison of capacitances with De Sauty's bridge .
13.Angle of Prism and angle of minimum Deviation using Spactrometer.
14. Angle of Minimum Deviation from I –D Curve using Spectrometer.
15.Wavelength of light by using Newton's rings .
16.Wavelength of monochromatic light by using plane diffraction grating .
17. Static characteristics of diode valve/ pn junction .
18.Static characteristics of triode valve /transistor .
19.Comparison of emfs using wire potentiometer .
20.Comparison of two nearly equal resistances using Carey Foster Bridge .

Books:

1.A Laboratory Manual of Physics for undergraduate classes ---D.P. Khandelwal,Vant Pub House,New Delhi .
2.Practical Physics Manual –Dr.P.P. Mishra
3. A book of Practical Physics –Dr.B.B. Swain
4.Advanced Practical Physics ----Worsnop and Flint
5.Physics experiments----. B saraf

SEMESTER IV

PHY 4.4 Atomic Physics & Quantum Mechanics

Unit1 Atomic Physics

Atomic spectra,Line spectra of hydrogen atom, Ritz Rydberg combination principle , Rutherford Model of atom and its limitations ,Bohr's model of H atom .explanation of atomic spectra, correction for finite mass of the nucleus ,Bohr correspondence principle ,limitations of Bohr model ,discrete energy exchange by atom, Frank Hertz Expt.

Inadequacy of classical physics, Photoelectric effect ,Compton effect, dual nature of radiation ,wave nature of particles, De-broglie hypothesis , Experimental confirmation of matter wave ,Davisson Germer Experiment, ,velocity of de Broglie wave , wave particle duality ,Complementarity.

Unit 2 Quantum Mechanics I

Heisenberg Uncertainty Principle ,Illustration of the Principle through thought Experiments of Gamma ray microscope and electron diffraction through a slit. Estimation of ground state energy of harmonic oscillator and hydrogen atom, non existence of electron in the nucleus .

Time dependent Schrodinger equation in one and three dimension ,the wave function , Normalization of wave function, eqn of continuity ,probability density and probability current density , Expectation value of an observable , operators in Quantum Mechanics ,Linear operator s,Algebra of Linear Operators ,position and momentum operator, commutation relation among position and momentum operators, commutation algebra , ,Hermitian operators. Adjoint of an operator.

Unit 3 : Quantum Mechanics II

Eigen value Equation, Eigen value spectrum, degeneracy,Eigen values and Eigenfunctions of Hermitian operators , Orthonormality of eigenfunctions ,

Time independent Schrodinger Eqn ,stationary state solutions , Ehrenfest Theorem,

Application of time independent Schrodinger Eqn in one dimension , Boundary conditions ,Eigen value spectrum of the Hamiltonian of a free particle , Eigenfunctions and energies of a particle in one dimensional box ,mono energetic particles incident on a potential Step, Reflection and Transmission Coefficients.

Books:

1.Concept of Modern Physics ----A.Beiser ,Mc Graw Hill
2. Introducton to Modern Physics ------H.S. Mani and G.K. Mehta
3.Modern Physics ---R.Murugeshan
4.Quantum mechanics----Powell and Craseman
5.Physics for degree Students –B.Bhuyan, M Das etal (Sri Krishna Prakashan)
6.Sub atomic Physics –Henley and Gragg-World Scientific

MAJOR ELECTIVES
(For additional credits)

PHY5.6 Medical Physics

Unit-1- X Rays

Electromagnetic Spectrum, Production of X rays ,X ray Spectra, Brehmsstrahlung characteristic X ray, X ray Tube , Coolidge tube, X ray Tube design , tube cooling , stationary mode Rotating anode X ray tubes Tube rating quality and Intensity of X rays, X ray generator Circuit , half wave and full wave rectification ,filament circuit, kilo voltage circuit , high frequency generator , exposure timers HT cables .

Unit 2- Radiation Physics and Imaging

Radiation Units, exposure, absorbed dose, rad, gray,kera, relative biological effectiveness ,effective dose, sievert, inverse square Law, interaction of Radiation with matter linear attenuation coefficient, Radiation Detectors, Thisble Chamber , condenser Chamber , Geiger Counter, Scintillation Counter Ionization Chamber, dosimeter, survey Methods, area Monitors ,TLD and semiconductor Detectors .

Radiological imaging , Radiography, filters grids , cassette, X Ray folm , film processing , fluoroscopy computed tomography scnner principle function display generations .Ultrasound imaging ,magnetic resonance imaging, thyroid uptake system, Gamma Camera (Only principle ,function ,display)

Unit 3- Radiation Therapy and Protection Physics

Radiotherapy,Kilo voltage Machine , deep Therapy Machine , Tele Cobalt Machine , Medical Linear Accelerator, Basics of Tele therapy Units - deep X ray ,telecobalt units ,medical linear accelerator, Radiation Protection External Beam characteristic , phantom , dose maximum and build up ,bolus , percentage depth dose ,tissue air ratio , back scatter factor .

Principle of Radiation Protection ,protective materials , radiation effects , somatic, genetic , stochastic, and deterministic effect, personal monitoring devices –TLD film badge, pocket Dosimeter .

Books:

1.Basic Radiological Physics Dr. K. Thyalan Jaypee Brothers Med P ublishing P Ltd New Delhi 2003
2.Physics of Radiation Therapy FM Khan Williamd and Willkins 3rd Ed 2003
3.The essential Physics of Medical Imaging –Bushberg ,Seibert ,Leidholdt ,and Boone Lippincot Williams Willikins 2 nd Ed. 2002
4.The Physics of Radiology –HE Johns and Cunningham .

OR

PHY5.6 ENVIRONMENT PHYSICS

Unit 1:Essentials

Structure and thermodynamics of the Atmosphere ,composition of air ,Green house effect ,Transport of Matter, energy, and momentum in nature ,stratification and stability of Atmosphere; Laws of motion, Hydrostatic Equilibrium, General circulation of the Tropics ,Elements of Weather and Climate of India .

Physics of Radiation ;Interaction of light with matter ;Rayleigh and Mie scattering ;Laws of Radiation (Kirchoff, Planck, Beer, Wien etc); Solar and Terrestrial spectra ,UV Radiation ;Ozone Depletion Problem ;IR absorption ;Energy Balance of the Earth Atmosphere system .

Unit 2:

Environmental Pollution and Degradation

Elementary Fluid Dynamics ,Diffusion ; turbulence ;and turbulent diffusion ;factors governing air water and noise Pollution ;Air and Water quality standard ;Waste disposal ;Heat island effect ;Land and Sea Breeze ;Puffs and Plumes ;Gaseous and Particulate Matter ;Wet and dry deposition ;Dispersal Mechanism of air and water Pollutants ;Mixing heights and turbulence ;Gaussian Plume Models ;Dispersion Models ;Environmental degradation ;Thermal and Radioactive Pollution ;Nuclear Radiation ;Health hazards and safety .

Unit 3:Environmental changes and Remote sensing

Energy sources and combustion processes ;Renewable sources of energy ;solar energy ;wind energy ; bioenergy ;Deforestation ;Remote sensing techniques ;Elements of weather and climate ;stability and vertical motion of air ;Horizontal motion of air and water ; Pressure Gradient forces ;viscous forces ;and inertial forces ;Reynold's Number ;Enhanced Green House Effect ;Energy Balance ;a zero dimensional greenhouse model **.**

Books :

1.Environmental Physics –Egbert Boekr and Rienk Groundell ,John Wiley
2.The Physics of atmosphere –J T Houghton ,Cambridge Univ Press
3.Renewable Energy Resources –J Twidell and J Weir ,ELBS ,1988
4.An introduction to solar energy for scientists and engineers ---Sol Weider, John Wiley