Syllabus of B.Sc. (Hons) in Physics

Department of Physics,

School of Sciences, CSJM University Campus
Kanpur.

Semester wise- Distribution of Course

Total Credit: 108

Semester-I, Credit:12

Sl.No.	Course No.	Name of the Course	Credit
1.	BPC-101	Mathematical Methods-I	6 (5 Th +1 T)
2.	BPC-102	Mechanics and General Properties of Matter	6 (5 Th +1 T)

Semester-II, Credit:12

Sl.No.	Course No.	Name of the Course	Credit
3.	BPC-201 BPC-201 Lab	Electricity and Magnetism-I + Laboratory-201	6 (4 Th+2 Lab)
4.	BPC-202 BPC-202 Lab	Waves and Geometrical Optics + Laboratory-202	6 (4 Th+2 Lab)

Semester-III, Credit:18

Sl.No.	Course No.	Name of the Course	Credit
5.	BPC-301	Mathematical Methods-II	6 (5 Th +1 T)
6.	BPC-302 BPC-302 Lab	Electronics-I+ Laboratory-302	6 (4 Th+2 Lab)
7.	BPC-303	Computer Applications in Physics	6 (5 Th +1 T)

Semester-IV, Credit:18

Sl.No.	Course No.	Name of the Course	Credit
8.	**BPC-401**	**Classical Mechanics**	**6(5 Th +1 T)**
9.	**BPC-402** **BPC-402 Lab**	**Electricity and Magnetism-II + Laboratory-402**	**6 (4 Th+2 Lab)**
10.	**BPC-403** **BPC-403 Lab**	**Thermal Physics+ Laboratory-403**	**6 (4 Th+2 Lab)**

Semester-V, Credit:24

Sl.No.	Course No.	Name of the Course	Credit
11.	**BPC-501** **BPC-501 Lab**	**Electronics-II+ Laboratory-501**	**6 (4 Th+2 Lab)**
12.	**BPC-502** **BPC-501 Lab**	**Physical Optics+ Laboratory-502**	**6 (4 Th+2 Lab)**
13.	**BPE-01/BPE-02/BPE-03/BPE-04/BPE-05/BPE-06/BPE-07**	**General Elective (Department Elective)***	**6 (5 Th +1 T)**
14.	**BPE-01/BPE-02/BPE-03/BPE-04/BPE-05/BPE-06/BPE-07**	**General Elective (Department Elective)***	**6 (5 Th +1 T)**

Semester-VI, Credit:24

Sl.No.	Course No.	Name of the Course	Credit
15.	**BPC-601**	**Elementary Quantum Mechanics**	**6(5 Th +1 T)**
16.	**BPC-602** **BPC-602 Lab**	**Statistical Mechanics and Solid State Physics + Laboratory-602**	**6(4 Th+2 Lab)**
17.	**BPE-01/BPE-02/BPE-03/BPE-04/BPE-05/BPE-06/BPE-07**	**General Elective (Department Elective)***	**6(5 Th +1 T)**
18.	**BPE-01/BPE-02/BPE-03/BPE-04/BPE-05/BPE-06/BPE-07**	**General Elective (Department Elective)***	**6(5 Th +1 T)**

*Several Elective courses will be offered (**BPE-01/BPE-02/BPE-03/BPE-04/BPE-05/BPE-06/BPE-07**) for semester-V and semester-VI. However the number of courses offered in each semester (V/VI) will be decided by the Physics Department. Out of the offered courses students have to select two courses for semester –V and another two courses for semester-VI. However final decision will be made by a committee with HOD as the convener.

SEMESTER-I

BPC-101

(MATHEMATICALMETHODS–I)

Credit:6 Total Lectures: 50

1. **VectorAnalysis:**Motivations,Definitionofavector,DotandCrossProducts;Scalartripleproduct; Vectortripleproduct,Reciprocalvectors, ApplicationsinPhysicalsystems; VectorDifferentiation and Integration; Line, surface and Volume Integrals; Gradient, Divergence andCurl;Gauss,Green'sandStokes'Theorems andApplications.

2. **CoordinateSystems:**CurvilinearCoordinates,DifferentialVectorOperators;OrthogonalCoordinateSystems–RectangularCartesianCoordinates,SphericalPolarCoordinates,Cylindrical Coordinates, Jacobian of transformation, Gradient, Divergence, Curl andLaplacianincurvilinearcoordinates

3. **Fourier Series:** Real and complex expansions, Odd and even functions, half-range expansions,Dirichlet condition,Gibb's phenomenon, Parseval's theorem, Convergence of Fourier series,Fourierintegrals.

4. **a. Ordinary Differential Equations:** Basic Concepts and ideas, separable equations, equationsreducible to separable form, exact differential equations, integrating factors, linear first-orderdifferential equations, homogeneous linear equations of the second order, homogeneous secondorder equations with constant coefficients. Characteristic equations, SHM – free, forced anddampedsystems.Non-homogeneousequations.

   b. Elements of partial differential equations: Separation of variables, Laplace equation, FourierequationsforHeatconduction, waveequation.

RecommendedReferences:

1. MathematicalmethodsforPhysicists:ArfkenandWeber.Elsevier
2. Mathematicalmethodsofphysics–J MathewsandRIWalker(Pearson)
3. AdvancedEngineeringMathematics --ErwinKreyszig,WileyEasternUniversityEdition
4. MathematicsforPhysicists–DenneryandKrzywicki(Dover)
5. Introductiontomathematicalphysics:C.Harper.(EasternEconomicEd.PHI)
6. MathematicalmethodsforphysicsandEngineering:Riley,Hobson,Bence(CUP,Indianed)
7. MathematicalMethodsinthePhysicalSciences: MaryL.Boas,(Wiley)
8. Mathematical tools for Physics – J Nearing, downloadable fromwww.physics.miami.edu/nearing/mathmethods
9. Mathematical Physics– PK Chattopadhyay(NewAge)
10. VectorandTensorAnalysis with applications– Borisenko andTarapov(Dover)
11. VectorAnalysis–MR Spiegel(Schaumseries)
12. FourierTransform–M.R.Spiegel(Schaumseries)
13. MathematicalPhysics –AjoyGhatak,GoyalandChua(McMillan)
14. Differentialequations– MRSpiegel(Schaumseries)

15. DifferentialEquations–Simmons,Tata-McGrawHill
16. DifferentialEquations–SimmonsandKantz,Tata-McGrawHill

SEMESTER-I
BPC-102

(MECHANICS& GENERALPROPERTIESOFMATTER)

Credit: 6 Total Lectures: 50

1. **Reference frames**: Inertial and non-inertial frames of references, Galilean transformationequations,applicationstorotatingframes,centripetalandCoriolisaccelerations.

2. **Rigid Bodies**: System of particles, center of mass, angular momentum, equations of motion,conservation theorems for energy, momentum and angular momentum of rigid bodies, degrees offreedom, Euler's equations, Moments and products of inertia, parallel and perpendicular axestheorem,equationofmotionforrotation,moment ofinertiaofregularrigidbodiesaboutdifferentaxes.

3. **Gravitation**: Inertial and Gravitational mass, Principle of equivalence and Einstein's thoughtexperiments, Gravitational potential and intensity, Gauss's law, applications of Gauss's law,Poisson'sequation,Laplace'sequation,gravitationalselfenergy,gravitationalfieldandpotentiald uetosphericalbodies.

4. **Elasticity**:Stress,strainandelasticconstantsforanisotropicsolid,interrelationshipsbetweenthe various elastic constants,Torsion of a cylinder and torsional rigidity,Bending of beams andcantilevers,flexuralrigidity,geometricalmomentofinertia,strain-energyrelations.

5. **Viscosityandfluiddynamics**:Viscousfluids,definitionofviscositycoefficientandNewton'slaw, streamline and turbulent flow, flow through a capillary tube and Poiseullie's equation,Reynold's number, Stoke's method and terminal velocity, Equation of continuity in differentialform,Bernoulli'stheoremanditsapplications,Toricelli'stheorem,velocityofefflux.

6. **Surface Tension**: Surface energy and surface tension,thermodynamic interpretation surfaceenergy,moleculartheoryofsurfacetension,capillarityandriseofliquidin atubeofinsufficientlength, Jurin's law, excess pressure caused inside the curved surface of a liquid, work done forblowingof bubble, spreadingandgatheringof liquid.

RecommendedReferences:

1.FundamentalsofPhysics,D.Halliday,R.ResnickandJ.Walker5th Ed,JohnWiley&Sons.2.BerkleyPhysic sVol.I.
3.FeynmanLecturesinPhysicsVol.I.
4.AnIntroductiontoMechanics,D.KleppnerandR.J.Kolenkov,TataMcGrawHillPublication

SEMESTER-II
BPC-201
(ELECTRICITY&MAGNETISM-I)

Credit: 6 (4 Th + 2 Lab) Total Lectures: 50

1. **Electrostatics in Vacuum**: Electric charge, conservation and quantization of charge, Coulomb'slaw, electric field, electric flux, Gauss's law and its application to field problems, mechanical forceon a charged conductor. Electric Potential: Resume of vector algebra. Line integral of electric field,potential difference and the potential function, relation between field and potential, potential andfielddueto variouschargedistribution, electricdipole andquadrupole.

2. **Electrostaticsindielectricmedia**:Dielectrics,polarization,boundcharges,Gauss'slawindielectric, electric susceptibility and electricdisplacement,Linear dielectrics, boundary conditionsatthedielectricsurface,energydensityinelectrostaticfield,microscopictheory ofdielectricpolarizability, Clausius-Mossotti relation, atomic radius from dielectric constant, polar moleculesandLangevin-Debyeformula.

3. **Capacitance and Condensers**: Capacitance of parallel-plate, spherical and cylindrical capacitorswithand without dielectrics, loss ofenergyin sharingcharges.

4. **Poisson's and Laplace's Equations**: Derivations, Earnshaw's Theorem, Application of Laplace'sequationinsphericalandcylindricallysymmetricproblem. Conductingsphereinuniform field.

5. **Electrical Images**: Point charge near a conducting plane, point charge near a conducting Sphere,Inducedsurfacecharge,Forceandenergy.

6. **Steady Current**: Current density, Electrical conduction in a metal, Ohm's law, Resistance andresistivity, Electromotiveforce, Kirchhoff'slawsandtheirapplications

7. **Magnetic effect of steady current**: Force exerted by a magnetic field on a moving Charge,Ampere'slaw,Biot-Savartlaw,CalculationsofMagneticInductionsforavariouscurrentconfigurations, Helmholtz double coil galvanometer, Force between long parallel current carryingconductors,Torqueonacurrentloop.

8. **Electromagnetic Induction**: Faraday's law, Lenz's law, Self inductance and mutual inductance-calculationsinsimple cases, measurement ofmagneticflux,energystoredin amagneticfield.

RecommendedReferences:

1. ElectricityandMagnetism(vol-I)-Fewkesand Yarwood
2. BerkeleyPhysics Course(Vol-II)
3. ElectricityandMagnetism-C.JSmith
4. Introductiontoelectrodynamics-DavidJ.Griffiths.
5. Physics(Vol-II)-HallidayandResnick

SEMESTER-II

BPC-201 Lab

SEMESTER-II

BPC-202

(WAVES & GEOMETRICAL OPTICS)

Credit: 6 (4Th +2 Lab) Total Lectures: 50

OSCILLATIONS &WAVES:

1. Free oscillation of simple system with one degree of freedom,general equation of motion, longitudinal and transverse oscillation of a mass between two springs, slinky approximation, smalloscillationsapproximation.

2. Composition of simple harmonic motion vibration ,interference, beat, Linearity and superposition principles, Lissajous figures; Theory of free vibrations with damping, critical damping, Q of anoscillator, Forced oscillator with one degree of freedom, Transient and steady state oscillators,resonance,sharpnessofresonance;Freeoscillationsofsystemwithtwodegreesoffreedom,coupledpendulum,Longitudinalandtransverseoscillationsofcoupledmasses.

3. Fourieranalysis,FourierseriesandFouriercoefficients,Fouriertransform,progressiveandstanding waves, phase and group velocity, Dispersive waves, energy and intensity of plane waves,relative and absolute intensity, Decibel and phon, classical wave equation, boundary conditions andnormalmodesvibrationofstretchedstrings-plucked,struckandbowedstrings,non-linearoscillations,combinationtones.

4. Shock waves, Doppler effect, Supersonic sound waves, Ultrasonics and application of ultrasonicwaves,Acousticsofbuilding,reverberations,Sabine‟sformula.

GEOMETRICALOPTICS:

1. Basicconcept,Fermat‟sprinciple-proofofthelawsofreflection,refractionandrectilinearpropagationoflight.

2. Refractionatsphericalsurfaces,aplanaticsurface,aplanaticfoci,Helmholtz‟srelationofmagnification, theory of thin lens, Two thin lenses separated by a distance, Matrix method inparaxialoptics,Matrixdescriptionofimageformation,thicklens,cardinalpoint,nodalslide.
3. Aberration of light, spherical aberration and other monochromatic defects, causes and corrections,chromatic aberration, dispersive power, achromatic doublet, case of two separated lenses, RamsdenandHuygenseyepieces.

RecommendedReferences:

1. BerkeleyPhysicsCourse,VolIII(Waves).
2. Thephysicsofwaves andoscillation,N.K.Bajaj(TataMcGraw-Hill,NewDelhi)
3. A text book on waves and acoustic, P.K.Chakrabartyand S.Choudhury (New Central BookAgency,Kolkata)
4. Optics,A.Ghatak(TataMcGraw-Hill, NewDelhi)
5. GeometricalandPhysicalOptics,R.S.Longhurst.

6. TheFeynmanLecturesonPhysics,Vol.I

SEMESTER-II

BPC-202 Lab

LABORATORYI

FullMarks: 50(40+10) Credit:4

1. Determinationof“g” byKater'spendulum.
2. Determinationof“g”bybarpendulum.
3. Determinationofsurfacetensionbycapillarytubemethodandverificationof Jurin'slaw.
4. Variationofsurfacetensionwithtemperaturebyjaeger'smethod.
5. Calibrationofammeter bypotential drop method.
6. DeterminationofcoefficientofviscosityPoiseuille'smethod.
7. DeterminationofcoefficientofviscositybyStoke'smethod
8. Comparisonof twolow resistances bypotential dropmethod.
9. DeterminationofYoungsModulus(Y),RigidityModulus(n)&Pois son'sratio ofawirebySearle's method.
10. DeterminationoftheYoung'smodulusofabeambyFlexuremethod.
11. Calibrationofammeter bycopper deposition method.
12. Calibration ofammeterbypotential drop method.

(NEWEXPERIMENTSMAYBEADDEDINPHASES)

SEMESTER-III
BPC-301

(MATHEMATICALMETHODS–II)

Credit: 6 (5 Th+ 1 T) Total Lectures: 50

1. **Matrices:**Special types of Matrices – Unitary, Hermitean, orthogonal, symmetric and skewsymmetric,matricesasoperators –rotationmatrix, Eigenvaluesand eigenvectorsofmatrices.

2.**Linear Vector Spaces:** Definitions, subspaces, Linear independence, bases of vector spaces,dimensions, linear transformations, the algebra of transformations, function space, space of infinitedimensionality.

3. **ProbabilityandStatistics:**Introduction,statisticaldistributions.Secondmomentsandstandarddeviation, definitions of probability, fundamental laws of probability, discrete probabilitydistributions, combinations and permutations, Stirling's approximations for the factorial, continuousdistributions,expectation.Thebinomialdistribution,the PoissonandGaussiandistribution.

4. **Complex Analysis:**Complex Number System, Fundamental operations and the axiomaticfoundations of complex algebra, graphical representation, polar form, De Moivre's theorem, roots ofcomplexnumbers,Euler'sformula,n-throotofunity,polynomialequations,variablesandfunctions, single and multiple valued functions, inverse functions, elementary functions**.**Functionsofacomplexvariable,analyticalfunctions,Cauchy-Riemannconditions,TaylorandLaurentSeries,Singularities and zeros – pole, branch point, and branch cut. Calculus of residue and evaluation ofintegrals,Mapping,Conformalmapping

RecommendedReferences:

1. MatricesandTensorsinPhysics–AWJoshi (NewAge)
2. AnintroductiontoProbabilityTheory&itsApplications,WilliamFeller,VolumeI,WileyEasternLimited.
3. Theoryandproblem ofprobabilityandstatistics–M RSpiegel (Schaumseries)
4. Theworldisbuiltonprobability,LevTarasov,MirPublishers,Moscow
5. Schaum's outline of theory and problems of complex variables with an introduction toconformalmappingand its applications, MurrayR. Spiegel, McGraw-Hill
6. ComplexVariablesandApplications:RVChurchill and JWBrown, (McGraw-Hill)
7. ComplexanalysisformathematicsandEngineering,J.H.Mathews,R.W.Howell,JonesandBartlettPublishers.
8. Complexanalysis,L.V.Ahlfors,McGraw-HillInternationalEdition
9. FoundationsofComplexAnalysisS.Ponnusamy,NarosaPublishingHouse.
10. ComplexVariables:TheoryandApplications,H.S.Kasana, Prentice Hall ofIndia PvtLtd.
11. Complexvariables–AblowitzandFokas(CUP)
12. AlsoseethelistofbooksrecommendedforcourseBPC-11

SEMESTER-III

BPC-302

(ELECTRONICS I)

Credit: Credit: 6 (4 Th +2 Lab) Total Lectures: 50

1. **Network**: Definition, mesh and nodal methods, two portnetwork, T and circuits and theirtransformations, Superposition theorem, Thevenin"s theorem, Norton"s theorem, Maximum powertransfertheorem.

2. **Thermionic emission and vacuum tubes**: Electron emission from solid, Richardson-Dushmanequation, Space charge effects and Child-Langmuir law, structure and characteristics of vacuumdiodeand triode

3. **SemiconductorPhysics**:Electricalconductivityofmaterials,metal,insulatorandsemiconductor,elementalandcompoundsemiconductor,intrinsicandextrinsicsemiconductor,concept of hole, law of mass action, density of majority and minority carriers, effective mass andmobility of holes and electrons, energy band concept, band diagram, direct and indirect band-gapsemiconductor.

4. **Semiconductor diodes**: Formation of p-n junction, electric field distribution at junctions, contactpotential and depletionlayer,Derivation of diode equation, forwardandreversebiased junction,half wave, full-wave and bridge rectifiers, rectifier with filter (C, L and), diode characteristics andloadline,diodeclampingandclippingcircuit.Zenerdiode,useofzenerdiodeasavoltageregulator.

5. **Transistors**: Bipolar Junction transistor: n-p-n and p-n-p transistors, Mechanism of current flow,current gains α andthe relations, Characteristics in CE, CB and CC mode, Load line analysis oftransistor, DC and AC load line, Q point, Active, cut-off and saturation region, amplifying action ofa transistor. Junction field effect transistor: Structure of JFET and their characteristics, pinch-off,structureofMOSFET andtheircharacteristics.

RecommendedReferences:

1. J.MillmanandA.Grabel,,,Microelectronics",McGraw-Hill.
2. StreetmanB.G.,,,SolidStateElectronicDevices"PrenticeHall.
3. Electronicsfundamental andapplication,J.Ryder.
4. Malvino,,,ElectronicPrinciples"TataMcGraw-Hill.
5. J.Nagrath,,,Electronics(AnalogandDigital),PrenticeHall.
6. T.Chattopadhyay,,,AnalogandDigitalElectronics"CBSpublishers,NewDelhi.
7. R.K.Kar,,,Electronics(Classical&Modern),BooksandAllied(P)Ltd.

SEMESTER-III

BPC-302 Lab

SEMESTER-III
BPC-303

(COMPUTERAPPLICATIONSINPHYSICS)

Credit: 6 (5Th+1T) Total Lectures: 50

1. **Introduction to Computers**:
Brief History of modern computing:Mechanical and electronic computers;hand held devices–smart phones, PDA's, e-book readers, etc.; embedded computers.
Generic hardware components: CPU, RAM, hard drive; variety of I/O devices, peripherals.Softwarestructure: OperatingSystems, daemons.

2. **:**
Datarepresentation NumberSystems–decimal,binary,octalandhexadecimalsystems;conversionfromonesystemto another.
Data representation– integer, float,ASCII, unicode.

3. **GraphicalTools**:
Graphical representation of data:
GnuplotDrawingTools: xfig

4. **IntroductiontoprogramminginC**:
Programmingmethodology:algorithmsandflowcharts.
ElementsofCthroughsimpleproblems:datatypes,operators,controlstatements,functions,pointers:
a. Findingmaximum, minimum,average, standard deviationand sortingof asetofnumbers.
b. Seriesofnumbers:Fibonacciseries,exponential,sineandcosine;
c. Manipulationofmatrices
d. LeastSquareFit

5. **NumericalMethods**:
Integration:trapezoidalrule,Simpson's1/3rule.
Solution of differential equations: Euler's method, Runge-Kutta method (4^{th} order)Solution of transcendental equations: half-section method, Newton-Raphson method;Interpolation:Newton's differential formulae.

6. **ApplicationtoProblemsinPhysics**:
Harmonicoscillator,planetarymotion,projectileandscattering,LCRcircuits,etc.

RecommendedReferences:
Gottfried: Schaum's Outline Series –
CComputerApplicationWorkbook

SEMESTER-IV

BPC-401

(CLASSICALMECHANICS)

Credit: 6 (5Th + 1T) Total Lectures: 50

1. Mechanics of a single particle and Mechanics of system of particles; Constraints of motion;Degreesoffreedom;Generalized coordinate;someexamples.

2. Lagrangianformalism;Virtualdisplacementandvirtualworkdone;D'Alembert'sprincipleand derivation of Euler-Lagrange equations; Lagrange"s equations for velocity-dependentpotential;ApplicationtoLagrange'sequationtosomesimplecases.

3. Cyclic coordinates Isotropy and Homogeneity of space, Lagrangian formulation ofconservationlawsoflinearmomentum,angularmomentumandenergy.

4. Hamiltonformalism;Variationalprinciples;Hamilton'sprinciple;DerivationofLagrange'sequationfromHamilton'sprinciple.

5. Hamilton's equation of motions; Hamiltonian; Applications of Hamilton's equation of motiontosomesimplecases.

6. Two-bodycentralforcesystems;reductiontotheequivalentonebodyproblem;Theequationofmotionsandthefirstintegrals; Theequivalentone-dimensionalproblemandclassification of orbits; The Kepler's Problem: Inverse-square law of force; Runge Lenzvector;TheVirialtheorem.

7. Decay and scattering problems; Kinematics of decay of a particle; transformation between Cand L frames of reference; elastic collisions; angle of scattering and recoil; scattering cross-section;Rutherfordscattering;someproblem.

RecommendedReferences:

1. ClassicalMechanics: H.Goldstein,C.Poole,J.Stafko.

2. Mechanics: L.D. LandauandE.M.Lifshitz.

3. ClassicalMechanics:N.C.RanaandP.S.Joag.

4. Theoretical mechanics: MurrayR.Spiegel-Schaum'soutlineseries

SEMESTER-IV
BPC-402
(ELECTRICITY&MAGNETISM II)

FULLMARKS: 50 (40+10) Credit: Credit: 6 (4 Th +2 Lab)Total Lectures: 50

1. VaryingCurrents&AlternatingCurrents:
Growth and decay of current in L-R circuit, Charging and discharging of capacitor in C-R and L-C-R circuits, Oscillating discharge, Moving coil ballistic galvanometer, damping ,Measurementof high resistance by leakage, Mechanical analogues of LR, CR and LCR circuits. Resonance, Q-value,powerfactor,AC networks,AC generators andtransformers.

2. Thermoelectricity:
Thermoelectric effects, thermoelectric power and thermoelectric diagram, application ofthermodynamicstothermoelectriccircuits.

3. Maxwell’sequations:
Displacement current and equation of continuity, plane electromagnetic waves in free space,vectorandscalarpotentials,gaugetransformation,energyandmomentumconservation,Poynting'svector,propagationofelectromagneticwavesinnon-conductors,propagationinconductingmedia,reflectionandrefraction,Fresnel'sequation.

4. SpecialTheoryof Relativityandelectromagnetism
Galileantransformation,Lorentztransformationofspace-time,lengthcontractionandtimedilation, Doppler effect for E.M waves, transformation of mass and energy, transformation offorce, transformation of an element of volume, transformation of an electric charge density andcurrent density. The electric and magnetic fields of moving electric charge: Magnetism as arelativisticeffectfromconstantfieldsofachargemovingataconstantvelocity,transformationofelectricand magnetic fields.

RecommendedReferences:

1. Berkeleyphysics course, Vol.I&II.
2. FeynmanLecturesinphysics,Vol I&II
3. Introductiontoelectrodynamics-DavidJ.Griffiths.
4. Electromagnetic Fields-Ritz, Milford,Christy
5. Introductiontospecial relativity-RobertResnick.

SEMESTER-IV

BPC-402 Lab

SEMESTER-IV
BPC-403
(THERMAL PHYSICS)

Credit: Credit: 6 (4 Th +2 Lab) Total Lectures: 50

1. **Kinetic theory of gases**:Ideal gas equation,Pressure of a gas,Kineticinterpretationoftemperature, Concept of probability, Total and compound probability, Maxwell's law of distributionof velocities – its verification, Mean free path and its experimental determination, Degrees offreedom,equipartitionofenergyanditsapplicationtospecificheat,experimentalstudyofisothermsofrea lgases,vanderWaal's equationofstate,Virialcoefficients.

2. **Thermodynamics**: Thermodynamic equilibrium, work, indicator diagram, state function, exactand inexact differentials, First law of thermodynamics – its applications, Reversible and irreversibleprocesses,Isothermalandadiabaticchangesofidealandrealgases,Secondlawofthermodynam ics, Carnot's theorem, Kelvin scale of temperature, Concept of entropy, principle ofincreaseofentropy,Maxwell'sthermodynamicrelations,theirapplicationsandphysicalinterpretation, Clausius-Clapeyron equation, Variation of latent heat with temperature, First-orderphasetransition,Triplepointofwater.

3. **Transportproperties**:Viscosity,conductivityanddiffusion,Brownianmotion.

4. **Conduction of heat**: Conductivity and diffusivity, Fourier equation of propagation of heat inisotropic homogeneous medium, its solution for rectilinear and radial flow, periodic flow of heat,Weidemann-Franzlaw.

5. **Radiation**:Emissionandabsorption,Kirchhoff‟slaw,Black-body,Stefan-Boltzmannlaw, Wien‟s law, Rayleigh-Jeans law, Ultraviolet catastrophe, Planck‟s theory of black body radiation,solarradiation and temperatureof thesun.

6. **Low temperature phenomena**: Joule-Thomson effect, Principle of refrigeration, Principle ofadiabatic cooling, Liquid helium and its properties, Second order phase transition, Nernst heattheoremandthirdlawof thermodynamics.

RecommendedReferences:

1.Heat and Thermodynamics: Zeemansky and Dittman2.Fundamentals of statistical and thermal physics: Frederick Reiff3.Thermodynamics:H.B.Callen
4.ATreatise onHeat:SahaandSrivastava

SEMESTER-IV

BPC-403 Lab

(LABORATORYCOURSE-II)

FULLMARKS: 50 (40+10) Credit:4

1. Determinationofthermalconductivityof abadconductor
2. DeterminationofJbyCallendar&Barnes method
3. Determinationofmelting pointofasolidusingthermocouple.
4. Tostudythermoe.m.f.vs.temperaturediagramofathermocoupleandhencetofindthethermoelectri cpowerat agiven temperature.
5. Todrawμ-λcurveusingspectrometer.
6. Todrawi-Hcurveusingasearchcoilandintegratingmeasurementsystem
7. TodrawB-Hcurveusingsearchcoilandintegratingmeasurementsystem.
8. DeterminationofSelf-inductanceusingAnderson"sbridge.
9. Tostudystaticcharacteristicsofatriode.
10. Tostudythecharacteristicsofajunctiondiode.
11. TostudythecharacteristicsofaZenerdiode.
12. Tostudythecharacteristicsofatransistor(CE&CBmodes)atdifferentbasecurrents,andcalculation oftransistor parameters.
13. Construction of a regulated power supply using discrete components on a breadboard.

(NEWEXPERIMENTSMAYBEADDED INPHASES)

SEMESTER-V
BPC-501
(ELECTRONICS II)

Credit: Credit: 6 (4 Th +2 Lab)   Total Lectures: 50

1.**Transistor amplifier**: Transistor biasing and stabilization circuit, typical biasing circuit-fixedbias, collector to base bias, self bias, Graphical analysis of transistor amplifier for large signal,voltage and power amplifier, class-A, class-B, class-AB and class-C operation of amplifier. Small-signal analysis of transistor amplifier using hybrid model, current gain, voltage gain, input andoutput impedance. Multistage amplifiers- RC coupled amplifier, direct coupled amplifier and theirfrequencyresponses.

2.**Feedback in amplifier**: Principal of feedback, negative and positive feedback, voltage andcurrentfeedback, advantages anddisadvantages of feedback.

3.**Oscillator**: Sinusoidal oscillator: Barkhausen‟s criterion for self sustained oscillation, tunedcollectoroscillator,Hartley,Colpitt‟s,phase-shiftandWien-bridgeoscillators.Non-sinusoidaloscillator:Astableand Monostablemultivibrator.

4.**Integrated circuits**: Steps for the development of IC, fabrication of simple circuits, simplemonolithiccircuitlayout.Scalesofintegration-SSI,MSI,LSI,VLSI(basic ideaonly)

5.**Number systems and Boolean algebra**: Decimal, binary, octal and hexadecimal number andconversionofonesystemtoanother,1‟sand2‟scomplementsofabinarynumber,Basicpostulatesand theorems of Boolean algebra, De-Morgan‟s theorem, binary addition, subtraction andmultiplication.

6.**Logic gates and digital circuits**: Fundamental gates-OR, AND, NOT, Universal gates-NOR,NAND, Ex-OR and Ex-NOR gates, design of gates using discrete components like transistor, diodeandresistances,simplificationofBooleanexpression,Karnaughmapping,RepresentationofBoolean expression by SOP and POS methods, conversion of truth table into an equivalent circuit.Combinationallogicgates-Halfadder/subtractor,fulladder,binarycomparator,multiplexer,demultiplexer.Sequentiallogic gates-SRandJKFlipflops,applicationof flipflops

RecommendedReferences:

1. J.MillmanandA.Grabel„„Microelectronics‟,McGraw-Hill.
2. StreetmanB.G.„„SolidStateElectronicDevices‟PrenticeHall.
3. Malvino„„ElectronicPrinciples‟TataMcGraw-Hill.
4. MalvinoandLeach„„Digitalprinciplesandapplications‟,TataMcGraw-Hill.
5. J.Nagrath„„Electronics(AnalogandDigital),PrenticeHall.
6. T.Chottopadhyay„„AnalogandDigitalElectronics‟CBSpublishers,NewDelhi.
7. R.K. Kar„„Electronics (Classical&Modern),BooksandAllied(P)Ltd

SEMESTER-V

BPC-501 Lab

(LABORATORY-III)

FULLMARKS: 50 (40+10) Credit: 4

1. Determinationofradiusofcurvatureofaplano-convexlensbyNewton‟sringmethod.
2. DeterminationofwavelengthofamonochromaticsourcebyNewton‟sringmethod.
3. DeterminationofwavelengthofamonochromaticsourcebyFresnel‟sbi-prism.
4. DeterminationofthicknessofafilmbyFresnel‟sbi-prism.
5. Determinationofslitwidthbystudyingthesingleslitdiffractionpattern.
6. Determinationofslitwidthandwidthofobstaclebystudyingthedoubleslitdiffractionpattern.
7. Determination of grating constant using a standard source, and hence determination of unknownwavelengthofasource.
8. VerificationofStefan‟slawbyelectricalmethod.
9. DeterminationofPlanck‟sconstant.
10. Determination of (a) specific rotation of a given substance, and hence (b) the unknownconcentrationofasolution.

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(NEWEXPERIMENTSMAYBEADDEDINPHASES)

SEMESTER-V
BPC-502
(PHYSICAL OPTICS)

Credit: Credit: 6 (4 Th +2 Lab) Total Lectures: 50

1. **Theoriesof Light**:WaveTheory,Huygens'Principle,lawsofreflectionandrefraction.

2. **Interference**: Coherent and incoherent sources, spatial and temporal coherence, constructive anddestructiveinterference.Young'sdouble-slitexpt.,Divisionofwavefront-Lloyd'smirror,Fresnel bi-prism, Fresnel bi-mirror. Division of Amplitude-fringes with plane parallel plate, fringes withwedgeshapedfilm.Fringesofequalinclinationandfringesofequalthickness.Michelsoninterferometer, Rayleigh refractometer. Multiple beam interference, Newton's ring, Fabry Perotinterferometer,LummerGehrckeinterferometer.

3. **Diffraction**: Huygens-Fresnel principle, rectilinear propagation of light. Fresnel diffraction-construction of zones, zone plate, Cornu's spiral, diffraction by straight edge, single slit, circularaperture and circular obstacle. Fraunhofer diffraction-single slit, double slit, rectangular aperture,circular aperture, plane transmission grating, concave grating, echelon grating. Resolving power oftelescopeandmicroscope.Babinet'sprinciple.

4. **Polarization**: Linear, circular and elliptic polarization, double refraction, Huygens' theory ofdouble refraction through uniaxial crystal, Nicol prism, quarter and half wave plates, polaroids,opticalactivityandpolarimeter,Interferenceofpolarizedlight.

5. **Electromagnetic Nature of Light**: Polarization, Dispersion (normal & anomalous), Rayleighscattering,Kerreffect,Faradayeffect.

RecommendedReferences:

1. Optics-Hecht&Zajac.

2. PhysicalandGeometricaloptics-Longhurst.

3. Optics-B.K.Mathur.

4. FundamentalsofOptics-Jenkins &White.

5. PrinciplesofOptics - Born&Woolf.

6. PhysicalOptics - Ghosh&Manna.

SEMESTER-V

BPC-502 Lab

SEMESTER-VI
BPC-601

(ELEMENTARY QUANTUM MECHANICS)

Credit: 6 (5 Th +1T) Total Lectures: 50

1.Role of experiment and theory in Physics. Quantum mechanics as paradigm shift from ClassicalMechanics:determinism-equationofmotiontoprobabilitydensity-expectation-uncertainty.

2.**Failureofclassicalphysics:**blackbodyradiation,photo-electriceffect;Planck'squantumhypothesis; Einstein's photo-electric equation; Bohr's atomic model and quantization of angularmomentum and atomic spectra; Franck and Hertz's experiment; Stern and Gerlach'sexperiment; deBroglie's hypothesis, Davisson and Germer's experiment;Young's double slit experiment in thelightofquantumhypothesis,wave-particledualityandcomplementarity.

3.**Wave-function:**interpretation of wave function; Schrodinger Equation – time dependent andtime independent forms; conditions to be satisfied by wave functions; observables, expectationvalue,operatorrepresentation,andmeasurements;stationarystates;Ehrenfest'stheorem;superpositionofstatesanddynamism.

4.**Wave functions and energies in one dimension with idea of barrier penetration:** infinitesquare well potential, delta function potential, finite square well potential, step function potential,freeparticle(illustratinguncertaintyprinciple).

5.**Formalism:**Operators,eigenvaluesandeigenfunctions;linearoperators,productoftwooperators,commutationrelations,simultaneouseigenfunctions,orthogonalfunctions;Diracnotation, dual space, inner and outer products of wave functions, projection and identity operators;Hermitianadjointofanoperator,Hermitianoperators,theireigenvalues,expectationvalues;generalizeduncertaintyprinciple.

6.**Harmonic oscillator problem:** algebraic and analytic solutions and their correspondence; groundandexcitedstates,zeropointenergy;comparisonwithclassicaloscillator.

7.**Schrodinger equation in three dimensions:** Cartesian coordinates, particle in a rectangular box,degeneracy; spherical coordinates, angular and radial equations, spherical harmonics; hydrogenatom problem; Orbital angular momentum, Cartesian components, raising and lowering operators,commutationrelations,eigenvalues;electronspin,explanationofobservationsfromSternandGerlach'sexperiment,Paulimatrices.

RecommendedReferences:

1. Quantum Mechanics, D.
Griffiths2.QuantumMechanics,Gasiorowich
3.QuantumMechanics,Mathews&Venkatasnan4.Quantum
Mechanics, Ghatak&Loknathan

SEMESTER-VI
BPC-602

(STATISTICAL MECHANICS & SOLID STATE PHYSICS)

Credit: Credit: 6 (4 Th +2 Lab) Total Lectures: 50

(EACHGROUPHASTOBEANSWEREDINSEPARATEANSWERSCRIPT)

GROUP–A:STATISTICALMECHANICS:
Marks:25

1. **Random walk and statistical basis of thermodynamics:** Basic concept of equilibriumtheory, Macroscopic and microscopic states of system, Probability and thermodynamic probability,Principle of equal a priori probability, Probability distribution, its narrowing with increasing n,Averageproperties,Accessibleandinaccessiblestates.

2. **Elements of ensemble theory**: Phase space of classical system, Microcanonical ensemble,Quantum states and phase space, Canonical ensemble, Equipartition of energy, Partition function,Entropy of an ideal gas, Gibbs paradox, Sackur-Tetrode equation, A system of harmonic oscillators,Statistics of paramagnetism, Langevin-Brillouin theory, Grand canonical ensemble, fluctuations indifferentensembles.

3. **Introductoryquantumstatistics**:LimitationsofMaxwell-Boltzmannstatistics,Bose-Einstein and Fermi-Dirac statistics, statistics of occupation numbers, Thermodynamical behavior ofan ideal Bose gas, Bose –Einstein condensation, Black-body radiation, Specific heat of solids at lowtemperature,IdealFermisystem,Chandrasekharlimit(ideaonly),Fermienergy,Thermionicemission.

RecommendedReferences:

1. Fundamentalsofstatisticsandthermalphysics:Reif
2. ATreatise onHeat:SahaandSrivastava
3. Heatandthermodynamics :ZemanskyandDittman
4. StatisticalPhysics:Reif(Berkeleyphysicscourse-V)
5. Statisticalthermodynamics:Lee,SearsandTurcotte
6. ThermalPhysics :GuptaandRoy

GROUP–B:SOLID STATE PHYSICS

Marks:25

1. Crystalline and Amorphous Solids, Lattice, Basis and Crystal, Miller Indices, InteratomicForces,TypesofBondingofSolids,CubicStructures(SC,FCC,BCC)ofCrystals.

2. OriginofX-Rays,ContinuousandCharacteristicSpectra,Mosley‟slawandPeriodicTable,Explanationfrom Bohr‟stheory.
   X-RayDiffraction, Lauespots,BraggsLaw,ReciprocalLattice.

3. Free Electron Theory of Metals, Bloch theorem, Energy Bands in Solids, Kronig-Pennymodel,Distinctionbetween Metals,Insulators andSemiconductors, Fermi-DiracDistribution and Energy Spectrum of Solids, Electron in Magnetic Field, Hall Effect.LatticeVibrations,SpecificHeats,EinsteinandDebyeModel.

4. Basicideaofdiamagnetism,paramagnetism,ferromagnetismandantiferromagnetism.

5. Superconductivity,Meissnereffect,Mössbauereffect(ideaonly)

RecommendedReferences:

1. SolidStatePhysics,Kittel
2. ElementarySolidStatePhysics,M.AliOmar
3. SolidStatePhysics,Ashcroft&Mermin
4. ConceptsofModernPhysics,Beiser

SEMESTER-VI

BPC-602 Lab

(LABORATORY-IV)

1. TodeterminethemutualinductancebyCareyFoster‟smethodusingdcsourceandballisticgalvanometer.
2. Measurementofhigh resistancebythemethodofleakageofchargeofachargedcondenser.
3. Tofindmutualconductance(M)betweentwocoilsbydirectmethod.
4. Construction of basic logic gates (OR, AND, NOT, NAND and NOR) using discretecomponents on a bread board, and hence verification of(i) the truth tables by measuring thevoltages,
   (ii)Demorgan‟stheoremand(iii)universalnatureofNANDandNORgates.
5. StudythecharacteristicsofaCEamplifier.
6. StudyofanOPAMPanditsapplicationasaNon-InvertingAmplifierand asaUnitygain buffer.
7. StudyofanOPAMPanditsapplicationasanInvertingAmplifier.
8. StudyofanOPAMPanditsapplicationasanInvertingAdder.
9. StudyoftheperformanceofasimplevoltagecomparatorusingOPAMP.
10. ConstructionofaPhase-shiftoscillatoronabreadboardusingtransistor.Studyofthewaveformofthe oscillatorand calibrate it using aCRO.
11. Studythecharacteristicsofafeedbackamplifier.

(NEWEXPERIMENTSMAYBEADDEDINPHASES)

ELECTIVECOURSES INPHYSICS

SEVERALELECTIVECOURSESWILLBEOFFEREDFORSEMV& SEMVI.HOWEVER,THENUMBEROFCOURSESOFFEREDINEACHSEMESTERWILLBEDECIDEDBYTHEDEPARTMENT.OUTOFTHEOFFEREDCOURSESSTUDENTSHAVE TO SELECT ONE COURSE FOR SEM-V AND ANOTHER FORSEM-VI.

PRESENTLY,THERE ARESEVENELECTIVECOURSESINTHESYLLABUS.

SEMESTER-V/VI
BPE-01

GROUPTHEORY&TENSORANALYSIS

Credit: 6 (5Th +1T) Total Lectures: 50

1. **Group Theory**: Symmetries in nature; Definition of group; Explanation of abstract ideas relatedto group theory using simple examples. Continuous group: O(2) and O(3) Rotation in two and threedimensions;Generatorsof rotationgroupangular momentum; Representation of O(3)and thesphericalharmonics;SU(2)andspin;Lorentzgroupin3+1dimensions;Generatorsandtheiralgebra; Origin of Thomas Precession; Solving quantum Coulomb and/or the oscillator problemusinggrouptheory.Discretegroup:Parityandtimereversalsymmetryinphysicsandtheconsequen ces (parity selection rule, Kramer‟s degeneracy etc.); Permutation symmetry of identicalobjects; Symmetry of a regular configuration like a square and/or triangular sheet; Symmetry ofdifferenttypesoflattices; Symmetryofmolecules;Normalmodecalculationsusinggrouptheory.

2. **Tensor Analysis and differential geometry**: Scalar, vector, pseudo scalar and pseudo vector;Outer product of two vectors as a tensor; Pseudo tensor; A few examples; General definition of atensor; Rank of a tensor; Brief overview of dual vector space; Covariant, Contra variant and mixedtensors; Kronecker delta as a tensor; Levi Civita tensor in 3 and higher dimensions; Contraction oftensors by using Kronecker delta andLevi Civita tensors; Maxwell's equations and tensor; Metricon a space as a rank two tensor; Derivative of tensors; Christoffel symbol; Riemann curvaturetensor;Elements of GTR.

THEPHYSICSOFENERGY

Credit: 6 (5Th +1T) Total Lectures: 50

Energyand its Uses

- Unitsandscalesof energyuse
- Mechanicalenergyandtransport
- Heatenergy:Conversion betweenheatandmechanicalenergy
- Electromagneticenergy:Storage,conversion,transmissionandradiation
- Introtothequantum,energyquantization
- Energyinchemical systemsandprocesses,flowofCO_2
- Entropyand temperature
- Heatengines,efficiency
- Conversion:Phasechangeenergyconversion, refrigeration andheat pumps
- Internalcombustionengines
- Sterlingengine
- Conversion:Steamandgaspower cycles,thephysicsofpowerplants

SourcesofEnergy

- Fundamentalforcesintheuniverse
- Quantummechanicsrelevantfornuclearphysics
- Nuclearforces,energyscalesandstructure
- Nuclearbindingenergysystematics,reactionsanddecays
- Nuclearfusion
- Nuclearfissionandfissionreactorphysics
- Nuclearfissionreactordesign,safety,operationandfuelcycles
- Theflowofenergyinthe universe
- Solar: Solarradiation
- Solar:Absorptionandthermalutilization
- Solar:Solar-thermalelectricity
- Solar:Photovoltaics
- Solar:AdvancedPV,overview
- Biologicalenergysourcesandfossilfuels
- Wind:Fluiddynamicsandpowerinthewind,availableresources
- Wind:Moreaboutfluids,viscosity,typesoffluidflow,lift
- Wind:Windturbinedynamicsanddesign,windfarms
- Geothermalpowerandoceanthermalenergyconversion
- Tidal/wave/hydropower

SystemsandSynthesis

- Nuclearradiation,waste andproliferation
- Climatechange
- Energystorage
- Energyconservation

References:

1. „SustainableEnergy-WithouttheHotAir‟byDavidJ.C.MacKay(Availableonline)
2. „Powerwithnature:solarandwindenergyDemystified‟byRexA.Ewing(availableonline)
3. „WindEnergyExplained:Theory,DesignandApplication‟,byJ.F.Manwell,J.G.McGo

wanand A.L. Rogers;John Wiley&SonsLtd., UK(2004).
4. „TheSolarEconomy:Renewableenergyforsustainableglobalfuture‟byHernammScheer;Earth scan,London,UK(2004).
5. „IntroductoryNuclearPhysics‟byKannethS.Krane;JohnWiley&SonsLtd.(1988).

SEMESTER-V/VI
BPE-03

MATERIALSCIENCE:EVOLUTIONANDAPPLICATIONS

Credit: 6 (5Th +1T) **Total Lectures: 50**

Preamble: TheDepartment of physics understands that Material sciencenot only surrounds us inour everyday life but critically helps the development in areas such as economy, health care,environment, sport, defense and much more.Materials science course teaches about the processesrequiredtochangetheatomicstructuresofmaterialsinordertoengineernewanddifferentmaterials. Studying materials science is really an exploration of a hugely progressive field andenrolledstudentswillhavethechancetogenerateownideasandresearchduringadegreeinIndiaor aboard.

CourseGoals

1.)Ageneralunderstanding ofdifferenttypes ofmaterialsandtheir structure
2.) A general understanding of the role of new materials on advances in technology, societyandcivilizations

Coursedescription:

The discovery of new materials has shaped history and built civilizations. Materials have playedsuchanimportantrolethatscholarshavenamedperiodsofhistoryafterthemliketheStoneAge,theBronzeAgeandtheIronAge.Thestudyoftheworldhistorygenerallyfocusesonwars,therulerswhogovernedandtheformationand(subsequent)downfallofempires.Littleifanythingissaidaboutthematerialsthathaveoftenledtothesuccess(andsometimesfailure)oftheseempires.Thistrendcontinuesinmoderncivilizationwiththeadvancesinmaterialsprecedingmanyoftheleapsintechnologythatwetookforgrantedaspartofoursociety.Thecomputerandtheelectronicrevolutionarecompletelybuiltuponsiliconandourabilitytochangetheelectricalpropertiesofthismostunusualmaterial.Rapid,reliable,modernairtransportationiscompletelydependentontheuseofaluminumandotherlightweightandstrongmaterials.Whatarethefuturechangesinmaterialsthatwillleadtorevolutionsinoursociety?
Advancesinhealthcare,thepromiseofnanotechnology,thecolonizationofspaceallareexcitingideaswithtremendouspotentialthatwillbetakencareofinsomepartoftheadvancesinthematerialswhichmaymakethesethingspossible.Thiscoursewilltracetheutilization,propertiesandproductiontechniquesofmaterialsfromtheBronzeAgeupthroughmoderntimesandintothefuture.Itwillstartwithadescriptionofpropertiesofthefirstmaterialsutilizedbymansuchasstone,fiberandcopper.Thesematerialsareexplainedbyconsideringtheiratomicstructure,thebindingforcesbetweenatomsandtheirarrangement.Thepropertiesofironandsteelareexplainedalongwiththehistoryofironandsteelmaking.Thepropertiesofmaterialsarealsocoveredfromahistoricalaswellasfromascientificpointof view.

I. Introduction(Mayconsultreferredbook3):ClassificationofMaterials,Metals,Polymers,Semiconductormaterials and other modernmaterials
II. Historical Development of Materials: The first materials: Stone and Clay, The first metals:Copper and Bronze, Gold and Silver and the basis of wealth, Mechanisms and Propertiesof Metals, The basics of structure, the basics of mechanical properties, The Discovery ofIron,ANewMaterial: Glass,Steel:TheModernMetal

III. Polymers:AModernClassofMaterials

TheDiscoveryofPolymerization, MechanismsandProperties:WhatarePolymers? TheUniquePropertiesofPolymers,TheGrowth ofaScienceand anIndustry

IV. PolymerStructures
Polymer molecules -mers, chemistry, common polymers, molecular structure andconfiguration,Crystallinity

V. The SemiconductorRevolution:TheInformationAge

VI. OtherModernMaterials(NanoMaterialsetc): NanostructuralCharacterizationTechniques,Nanosystems.

VII. Atomic Structure and Interatomic Bonding, Atomic Structure and the Periodic Table,AtomicBonding inSolids,itseffects

VIII. StructureofCrystallineSolids(metalsandsemiconductors)
Crystal Structures: Unit cells, common structures, lattice parameters, density calculations,crystalsystems

IX. Defectsandimperfectionsinsolids,Point Defects,Dislocations.

X. Diffusion:Diffusionmechanisms,Steady-Statediffusion,Factorsthatinfluencediffusion

XI. Mechanical Properties: Concepts of stress and strain, Elastic Deformations, PlasticDeformations,Hardness

XII. Deformation & strengthening: Dislocations and Plastic Deformations, Deformation andStrengtheningofpolymers

XIII. Failure:Fracture,Fatigue:theS-Ncurve,Creep

XIV. PhaseDiagramsandPhaseTransformations:BasicConcepts,EquilibriumPhase diagrams & Phase transformations- basic concepts, Glass transition and crystallization ofpolymer

XV. Electrical Behavior: Basic Concepts, Band Structure and Material Behavior: Conductors,Semiconductors,ionicconductors, passiveandactivedielectrics

XVI. Applications of Materials: Traditional metal, semiconductors and polymer applications,Nanocomposites

Resourcematerials:

1.“TheSubstanceofCivilization”,Stephen,L.Sass,ArcadePublishing,19992."MaterialsScience andEngineering:AnIntroduction",Callister,WilliamD.,4th or5thEdition,JohnWiley&Sons, NewYork,1999.

3. FundamentalsofMaterialsScienceandEngineering:AnIntegratedApproach,Callister,William D.Jr.,2nd Ed.,JohnWileyandSons,2003, ISBN 0-471-47014-7

4. http://ojps.aip.org/Online search ofAIPsciencearticles

Inaddition:FacultymaypoststudymaterialsonwebormayuseE-mailIDofenrolledstudentstopostKnowledgematerials

SEMESTER-V/VI
BPE-04

PHYSICSINEVERYDAYLIFE

Credit: 6 (5Th +1T) Total Lectures: 50

Basics: Units and dimensions; Dimensional analysis and estimation of energy scales for differentphysicalprocesses;Orderofmagnitudecalculations;TheFermiproblem.

Physics of Earth: Estimating the radius and mass of earth by elementary methods; Age of the earth;Other Physical parameters of the earth; Earth's interior; Thermal structure of Earth; Gravity andmagneticfieldsoftheearth;Platetectonics&Geodynamics;Seismology&Tomography;Gravity& magnetic methods; Electrical & Electromagnetic methods; Seismic Methods; Well logging andothermethods.

AtmosphericPhysics:Compositionandstructureoftheatmosphere;Radiationscatteringofradiation by atmosphere; Emission & absorption of terrestrial radiation; Greenhouse effect; globalwarming and climate change; Atmospheric thermodynamics and role of water vapour; Atmosphericelectricity;Physicsofclouds;CloudSeeding;Airandtheatmosphericdynamics;Weatherprediction.

Human body and medical physics: Eye and the vision; working principles of spectacles, contactlenses, binoculars, telescopes, microscopes etc.; Ear and sound; working principles of hearing aiddevice; How the lungs and the heart work? Physics of rotator cuff and the skeleton; Noninvasiveprobe inside the body: Sound waves and working principles of stethoscope, ultrasonography; Bloodcirculation,bloodpressure&sphygmomanometer;Electricalactivityofheart&ECG(Electrocardiography);Electromagneticradiation,interactionofmatterwithradiationandworkingprinciplesofX-ray;NuclearmagneticresonanceandMRI;electronpositronannihilation& the PET scan. Working principles of LASER and its use in surgery; Nanoscience and futurepromisesinmedicalphysics.Thestructureofahumancell;DNA,RNA;ProteinandEnzymes.

Physicsofcooking:Controlleduseoffireforcooking:fromclayoventoelectricheaters;Conduction, convection and radiation; Interaction of microwaves with matter & microwave ovens;Heat pumps and domestic refrigerator; the Mpemba effect: can hot water freeze faster than coldwater? Physics behind the working principles of a few kitchen appliances: bottle opener as a lever,electricchimney,nanotechnologybasedauto-cleaningutensils.

Communication Physics: Use of electromagnetic waves for telecommunication; from J. C. Bose topresent day technology; Working principles of cell phone, GPS, internet etc.; physics of fiber opticsbased communication; difficulty with faster signal transmissions and possible remedies; elementaryideasonpossiblenextgenerationtelecommunicationmodesanddevices.

DATA Storage devices: Different forms of energy used in storing data; Working principles ofmagnetic storage devices; Magnetic tapes, Floppy disk and HDD; Working principles of opticalstorage devices; CD, DVD etc.; Electrical storage devices; semiconductors; DATA storage in RNA& DNA; elementary ideas about future generation storage devices based on spintronics, ion traptechnologies.

Physics & Sports: Throwing Javelin, shot-put etc.; Swimming & diving; Other field & track events.Aerodynamicsofaflyingball;SpinandSwingbowling;Instantaneousmeasurementofthespeedof the cricket ball; howaccurate these measurements are? Heavy Vs. light bat; the swing mass ofthe bat; the sweet spot of a bat; Physics of base ball and other soft balls.

References:

1.PhysicsoftheEarth, 4thedition, F.D. Stacy,andP. M.Davis, Cambridge UniversityPress

SEMESTER-V/VI
BPE-05

THEORETICALANDOBSERVATIONALASPECTSOFASTRONOMY

Credit: 6 (5Th +1T) Total Lectures: 50

1. (a)Whatisastronomy?-Anintroductiontheprospectsofastronomy.
   (b) Anoverviewonsphericaltrigonometry.
   (c) Geodesics,smallcirclesand greatcircles.

2. (a)Earthandtherelatedterrestrialastronomy.
   (b) CelestialSphereandrelatedtopics.
   (c) Threesystemsof celestialcoordinatesandtheirtransformations.

3. (a)Timeassociatedwithastronomy.
   (b) Astronomicalrefraction,parallax,aberration,precession andnutation.

4. Generaldescriptionof
   (a) sunand solar system,
   (b) comets,
   (c) meteors,
   (d) moon and
   (e) eclipses.

5. StellarAstronomy:
   (a) star: formation, evolution and death (b) constellations, (c) Stellar magnitudes, (d) variablestars,(e) doublestars and(f)Cepheid variables.

6. Observationalastronomy.

References:

1.Textbookofastronomyandastrophysicswithelementsofcosmology,V.B.Bhatia,Narosapublishinghouse,2001.
3. Astrophysics-starsandgalaxies,K.D.Abhyankar,Universitiespress,2001
4. Astronomy,K,K,Dey

(TOBEOFFERREDONLYINSEMVI)

SEMESTER-V/
VIBPE-06

INTRODUCTIONTO NANOSCIENCE

Credit: 6 (5Th +1T) Total Lectures: 50

- **Introduction:**

What is nanoscience? Why is nanoscience interesting and important? Fundamental phenomena as afunctionofsizeandreduceddimensionality;theroleofsurfaces;Emphasisonusesofnewmaterials.

- **Theoreticalbasis**

Theuncertaintyprinciple,ProbabilityamplitudesandtherulesofquantumMechanics,Manyparticle wave functions and identical Particles, The Pauli exclusion principle, Multielectron atomElectronsinnanostructuresandquantumeffects,Fermiliquidsandthefreeelectronmodel,Transportinf reeelectronmetals,Crystalstructure,X-Raydiffraction,Bloch"stheorem,bandstructure,Brillouin zones and Fermi surfaces.

Hartree,Hatree-Fock Approximation for many electronsystems,Introductiontodensity functiontheory,modelingofnanotubes andnanowires.

- **Generic methodologies**: The principles of nanostructure production, laboratorypreparation and the limitations of materials including nanoscale fabrication and characterizationtechnologies.

- **Tools:**

X-rayDiffractometer,ScanningElectronMicroscope(SEM),TransmissionElectronMicroscope(TEM),Atomic forcemicroscope(AFM), Scanningtunnelingmicroscope(STM) (ideaonly).

- **NanomaterialsandNanocomposites:**
- Metalnanoparticles,nano-rodandnano-tube:Preparationandcharacterization,Electronicproperties,metal-non-metaltransition,Quantumsizeeffect,core-shellstructure,quantumconductancein metal nanowires.
- Nanocomposites: Synthesize of nanoclusters (metal/semiconductor) inside a medium, such asglass, and ceramic media, Important nanoscale systems and their novel properties (clusters, dots,films).
- Oxide nanostructures (semiconductor, Ferroelectric, ferrites etc.) createdby various Physicaland chemical routes. Explore the physical properties of oxides that make them important to optical,electronicandmagneticapplications.Mechanicalproperties(Individualnanostructures,Bulknanostructuredmaterials).
- Carbonnano-tube:FabricationandcharacterizationalignedCNT,EmissiondevicesusingCNT.

References:

S.M.Lindsay,„*Introductiontonano-science'*,OxfordUniversityPress,2010.

Richard Martin, *‘Electronic Structure: Basic theory and practical methods’*, Cambridge UniversityPress,2004.
A.A.Balandin&K.L.Wong, Eds Handbook of semiconductor nanostructures and nanodevicesH.S.Nalwa, Handbook of nanostructured biomaterials and their application in nanobiotechnologyH.S.Nalwa,Nanoclustersand nanocrytals

SEMESTER-V/
VIBPE-07

ELECTRICAL&ELECTRONICINSTRUMENTS

Credit: 6 (5Th +1T) **Total Lectures: 50**

1.**Voltmeters and Ammeters:** Analog Voltmeters: DC Voltmeter, AC Voltmeter, Vacuum TubeVoltmeter(VTVM),FieldEffectTransistorVoltmeter(FET-VM);AnalogAmmeters.
Digital Voltmeters: General Characteristics, Ramp Type, Integrating Type, Continuous Balance,DigitalMultimeters.
2.**Power Supply:**Rectifierswith/withoutFilter,Principle ofRegulation,RegulatedPowerSupply using Zener, Transistor and ICs,Fixed and Variable Voltage Source(s) using ICs,Constantcurrent supplies, Power Supply using SCRs, Fabrication of Regulated Power Supply, SwitchedMode Power Supply(SMPS),
DC–DCConverters: BuckConverters, BoostConverters, Buck –BoostConverters.
3.**Uninterrupted Power Supply (UPS) :**Technologies, Offline / Standby,Line-interactive,Double-conversion / Online, Double Conversion On Demand, Ferro-resonant, DC Power, RotaryDRUPS (Diesel RotaryUPS),Air-DRUPS.
4.**Inverters:** BriefHistory,BasicDesigns,Advanced Designs,ThreePhaseInverters.
5.**Signal Generators:** Basic Oscillator circuits, Pulse and Square wave generators, Standard SignalGenerators – Description with Block diagrams, Signal Generators with different frequency ranges,FunctionGenerators.
6.**Cathode Ray Oscilloscope:** Basic CRO operation, Block diagram, Cathode Ray Tube (CRT),PrincipleofFocusingandDeflectionofElectronBeam,VerticalandHorizontalDeflectingSystems , Sweep generators, Synchronization of sweep, Dual Trace CRO, Dual Beam CRO.
7.**LCR Bridges :**General Form of AC Bridges, Measurement of Inductance and Capacitance,MaxwellBridge,HayBridge,ScheringBridge.
8.**ThreePhase Transformer:**Transformer – Review, ThreePhase Transformer – Theory andmodeofoperation,VoltageStabilizer.
9.**Electric Motor:** Principle of DC motor, Theory of Rotating Magnetic field – Induction Motors,ThreePhaseACMotor,Stepper Motor, Servo Motor.

RecommendedReferences:

1. ModernElectronicInstrumentation&MeasurementTechniques,Helfrick&Cooper,Prentice-Hall.
2. ElectronicMeasurement,Terman&Petit,McGrawHill
3. Electricity&Magnetism,Sterling.

SEMESTER-V/VI
BPE-08
(MATHEMATICALMETHODS–III)

Credit: 6 (5Th +1T) Total Lectures: 50

1. Second order differential equations: – Singular points, series solutions, Frobenius method,Legendre,BesselandHermiteequations

2. Special Functions – Legendre, Bessel, Hermite and Laguerre functions – recurrence relations,orthogonality, generating functions, Rodrigues formula.Beta and Gamma functions, Dirac Deltafunction.Occurrenceofspecialfunctionsinphysicalproblems.

3. Non-linear differential equations – Non-linearity in some simple dynamical systems, fixedpoints and their classification, stability, linear stability analysis, Bifurcations. Examples, phaseplaneandphaseportrait, limitcycle Lorenz equation,Chaos.

4. Tensors: Introduction, coordinate transformation, scalars, covariant and contravariant tensors,ranks, Symmetric and Anti-symmetric tensors, Einstein summation rule, Kronecker delta, Levi-Civitatensor,andmetrictensors,contraction,innerproductandouterproduct.

5. Integrals transforms: Fourier transforms, convolution theorems, short-comings of Fouriertransforms,Wavelettransform.Applications.

RecommendedReferences:

1. MathematicalmethodsforPhysicists:Arfkenand Weber.Elsevier
2. Mathematicalmethodsofphysics–J MathewsandRIWalker(Pearson)
3. AdvancedEngineeringMathematics --ErwinKreyszig,WileyEasternUniversityEdition
4. MathematicsforPhysicists–DenneryandKrzywicki(Dover)
5. Introductiontomathematicalphysics:C.Harper.(EasternEconomicEd.PHI)
6. MathematicalmethodsforphysicsandEngineering:Riley,Hobson,Bence(CUP,Indianed)
7. MathematicalMethodsinthePhysicalSciences: MaryL.Boas,(Wiley)
8. Mathematical tools for Physics – J Nearing, downloadable fromwww.physics.miami.edu/nearing/mathmethods
9. Mathematical Physics– PK Chattopadhyay(NewAge)
10. VectorandTensorAnalysis with applications– Borisenko andTarapov(Dover)
11. VectorAnalysis– MRSpiegel (Schaum series)
12. FourierTransform–M.R.Spiegel(Schaumseries)
13. MathematicalPhysics –AjoyGhatak,GoyalandChua(McMillan)
14. Differentialequations– MRSpiegel(Schaumseries)
15. DifferentialEquations–SimmonsandKantz,Tata-McGraw-Hill.
16. SpecialFunctions–NNLebedev (Dover)
17. MathematicalMethodsinclassicalandquantumphysics–TulsidassandSKSharma
18. TensorAnalysis–BarySpain(RadhaPublishers)
19. Non-lineardynamicsandChaos–SHStrogatz (Levant)
20. ClassicalMechanics–JCUpadhyay

SEMESTER-V/VI
BPE-09

(ATOMIC,MOLECULAR,NUCLEAR &PARTICLEPHYSICS)

Credit: 6 (5 Th +1T) Total Lectures: 50

(EACHGROUPHASTOBEANSWEREDINSEPARATESCRIPTS)

GROUPA:ATOMIC&MOLECULARPHYSICS

MARKS:20

1. **AtomicSpectra**:
   Bohr atom model, Somerfield‟s elliptical orbits and space quantization, spin quantization,Larmourstheorem,magneticmoment,Bohrmagneton.

   Alkali spectra, Explanation of the doublet nature from vector atom model, selection rules fortransition, Pauli‟s exclusion principle and periodic table. Effect of magnetic field on the spectrallines-Zeeman effect (normal and anomalous), Lande g-factor, Paschen Bach effect, effect ofelectricfieldonthespectrallines-Starkeffect, L-Scoupling, Landeintervalrule,J-Jcoupling.

2. **MolecularSpectra**:
   Classification of molecular spectra - electronic, vibrational and rotational spectra of diatomicmolecules, fluorescence, phosphorescence, Raman spectra, optical pumping.

RecommendedReferences:

1. IntroductiontoAtomic Spectra,White
2. StructureofAtomsandMolecules,Kondratiev
3. AtomicSpectraandAtomicStructure,Herzberg.
4. SpectraofDiatomicMolecules,Herzberg.
5. IntroductiontoMolecularSpectroscopy,Barrow.
6. MolecularSpectroscopy,Banwell

GroupB:NuclearPhysics
FullMarks:15

1.**IntroductiontoNuclearPhysics**:Compositionofnucleus,nuclearsize,nuclearforceandotherforcesof nature,bindingenergycurve.;propertiesofnuclearforce,rangeanddepthofpotential:deuteronproblem,n-p,p-pscatteringatlow-energies,non-centralforces,quadrupolemomentofdeuteron, saturation of nuclear force, meson theory of nuclear force, Yukawa theory.2.**Radioactivity**: ✔ , 🚲, ■decayand internal conversion
3.**Modelsofthenucleus**:liquiddropmodel,semi-empiricalmassformula,Fermigasmodel,shellmodeland magic numbers.
4.**Nuclearreactions**:conservationlaws,directandcompoundreactions–Ghoshal'sexperiment,fissionand fusion reaction, nuclear reactor.

GroupC:ParticlePhysics
FullMarks:15

1.**Introduction to particles and interactions**: source of 'elementary' particles: cosmic ray, nuclearreactors,particleaccelerators;discovery ofneutron,positron,neutrinos,anti-protonandanti-neutron, baryons, mesons, leptons and 'strange' particles; fundamental forces of nature; quarks,leptonsand mediators
2.**Quantum numbers**: quantum numbers associated with 'elementary' particles, their conservationandviolation
3.**QuarkModel**:TheEightfoldWay,quarkmodel,multiplets4.

References:
1.NuclearTheory(Vol.-I),Eisenberg&Greiner,North-Holland.2.Conceptsof Nuclear Physics,B. Cohen, North-Holland.
3.Theoryof NuclearPhysics, Bohr &Mottelson.
4.NuclearPhysics(TheoryandExperiment),Roy&Nigam,Wiley&Sons.5.TheoreticalNuclearPhysics,Blatt&Weisskopf,JohnWiley&Sons.
6.TheAtomicNucleus, Evans,McGraw-Hill.
7.Introduction to Elementary Particles, David Griffiths, John Wiley & Sons.8.IntroductiontoParticlePhysics,M.P.Khanna,Prentice-HallofIndiaPrivateLimited.9.Concepts of Modern Physics, A. Beiser, McGraw-Hill Education10.http://public.web.cern.ch/public/en/Science/Science-en.htmL
11.http://ed.fnal.gov/home/students.shtml.

GEBERIC ELECTIVE/INTERDISCIPLINARY COURSES IN PHYSICS

SEMESTER-
IGE-101

(MECHANICS&THERMALPHYSICS)
FullMarks:50(40+10), Credit=4Total Lectures: 50
(EACHGROUPHASTOBEANSWEREDINSEPARATESCRIPT)

GroupA **(Mechanics)** **Marks: 20**

1. **Vectors:**Axialandpolarvectors,dotandcrossproduct,scalartripleproductandvectortriple product.Gradient,divergence andcurl,statementof divergence theorem and Stokes‟theorem.

2. **Rotationalmotion:**Angularvelocity,angularacceleration,angularmomentum,torque,fundamentalequationsofrotationalmotion,principleofconservationofangularmomentum.

3. **Dynamicsofrigidbodies:**Momentofinertiaandradiusofgyration,theirphysicalsignificance, theorem of parallel and perpendicular axes. Rotational kinetic energy, calculation ofmomentofinertiaofsomesimple systems.

4. **Gravitation:** Law of universal gravitation, gravitational potential and intensity, calculationofpotentialandintensityofthinuniformsphericalshell andsolidsphere,escapevelocity.

GroupB **(ThermalPhysics)** **Marks: 30**

1. **Kinetic theory of gases**: Perfect gas, pressure exerted by gas, Maxwell‟s law of distributionof molecular velocities (statement only) – r.m.s., mean and most probable velocities, degrees offreedom,principleofequipartitionofenergy–applicationinsimplecases.Meanfreepath,Brownian motion (qualitative). Equation of state – defects of ideal gas equation, Van der Waal‟sequation,andcritical constants.

2. **Thermalconductivityofsolids:**Differentprocessesoftransmissionofheat,thermalconductivityanddiffusivity,Fourierequationin1-Dimensionforheatflow,Ingen-Hausz‟sexperiment,conductivityofcompositeslabs,conductivityofpoorconductors,Searle‟sexperiment.

3. **Thermodynamics:**Specific heat, Internal energy, Isothermal and adiabatic processes, firstlaw of thermodynamics; Indicator diagram, reversible and irreversible processes, cyclic process;Secondlawofthermodynamics,Carnotcycle,Carnottheorem,absolutescaleoftemperature,entropy.

4. **Radiation:** Radiation of heat, emissive and absorptive power, Kirchhoff‟s law,black bodyRadiation, Stefan‟s law,Planck‟s law (statement only), Wien‟s displacement law, Rayleigh-Jean‟slaw.

SEMESTER-
IGE-102

(LABORATORYCOURSE)

FullMarks–25 (20+ 5),Credit=2

1. Determinationofspecific gravityofgranularsolidinsolubleinwater.
2. Determinationofspecificgravityofgranularsolidsolubleinwater.
3. Determinationofmomentofinertiaofmetalliccylinder/rectangularbar.
4. VerificationofBoyle"slaw.
5. n– Lcurveusingsonometer.
6. m-l^2curveusingsonometer.
7. Determinationofvelocityofsoundbyaircolumnmethod.
8. DeterminationtheYoung'smodulusofamaterialtakenintheformofawirebyVerniermethod(stretching).

(NEWEXPERIMENTSMAYBEADDEDINPHASES)

SEMESTER-
IIGE-201

(GENERALPROPERTIESOFMATTER &OPTICS)
FullMarks-50(40+10), Credit:4Total Lectures: 50
(EACHGROUPHASTOBEANSWEREDIN SEPARATESCRIPT)

Group-A:GeneralPropertiesofMatter Marks: 25

1. **Elasticity**: Stress and strain, Hook's law, elastic constant and their interrelations, work done instretching a wire, torsion of a cylinder, determination of Y, determination of η (static and dynamicalmethod)

2. **SurfaceTension**:Surfacetensionandsurfaceenergy,moleculartheoryofsurfacetension,angleofcontact,capillary,excesspressureofacurvedliquidsurface, factorsaffectingSurfaceTension.

3. **Viscosity**: Coefficient of viscosity, streamline and turbulent motion, Reynolds number,Bernoulli‟sequation,flowofliquidthroughacapillarytube,Poiseuille'sequationanddeterminationofviscosityofaliquid,Stokes'law,factorsaffectingviscosity, applicationtobloodflow.

4. **Wave Motion**: Different types of waves, Longitudinal/Transverse waves and progressive/stationary waves, Period, Amplitude, Frequency, Wavelength, Velocity, Phase etc., Forced Vibrations and Resonance, Resonance column method of finding velocity of sound waves,Transverse waves in a string, Laws of vibration of strings, Characteristics of musical sound,Dopplereffect,Ultrasonics,Ultrasonography,Intensity,decibel.

Group-B:Optics Marks: 25

1. **Fermat'sPrinciple**:Fermat'sprinciple,LawsofreflectionandrefractionfromFermat'sprinciple.

2. **Prism**:Dispersion,Dispersivepower,Deviation,dispersionbyraindrop,rainbow.

3. **Thin Lenses**: Equivalent focal length of two lenses in contact, Equivalent focal length of twolenses separated by a distance, chromatic aberration in lens, achromatic combination of lenses,sphericalaberrationinalensanditsremedy.

4. **Velocity of Light**: Introduction, Determination of velocity of light: Fizeau (Terrestrial),Foucault‟sandMichelson'smethod,Constancyofvelocityoflightinallframesofreferences.

5. **WaveTheoryof Light**:Huygen'sprinciple,thelawsofreflectionandrefraction.

6. **Interference**:Young'sExperiment,Coherence,Theoryofinterferencebydivisionof Wave front, Biprism Experiment, Interference by division of amplitude, Interference from thinfilms,Newton'sring.

7. **Diffraction**: Introduction, Fraunhofer diffraction, single slit, circular aperture, double slit, planediffractiongratings,Fresneldiffraction,Zoneplate.

8. **Polarization**: Introduction to polarization, polarization by reflection; Nicol Prism, Doublerefraction,opticalactivity,polarimeter,Faradayeffect

SEMESTER-
IIGE-202

(LABORATORYCOURSE)
Fullmarks:25(20+5).Credit=2

1.Determination the rigidity modulus of a material taken in the form of wire by statical method.2.Determination the rigidity modulus of a material taken in the form of wire by dynamical method.3.Determinationofthefocal lengthofaconvexmirrorwiththehelp ofanauxiliarylens.
4.Determination of the focal length of a convex lens by combination method.5.Determination of the focal length of a convex lens by displacement method.6.Determinationoftherefractiveindexofthematerialofaprismbyspectrometer.7.Determinationoftherefractiveindex of aliquidbylensandmirror.
8.Determinationoftherefractiveindex ofaliquidbytravellingmicroscope.

(NEWEXPERIMENTSMAYBEADDEDINPHASES)

SEMESTER-
IIIGE-301

(ELECTRICITY&MAGNETISM)
FullMarks: 50 (40+10), Credit= 4 Total Lectures: 50

1. **Electrostatics:**Electriccharge,Coulomb"slaw,electrostaticpotentialandintensity,intensityandpotential due to a point charge,; Induction, lines of force, Gauss" theorem and its application,capacity of condenser, parallel-plate, spherical and cylindrical condensers; Loss of energy due tochargesharing,;Dielectrics,electricpolarization.

2. **Magnetostatics:**Magneticpole,polestrength,magneticpotentialandintensity,potentialdueto abar magnet and magnetic shell, moment of a magnet, forces between two magnets, couple on amagnet, work done in deflecting a magnet, magnetometers – deflection and vibration; Terrestrialmagnetism,magnetic elementsofearth,determinationofH.

3. **D.C.Circuit:**Kirchhoff"slawanditsapplication,potentiometeranditsapplication,measurementofe.m.f.,currentandresistancebypotentiometer,Wheatstone"sbridgeanditssensitivity.

4. **Electro-magneticinduction:**Selfandmutualinductances, calculationofinductanceinsolenoid.

5. **Varying current :**Growth and decay of current in L-R and C-R circuits, time constant and logdecrement; Inductioncoil.

6. **Alternating current :**R.M.S. and mean value of current, e.m.f., reactance and impedancephaseandvectordiagram,choke,powerfactorinA.C.circuits, L-R,C-RandL-C-Rcircuits–seriesandparallelresonance,applicationstoradioandTV;Transformers.

7. **Electrolysis:**Faraday"slawofelectrolysisandtheirexperimentalverification,chemicalequivalent,electro-chemical equivalent, determination of reduction factor of a tangent galvanometer,dissociation,ionicmobility.

8. **Thermo-electricity:**
   Thermo-electric effect, Seebeck, Peltier and Thomson effect, laws of thermo-electricity, thermo-electriccurvesandthermo-electricinversion,thermo-electricpower,thermo-electricseries,thermo-couple.

9. **Electromagnetism :**Magnetic effect of electric current, Laplace"s equation, Ampere"s theorem,calculationofmagneticfieldatapointontheaxisofacircularcoil;Solenoid,Helmholtzgalvanometer, field due to a current in an infinitely long wire, effect of magnetic field on currentcarryingconductor,ammeter,voltmeter,shunt

SEMESTER-
IIIGE-302

(LABORATORYCOURSE)
Full marks:25(20+5),   Credit= 2

1. Determinationoftheresistanceperunitlengthofameterbridgewireby CareyFoster'smethod.
2. Determinationofthevalueoflowresistancebydropof potentialmethod.
3. Tomeasurethee.m.f.ofacellbyapotentiometerusingamilli-ammeter.
4. Determinationofspecific resistancebymeterbridge withendcorrection.
5. Determinationoftheelectrochemicalequivalenceofcopperusinganammeter(singledepositnecessary).
6. Determinationofthemomentofabarmagnetandthehorizontalcomponentofearth'smagneticfield bymagnetometer.

(NEWEXPERIMENTSMAYBEADDEDINPHASES)

SEMESTER-
IVGE-401

(MODERNPHYSICS&ELECTRONICS)
Full marks:50(40+10), Credit= 4, Total Lectures: 50

(EACHGROUPHASTOBEANSWEREDIN SEPARATESCRIPT)

GroupA:ModernPhysics Marks:35

1. Atomic Physics: Discharge of electricity through rarefied gas, cathode ray and their properties;Ionization of gases by radiation, measurement of e/m (specific charge) by Thomson's method,determinationof'e'(electroniccharge)byMillikan'soildropexperiment;Aston'smassspectro graph, Frank-Hertz expt.

2. Quantumtheoryofradiation:Planck'sconcept---radiationformula(statementonly)---qualitative discussion of photo-electric effect and Compton effect in support of quantum theory;Ramaneffect.

3. BasicQuantumMechanics:Wavenatureofmaterialparticles,wave-particleduality,wavelengthof de Broglie waves, Heisenberg uncertainty principle, Bohr's theory of hydrogen spectra --- conceptofquantumnumber,Schrödingerequation,particleinaonedimensionalinfinitewell--- energyEigenvalues,wavefunctionanditsprobabilisticinterpretation.Pauliexclusionprinciple.

4. SolidStatePhysics:Crystallinenature ofsolid,diffractionofX-ray,Bragg'slaw;Moseley'slaw - explanationfromBohr'stheory.

5. Nuclear Physics: Binding energy of nucleus, binding energy curve and stability; Radioactivity,successive disintegration, radioactive equilibrium, radioactive dating, radioisotopes and theiruses,nucleartransmutation,fissionandfusion,nuclearreactor.

6. Special Theory of Relativity: Postulates of STR, formulae of (i) Length contraction; (ii) Timedilation;(iii)Velocityaddition;(iv)Massvariation,and(v)Mass-energyequivalence.

GroupB:Electronics Marks: 15

1. Diodes and Transistors : Introduction to semiconductors, P-N junction diode, bridge rectifier,capacitanceinputfilter,Zenerdiode,voltageregulator,Transistors--- αandβandtheirinterrelations; output characteristics in CE mode, single stage CE amplifier --- approximateexpressionsofcurrent andvoltagegainwiththehelpof'LoadLine'.

2. Digital electronics: binary systems, binary numbers. Decimal to binary and reverse conversions;binaryaddition and subtraction.
   Logic gates : OR, AND, NOT gates --- truth tables. Statement of de Morgan's theorem, NORandNANDuniversalgates.

SEMESTER-
IVGE-402

(LABORATORYCOURSE)

Full marks:25(20+5), **Credit:2**

1. Todrawthecharacteristiccurveofap-njunctiondiodeandhencetodetermineitsacresistance from thecharacteristic curve.
2. Tostudytheperformanceofap-njunctiondiodeasahalf-waveandafull-waverectifierandhenceto find out the percentageregulation.
3. Todrawtheforwardand reversecharacteristiccurvesofaZener diode.
4. Todrawthestaticoutputcharacteristiccurveofatransistorincommonemitterconfiguration for different base currents and hence to find out the forward current gainparameter.
5. To construct OR, AND, NOT and NAND gates using discrete circuit components and toverifytheirtruth table.
6. To verifythe truth tablesof OR,AND and NOTgates and to verifyDeMorgan's theorembyusingNANDgates.

(NEWEXPERIMENTSMAYBEADDEDINPHASES)