HONOURS COURSES AT A GLANCE

SUBJECT:PHYSICS

DISCIPLINE SPECIFIC CORE (14 PAPERS)(Credit: 06 each)

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
DSC-H-PHY-1	1st	**Mathematical Physics-1**	4	2
DSC-H- PHY-2		**Mechanics**	4	2
DSC-H-PHY- 3	2nd	**Electricity & Magnetism**	4	2
DSC-H-PHY- 4		**Waves & Optics**	4	2
DSC-H- PHY 5	3rd	**Mathematical Physics-II**	4	2
DSC-H-PHY -6		**Thermal Physics**	4	2
DSC-H-PHY -7		**Digital Systems & Applications**	4	2
DSC-H-PHY -8	4th	**Mathematical Physics-III**	4	2
DSC-H-PHY-9		**Elements of Modern Physics**	4	2
DSC-H- PHY -10		**Analog Systems & Applications**	4	2
DSC-H- PHY-11	5th	**Quantum Mechanics &application**	4	2
DSC-H- PHY -12		**Solid State Physics**	4	2
DSC-H- PHY -13	6th	**Electromagnetic Theory**	4	2
DSC-H- PHY -14		**Statistical Mechanics**	4	2

DISCIPLINE SPECIFIC ELECTIVE (4 PAPERS)(Credit: 06 each)

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
DSE-H- PHY-1	5th	**Classical Dynamics**	5	1
DSE-H- PHY-2		**Physics of Devices &Instruments**	4	2
DSE-H- PHY -3	6th	**Nuclear & Particle Physics**	5	1
DSE-H- PHY -4		**Astronomy & Astro-Physics**	5	1

GENERIC ELECTIVE (4 PAPERS) (Credit: 06 each)

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	*Prac/Tuto*
GE-H-PHY-1	1st	**Mechanics**	4	2
GE-H-PHY-2	2nd	**Electricity & Magnetism**	4	2
GE-H-PHY-3	3rd	**Thermal Physics**	4	2
GE-H-PHY-4	4th	**Elements of Modern Physics**	4	2

SKIL ENHANCEMENT COURSES-LIST-A *(Any 1 paper)*

Number	*Semester*	*Title of the Course*	*Credit*	
			Theory	
SEC-H-PHY-1	3rd	Electrical circuits and Network Skills	2	
SEC-H-PHY -2	3rd	Computational Physics Skills	2	

DISCIPLINE SPECIFIC CORE (14 PAPERS)

SemesterI

DSC-H-PHY-1: MATHEMATICALPHYSICS-I

(Credits:Theory-04,Practicals-02)

Theory:50Lectures

The emphasis of this course is to provide some mathematical methods/tools which are required to understand the various phenomena of nature. These mathematical methods are routine in Physics course and requires practice by the students.

Unit-I

Calculus:

Recapitulation:Limits,continuity,averageandinstantaneousquantities,differentiation.Plottin g functions. Intuitive ideas of continuous, differentiable, etc. functionsandplottingofcurves.Approximation:Taylorandbinomialseries(statementsonly). **(2Lectures)**

FirstOrderandSecondOrderDifferentialequations:FirstOrderDifferentialEquationsand Integrating Factor. Homogeneous Equations with constant coefficients.Wronskianand general solution. Statement of existence and Uniqueness Theorem for InitialValueProblems.ParticularIntegral. **(10Lectures)**

Calculus of functions of more than one variable: Partial derivatives, exact andinexactdifferentials. Integrating factor, with simple illustration. **(5Lectures)**

Unit -II

VectorCalculus:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and itsinvarianceunderrotations.Vectorproduct,Scalartripleproductandtheirinterpretationinterms ofareaandvolumerespectively. **(4Lectures)**

Vector Differentiation: Directional derivatives and normal derivative. Gradient ofascalarfieldanditsgeometricalinterpretation.Divergenceandcurlofavectorfield.**(6Lectures)**

Unit -III

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian.Notionof infinitesimal line, surface and volume elements. Line, surface and volumeintegralsof Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's andStokesTheorems. **(12Lectures)**

Unit-IV

Orthogonal CurvilinearCoordinates:

OrthogonalCurvilinearCoordinates.DerivationofGradient,Divergence,CurlandLaplacianinC artesian,SphericalandCylindricalCoordinateSystems. **(6Lectures)**

Unit-V

Introductiontoprobability:

Independentrandomvariables:Probabilitydistributionfunctions;binomial,Gaussian,andPoisson, withexamples.Meanandvariance. **(3 Lectures)**

DiracDeltafunctionanditsproperties:

Definition of Dirac delta function. Representation as limit of a Gaussian functionandrectangularfunction.PropertiesofDiracdeltafunction. **(2Lectures)**

Text Book

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013,7th Edn.,Elsevier.
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, WileyIndia.

ReferenceBooks:

- Anintroductiontoordinarydifferentialequations,E.A.Coddington,2009,PHIlearning
- Differential Equations, George F. Simmons, 2007, McGrawHill.
- Mathematical Tools for Physics, James Nearing, 2010, DoverPublications.
- MathematicalmethodsforScientistsandEngineers,D.A.McQuarrie,2003,VivaBook
- AdvancedEngineeringMathematics,D.G.ZillandW.S.Wright,5Ed.,2012,Jonesand BartlettLearning
- Mathematical Physics, Goswami, 1st edition, CengageLearning
- EngineeringMathematics,S.PalandS.C.Bhunia,2015,OxfordUniversityPress
- Schaum's Outline of Vector Analysis, 2nd Edn. By Murray Spiegel, Seymour Lipschutz (McGraw-Hill, 2009)
- Vector Analysis and Cartesian Tensors, 3ed By D. E. Bourne, P C Kendall (Chapman & Hall, 1992)
- Schaum's Outline of Theory and Problems of Fourier Analysis By Murray R. Spiegel (McGraw-Hill, 1974)
- Introduction to Mathematical Physics by Charlie Harper. (P.H.I., 1995). 6. Higher Engineering Mathematics by B S Grewal, Khanna Publishers (2000).
- EssentialMathematicalMethods,K.F.Riley&M.P.Hobson,2011,CambridgeUniv.Press

Scheme of Examination:

Duration: 2 Hours
Marks: 50
Six problems to be solved out Eight problems/proofs (2 from each Unit)

DSC-H-PHY-1: MATHEMATICALPHYSICS-I LAB

TheaimofthisLabisnotjusttoteachcomputerprogrammingandnumericalanalysisbuttoemphasizeitsroleinsolvingproblemsinPhysics.

- *Highlights the use of computational methods to solve physicalproblems*
- *Thecoursewillconsistoflectures(boththeoryandpractical)intheLab*
- *Evaluationdonenotontheprogrammingbutonthebasisofformulatingtheproblem*
- *Aimatteachingstudentstoconstructthecomputationalproblemtobesolved*
- *StudentscanuseanyoneoperatingsystemLinuxorMicrosoftWindows*

Topics	**Description withApplications**
Introduction andOverview	Computerarchitectureandorganization,memoryand Input/outputdevices
Basicsofscientificcomputing	Binaryanddecimalarithmetic,Floatingpointnumbers,algorithms,Sequence,SelectionandRepetition,singleanddoubleprecisionarithmetic,underflow&overflow-emphasizetheimportanceofmakingequationsintermsofdimensionlessvariables,Iterativemethods
ErrorsanderrorAnalysis	Truncationandroundofferrors,Absoluteandrelativeerrors,Floatingpointcomputations.

ReviewofC&C++Programming fundamentals	IntroductiontoProgramming,constants,variablesanddatatypes,operatorsandExpressions,I/Ostatements,scanfandprintf,cinandcout,Manipulatorsfordataformatting,Controlstatements(decisionmakingandloopingstatements)(*If-statement.If-elseStatement. NestedifStructure.Else-ifStatement.TernaryOperator.GotoStatement.SwitchStatement.UnconditionalandConditionalLooping.WhileLoop.Do-WhileLoop.FORLoop. Break and Continue Statements. NestedLoops*),Arrays(*1D&2D*)andstrings,userdefinedfunctions,StructuresandUnions,Ideaofclassesandobjects
Programs:	Sum&averageofalistofnumbers,largestofagivenlistofnumbersanditslocationinthelist,sortingofnumbersinascendingdescendingorder,Binarysearch
Random numbergeneration	Area of circle, area of square, volume of sphere,valueof pi(**π**)
SolutionofAlgebraicandTranscendentalequationsbyBisection,Newton Raphsonand Secantmethods	Solutionoflinearandquadraticequation,solving $\alpha = \tan\alpha$; $I = I_0\left(\frac{\sin\alpha}{\alpha}\right)^2$ inoptics
InterpolationbyNewtonGregoryForwardand Backward difference formula,Errorestimation of linearinterpolation	Evaluationoftrigonometricfunctionse.g.*sinθ,cosθ,tan θ,etc.*
Numericaldifferentiation(Forwardand Backward difference formula)andIntegration (Trapezoidal andSimpsonrules),MonteCarlomethod	GivenPositionwithequidistanttimedatatocalculatevelocityandaccelerationandviceversa.FindtheareaofB-HHysteresisloop

SolutionofOrdinaryDifferential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	Firstorderdifferentialequation • Radioactivedecay • Current in RC, LC circuits with DCsource • Newton's law ofcooling • Classical equations ofmotion AttemptfollowingproblemsusingRK4ordermethod: Solve the coupled differentialequations $\frac{dx}{dt} = y + x - \frac{x^3}{3}; \frac{dy}{dt} = -x$ For four initial conditions $x(0) = 0, y(0) = -1, -2, -3, -4$ Plot x vs y for each of the four initial conditions on the same screen for $0 \leq 1 \leq 15$ The differential equation describing the motion of a pendulum is $\frac{d_2\emptyset}{dt^2} = -\sin(B)$ Thependulumisreleased fromrestatanangulardisplacementα,i.e.$B(0) = a$ *and* $B'(0) = 0$. Solve the equation for α = 0.1,0.5and1.0andplot$B$asafunctionoftimeintherange$0 \leq t \leq 8\pi$. Alsoplottheanalyticsolutionvalidforsmall

ReferredBooks:

- IntroductiontoNumericalAnalysis,S.S.Sastry,5th Edn.,2012,PHILearningPvt.Ltd.
- Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-HillPub.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rd Edn. , 2007, Cambridge UniversityPress.
- A first course in Numerical Methods, U.M. Ascher& C. Greif, 2012, PHILearning.
- Elementary Numerical Analysis, K.E. Atkinson, 3 rd Edn. , 2007 , Wiley IndiaEdition.
- NumericalMethodsforScientists&Engineers,R.W.Hamming,1973,CourierDoverPub.
- AnIntroductiontocomputationalPhysics,T.Pang,2nd Edn.,2006,CambridgeUniv.Press
- Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt.Ltd.

DSC-H- PHY -2 : MECHANICS

(Credits:Theory-04,Practicals-02)

Theory: 50Lectures

It is concerned with set of physical laws describing the motion of bodies. It is a routine in Physics course and plays an important role to explore the various phenomena of nature.It requires practice by the students.

Unit-I

Fundamentals of Dynamics: Reference frames. Inertial frames; Review ofNewton'sLawsofMotion.Galileantransformations;Galileaninvariance.Momentumofvariable-masssystem:motionofrocket.MotionofaprojectileinUniformgravitationalfieldDynamics of a system of particles. Centre of Mass. Principle of conservationofmomentum.Impulse. **(6Lectures)**

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- orces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. **(4Lectures)**

Collisions: Elastic and inelastic collisions between particles. Centre of MassandLaboratoryframes. **(3Lectures)**

Unit -II

Rotational Dynamics: Angular momentum of a particle and system ofparticles.Torque. Principle of conservation of angular momentum. Rotation about a fixedaxis.MomentofInertia.Calculationofmomentofinertiaforrectangular,cylindricalandsphericalbodies.Kineticenergyofrotation.Motioninvolvingbothtranslationandrotation.

(11Lectures)

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder orWire. **(3Lectures)**

FluidMotion: KinematicsofMovingFluids:Poiseuille'sEquationforFlowofaLiquidthrougha CapillaryTube. **(2Lectures)**

Unit -III

Gravitation and Central Force Motion: Law of gravitation. Gravitationalpotentialenergy.Inertialandgravitationalmass.Potentialandfieldduetosphericalshellandsolidsphere. **(3Lectures)**

Motion of a particle under a central force field. Two-body problem and its reductiontoone-body problem and its solution. The energy equation and energy diagram.Kepler'sLaws. Satellite in circular orbit and applications. Geosynchronousorbits.. **(5Lectures)**

Unit-IV

Oscillations:SHM:SimpleHarmonicOscillations.DifferentialequationofSHManditssolution. Kinetic energy, potential energy, total energy and their time-averagevalues.Damped oscillation. Forced oscillations: **(5Lectures)**

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformlyrotatingframe.LawsofPhysicsinrotatingcoordinatesystems.Centrifugalforce.Coriolisforceand its applications. **(3Lectures)**

Unit-V

Special Theory of Relativity: Michelson-Morley Experiment and its outcome.Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneityandorder of events. Lorentz contraction. Time dilation. Relativistic transformationofvelocity, frequency and wave number. Relativistic addition of velocities. Variationofmass with velocity.

(10 Lectures)

Text Books

- Classical Mechanics, third edition, H. Goldstein,Pearson edition
- Classical mechanics, J.C. Upadhyaya, Himalaya Publishing House
- Mechanics by D S Mathur (S. Chand & Company Limited, 2000)

ReferenceBooks:

- Anintroductiontomechanics,D.Kleppner,R.J.Kolenkow,1973,McGraw-Hill.
- Mechanics,BerkeleyPhysics,vol.1,C.Kittel,W.Knight,et.al.2007,TataMcGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008,Wiley.
- AnalyticalMechanics,G.R.FowlesandG.L.Cassiday.2005,CengageLearning.
- FeynmanLectures,Vol.I,R.P.Feynman,R.B.Leighton,M.Sands,2008,PearsonEducation
- IntroductiontoSpecialRelativity,R.Resnick,2005,JohnWileyandSons.
- University Physics, Ronald Lane Reese, 2003, ThomsonBrooks/Cole.
- UniversityPhysics.F.WSears,M.WZemansky,H.DYoung13/e,1986,AddisonWesley
- PhysicsforscientistsandEngineerswithModernPhys.,J.W.Jewett,R.A.Serway,2010, CengageLearning
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGrawHill.

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives from each Unit. Each question must carry a short problem of 3/4 marks minimum.

DSC-H- PHY -2 : Mechanics-LAB

1. Measurements of length (or diameter) using vernier caliper, screw gaugeandtravellingmicroscope.
2. To study the random error inobservations.
3. To determine the height of a building using aSextant.
4. TostudytheMotionofSpringandcalculate(a)Springconstant,(b)**g**and(c)Modulus ofrigidity.
5. To determine the Moment of Inertia of aFlywheel.
6. Todetermine**g**andvelocityforafreelyfallingbodyusingDigitalTimingTechnique
7. To determine Coefficient of Viscosity of water by Capillary FlowMethod(Poiseuille'smethod).
8. TodeterminetheYoung'sModulusofaWirebyOpticalLeverMethod.
9. TodeterminetheModulusofRigidityofaWirebyMaxwell'sneedle.
10. To determine the elastic Constants of a wire by Searle'smethod.
11. To determine the value of g using BarPendulum.
12. To determine the value of g using Kater'sPendulum.

ReferenceBooks

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishingHouse
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4th Edition,reprinted 1985, Heinemann EducationalPublishers
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11th Edn,2011,KitabMahal
- Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, CengageLearningIndia Pvt.Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge UniversityPress.

SemesterII

DSC-H- PHY- 3 : ELECTRICITY ANDMAGNETISM

(Credits:Theory-04,Practicals-02)

Theory: 50 Lectures

Electricity and magnetism are two very important topics in Physics. It is difficult to imagine the present society without the knowledge of it. It is routine in Physics course, and requires practice by the students.

Unit-I

ElectricFieldandElectricPotential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications tochargedistributionswithspherical,cylindricalandplanarsymmetry. **(4Lectures)**

ConservativenatureofElectrostaticField.ElectrostaticPotential.Laplace'sandPoissonequations.The UniquenessTheorem.PotentialandElectricFieldofadipole.ForceandTorqueonadipole.

(5Lectures)

Electrostaticenergyofsystemofcharges.Electrostaticenergyofachargedsphere.Conductors in an electrostatic Field. Surface charge and force on aconductor.Capacitanceofasystemofchargedconductors.Parallel-platecapacitor.Capacitanceofan isolated conductor. Method of Images and its application. **(8 Lectures)**

Unit-II

Dielectric Properties of Matter: Electric Field in matter. Polarization,PolarizationCharges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallelplate,spherical, cylindrical) filled with dielectric. Displacement vector **D**. RelationsbetweenE,PandD.Gauss'Lawindielectrics.

(7 Lectures)

Unit -III

Magnetic Field: Magnetic force between current elements and definition ofMagneticField**B**. Biot-Savart's Law and its simple applications: straight wire and circularloop.CurrentLoopasaMagneticDipoleanditsDipoleMoment(AnalogywithElectricDipole). Ampere'sCircuitalLawanditsapplicationtoSolenoid.Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1)pointcharge(2)currentcarryingwire(3)betweencurrentelements.

(7 Lectures)

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer:CurrentandChargeSensitivity.Electromagneticdamping.

(2Lectures)

Unit-IV

MagneticPropertiesofMatter: Magnetizationvector(**M**).MagneticIntensity(**H**).MagneticSuscepti bilityandpermeability.RelationbetweenB,H,M.Ferromagnetism.B-Hcurveandhysteresis.

(4Lectures)

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self-Inductance andMutualInductance. Reciprocity Theorem. Energy stored in a Magnetic Field. IntroductiontoMaxwell's Equations.

(5Lectures)

Unit -V

ElectricalCircuits:ACCircuits:Kirchhoff'slawsforACcircuits.ComplexReactanceandImpedance. SeriesLCRCircuit:(1)Resonance,(2)PowerDissipationand(3)QualityFactor,andParallelLCRCircuit . **(4Lectures)**

Network theorems: Ideal Constant-voltage and Constant-current Sources.NetworkTheorems:Thevenintheorem,Nortontheorem,Superpositiontheorem,Reciproc itytheorem,MaximumPowerTransfertheorem.Applicationstodccircuits. **(4Lectures)**

Text Books

- ElementsofElectromagnetics,M.N.O.Sadiku,2010,OxfordUniversityPress.
- Circuit Theory: Analysis and Synthesis, by A. K. Chakraborty, Dhanpat rai publication.
- Introduction to Electrodynamics, D.J.Griffiths,3rdEdn.,1998,BenjaminCummings
- Electricity and Magnetism, D.C. Tayal, 3rdEdn, Himalaya Publishing House

ReferenceBooks:

- Electricity,Magnetism&ElectromagneticTheory,S.MahajanandChoudhury,2012, TataMcGraw
- ElectricityandMagnetism,EdwardM.Purcell,1986McGraw-HillEducation
- FeynmanLecturesVol.2,R.P.Feynman,R.B.Leighton,M.Sands,2008,PearsonEducation
- ElementsofElectromagnetics,M.N.O.Sadiku,2010,OxfordUniversityPress.
- ElectricityandMagnetism,J.H.Fewkes&J.Yarwood.Vol.I,1991,OxfordUniv.Press.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a short problem of 3/ 4 marks minimum.

DSC-H- PHY- 3:ELECTRICITY ANDMAGNETISMLAB

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c)DCCurrent, (d) Capacitances, and (e) Checking electricalfuses.
2. To study the characteristics of a series RCCircuit.
3. To determine an unknown Low Resistance usingPotentiometer.
4. TodetermineanunknownLowResistanceusingCareyFoster'sBridge.
5. To compare capacitances using De'Sauty'sbridge.
6. MeasurementoffieldstrengthBanditsvariationinasolenoid(determinedB/dx)
7. To verify the Thevenin and Nortontheorems.
8. ToverifytheSuperposition,andMaximumpowertransfertheorems.
9. TodeterminselfinductanceofacoilbyAnderson'sbridge.
10. To study response curve of a Series LCR circuit and determine its (a)Resonantfrequency,(b)Impedanceatresonance,(c)QualityfactorQ,and(d)Bandwidth.
11. TostudytheresponsecurveofaparallelLCRcircuitanddetermineits(a)Anti-resonant frequency and (b) Quality factorQ.
12. Measurement of charge and current sensitivity and CDR ofBallisticGalvanometer
13. DetermineahighresistancebyleakagemethodusingBallisticGalvanometer.
14. To determine self-inductance of a coil by Rayleigh'smethod.
15. TodeterminethemutualinductanceoftwocoilsbyAbsolutemethod.

ReferenceBooks

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971,AsiaPublishingHouse
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11thEd.,2011,KitabMahal
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4thEdition,reprinted 1985, Heinemann EducationalPublishers
- EngineeringPracticalPhysics,S.PanigrahiandB.Mallick,2015,CengageLearning.
- ALaboratoryManualofPhysicsforundergraduateclasses,D.P.Khandelwal,1985,VaniPub.

DSC-H- PHY- 4: WAVES ANDOPTICS

(Credits:Theory-04,Practicals-02)

Theory: 50Lectures

Wave and optics are two very important topics in Physics. These have direct influence on day to day life of a living being. It is routine in Physics course and requires practice by the students.

Unit-I

Superposition of Collinear Harmonic oscillations: Linearity andSuperpositionPrinciple. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear HarmonicOscillationswith(1)equalphasedifferencesand(2)equalfrequencydifferences. **(4Lectures)**

SuperpositionoftwoperpendicularHarmonicOscillations:GraphicalandAnalyticalMethods.LissajousFigureswithequalanunequalfrequencyandtheiruses.

(2Lectures)

Unit -II

WaveMotion: PlaneandSphericalWaves.LongitudinalandTransverseWaves.PlaneProgressive (Travelling) Waves. Wave Equation. Particle and WaveVelocities.Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. IntensityofWave.WaterWaves:RippleandGravityWaves. **(4Lectures)**

VelocityofWaves: VelocityofTransverseVibrationsofStretchedStrings.VelocityofLongitudinalWavesinaFluidinaPipe.Newton'sFormulaforVelocityofSound.Laplace'sCorrection.

(5Lectures)

Unit III

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in aString:Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changeswithrespect to Position and Time. Energy of Vibrating String. Transfer of Energy.NormalModes of Stretched Strings. Plucked and Struck Strings. Melde'sExperiment.Longitudinal Standing Waves and Normal Modes.**(6Lectures)**

Unit -IV

WaveOptics: Electromagneticnatureoflight.Definitionandpropertiesofwavefront.HuygensPrinciple.TemporalandSpatialCoherence. **(3Lectures)**

Interference: Division of amplitude and wavefront. Young's double slitexperiment.Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes'treatment.InterferenceinThinFilms:parallelandwedge-shapedfilms.Fringesofequalinclination(HaidingerFringes);Fringesofequalthickness(FizeauFringes).Newton'sRings:Measurementofwavelengthandrefractiveindex.

(8Lectures)

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (Notheoryrequired), (2) Determination of Wavelength, (3) Wavelength Difference, (4)RefractiveIndex,and(5)VisibilityofFringes.Fabry-Perotinterferometer. **(4Lectures)**

Unit -V

Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integralformula.(Qualitativediscussiononly) **(2Lectures)**

Fraunhoferdiffraction:Singleslit.Circularaperture,ResolvingPowerofatelescope.Doubleslit.Multiple slits.Diffractiongrating.Resolvingpowerofgrating.**(6 Lectures)**

FresnelDiffraction:Fresnel'sAssumptions.Fresnel'sHalf-PeriodZonesforPlaneWave.ExplanationofRectilinearPropagationofLight.TheoryofaZonePlate:MultipleFoci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge,aslit and awire.

(6Lectures)

Text Book

- Optics, AjoyGhatak, 2008, Tata McGrawHill
- A textbook of Optics, Dr N SubrahmanyamBrijlal, Dr M N Avadhanulu (S Chand)

ReferenceBooks

- Waves:BerkeleyPhysicsCourse,vol.3,FrancisCrawford,2007,TataMcGraw-Hill.
- FundamentalsofOptics,F.A.JenkinsandH.E.White,1981,McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7thEdn., 1999, PergamonPress.
- ThePhysicsofVibrationsandWaves,H.J.Pain,2013,JohnWileyandSons.
- ThePhysicsofWavesandOscillations,N.K.Bajaj,1998,TataMcGrawHill.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R.ChandPublications.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H-PHY- 4:WAVES ANDOPTICS - LAB

1. TodeterminethefrequencyofanelectrictuningforkbyMelde'sexperimentandverify λ^2 –Tlaw.
2. To investigate the motion of coupledoscillators.
3. To study LissajousFigures.
4. Familiarizationwith:Schuster`sfocusing;determinationofangleofprism.
5. TodeterminerefractiveindexoftheMaterialofaprismusingsodiumsource.
6. TodeterminethedispersivepowerandCauchyconstantsofthematerialofaprism using mercurysource.
7. TodeterminethewavelengthofsodiumsourceusingMichelson'sinterferometer.
8. TodeterminewavelengthofsodiumlightusingFresnelBiprism.
9. TodeterminewavelengthofsodiumlightusingNewton'sRings.
10. Todeterminethethicknessofathinpaperbymeasuringthewidthoftheinterference fringes produced by a wedge-shapedFilm.
11. Todeterminewavelengthof(1)Nasourceand(2)spectrallinesofHgsourceusing plane diffractiongrating.
12. Todeterminedispersivepowerandresolvingpowerofaplanediffractiongrating.

ReferenceBooks

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971,AsiaPublishingHouse
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11thEd.,2011,KitabMahal
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4thEdition,reprinted 1985, Heinemann EducationalPublishers
- ALaboratoryManualofPhysicsforundergraduateclasses,D.P.Khandelwal,1985,VaniPub.

SemesterIII

DSC-H- PHY-5 : MATHEMATICALPHYSICS-II
(Credits:Theory-04,Practicals-02)
Theory: 50Lectures

The emphasis of this course is to provide some mathematical methods/tools which are required to understand the various phenomena of nature. These mathematical methods are routine in Physics course and requires practice by the students.

Unit-I

FourierSeries:Periodicfunctions.Orthogonalityofsineandcosinefunctions,DirichletConditions(Statementonly).Expansionofperiodicfunctionsinaseriesofsineandcosine functions and determination of Fourier coefficients. Complex representationofFourier series. Expansion of functions with arbitrary period. Expansion ofnon-periodicfunctions over an interval. Even and odd functions and their Fourierexpansions.Application. Summing of Infinite Series. Term-by-Term differentiation andintegrationofFourierSeries.ParsevalIdentity.

(10Lectures)

Unit -II

Frobenius Method and Special Functions: Singular Points of Second OrderLinearDifferential Equations and their importance. Frobenius method and its applicationstodifferential equations. Legendre, Bessel, Hermite and Laguerre DifferentialEquations.Properties of Legendre Polynomials: Rodrigues Formula, GeneratingFunction,Orthogonality. Simple recurrence relations. Expansion of function in a seriesofLegendrePolynomials.BesselFunctionsoftheFirstKind:GeneratingFunction,simplerecurrencerelations.

(20 Lectures)

Unit -III

SomeSpecialIntegrals: BetaandGammaFunctionsandRelationbetweenthem.ExpressionofIntegralsintermsofGammaFunctions.ErrorFunction(ProbabilityIntegral). **(4Lectures)**

Unit -IV

TheoryofErrors: SystematicandRandomErrors.PropagationofErrors.NormalLawof Errors. Standard and Probable Error. Least-squares fit. Error on the slopeandinterceptofafittedline.

(6Lectures)

Unit -V

Partial Differential Equations: Solutions to partial differential equations,usingseparation of variables: Laplace's Equation in problems of rectangular, cylindricalandsphericalsymmetry.

(10Lectures)

Text Books

- MathematicalMethodsforPhysicists:Arfken,Weber,2005,Harris,Elsevier.
- **Advanced Engineering Mathematics, Erwin Kreyszig, 2008, WileyIndia.**

ReferenceBooks:.

- Fourier Analysis by M.R. Spiegel, 2004, TataMcGraw-Hill.

- MathematicsforPhysicists,SusanM.Lea,2004,ThomsonBrooks/Cole.
- Differential Equations, George F. Simmons, 2006, TataMcGraw-Hill.
- PartialDifferentialEquationsforScientists&Engineers,S.J.Farlow,1993,DoverPub.
- EngineeringMathematics,S.PalandS.C.Bhunia,2015,OxfordUniversityPress
- MathematicalmethodsforScientists&Engineers,D.A.McQuarrie,2003,VivaBooks

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Scheme of Examination:

Duration: 2 Hours

Marks: 50

Six problems to be solved out of eight problems/proofs (2 from each units)

DSC-H- PHY- 5: MATHEMATICALPHYSICS-II - LAB

The aim of this Lab is to use the computational methods to solve physicalproblems.Coursewillconsistoflectures(boththeoryandpractical)intheLab.Evaluationdonenotontheprogrammingbutonthebasisofformulatingtheproblem

Topics	**Description withApplications**
Introduction to NumericalcomputationsoftwareScilab	Introduction to Scilab, Advantages anddisadvantages,Scilab environment, Command window,Figurewindow,Editwindow,Variablesa ndarrays,Initialisingvariables in Scilab, Multidimensional arrays,Subarray,Special values, Displaying output data, data file,Scalarand array operations, Hierarchy of operations, BuiltinScilab functions, Introduction to plotting, 2D and3Dplotting (2), Branching Statements and programdesign,Relational & logical operators, the while loop, forloop,details of loop operations, break & continuestatements,nested loops, logical arrays and vectorization (2)Userdefined functions, Introduction to Scilabfunctions,Variable passing in Scilab, optionalarguments,preserving data between calls to a function,Complexand Character data, string function,Multidimensionalarrays (2) an introduction to Scilab file processing,fileopening and closing, Binary I/o functions,comparingbinaryandformattedfunctio ns Numericalmethodsanddevelopingtheskillsof
Curvefitting,Leastsquarefit,Goodness offit,standarddeviation	OhmslawtocalculateR,Hooke'slawtocalculatespr ing
SolutionofLinearsystemofequations byGausseliminationmethodandGaussSe idal method. Diagonalizationofmatrices,Inverseofa matrix,Eigenvectors,eigenvaluesproble	Solutionofmeshequationsofelectriccircuits(3mesh es)Solutionofcoupledspringmasssystems(3masses)
GenerationofSpecialfunctionsusing UserdefinedfunctionsinScilab	GeneratingandplottingLegendrePolynomialsGen eratingandplottingBesselfunction

Solution ofODE First order Differential equationEuler,modifiedEulerandRunge -Kuttasecondordermethods Secondorderdifferentialequation Fixeddifferencemethod	Firstorderdifferentialequation • Radioactivedecay • Current in RC, LC circuits with DCsource • Newton's law ofcooling • Classical equations ofmotionSecond order DifferentialEquation • Harmonic oscillator (nofriction) • Damped Harmonicoscillator • Overdamped • Criticaldamped • Oscillatory • Forced Harmonicoscillator • Transientand • Steady statesolution • Apply above to LCR circuitsalso • Solve $x^2 \frac{d^2y}{dx^2} - 4x(1+x)\frac{dy}{dx} + 2(1+x)y = x^3$ with the boundary conditionsat $x = 1, y = \frac{1}{2}e^2, \frac{dy}{dx} = -\frac{3}{2}e^2 - 0.5,$ *in the range 1* ? ?. Plot y and $\frac{dy}{dx}$ against x inthe givenrangeonthesamegraph.
Partial differentialequations	PartialDifferentialEquation: • Wave equation • Heatequation • Poissonequation • Laplaceequation
UsingScicos/xcos	• Generatingsquarewave,sinewave,sawtoothwave • Solution to harmonicoscillator • Study of beatphenomenon

ReferenceBooks:

- MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.HobsonandS.J.Bence, 3rded., 2006, Cambridge UniversityPress
- Complex Variables, A.S. Fokas& M.J. Ablowitz, 8thEd., 2011, Cambridge Univ.Press
- First course in complex analysis with applications, D.G. Zill and P.D.Shanahan,1940, Jones &Bartlett
- Computational Physics, D.Walker, 1stEdn., 2015, Scientific International Pvt.Ltd.
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rdEdn.,Cambridge UniversityPress
- SimulationofODE/PDEModelswithMATLAB®,OCTAVEandSCILAB:ScientificandEngineeringApplications:A.V.Wouwer,P.Saucez,C.V.Fernández.2014Springer
- Scilab by example: M. Affouf 2012, ISBN:978-1479203444
- Scilab(AfreesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand&Company
- ScilabImageProcessing:LambertM.Surhone.2010BetascriptPublishing
- www.**scilab**.in/textbook_companion/generate_book/291

DSC-H- PHY- 6: THERMALPHYSICS
(Credits: Theory-04,Practicals-02)
Theory: 50Lectures

Thermal physics, the combined study of thermodynamics, statistical mechanics, and kinetic theory, has played an important role in the development of our current technology and hence is a routine in Physics course and requires practice by the students.

Unit-I

Introduction toThermodynamics

ZerothandFirstLawofThermodynamics:ExtensiveandintensiveThermodynamicVariables,ThermodynamicEquilibrium,ZerothLawofThermodynamics&ConceptofTemperature,ConceptofWork&Heat,StateFunctions,FirstLawofThermodynamicsanditsdifferentialform,InternalEnergy,FirstLaw&variousprocesses,ApplicationsofFirstLaw:GeneralRelationbetween$C_P$andC_V,WorkDoneduringIsothermalandAdiabaticProcesses,CompressibilityandExpansionCo-efficient.**(8Lectures)**

Unit -II

SecondLawofThermodynamics:ReversibleandIrreversibleprocesswithexamples.ConversionofWorkintoHeatandHeatintoWork.HeatEngines.Carnot'sCycle,Carnotengine&efficiency.Refrigerator&coefficientofperformance,2nd LawofThermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence.
Carnot's Theorem. Applications of Second Law of Thermodynamics:**(7Lectures)**

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second LawofThermodynamicsintermsofEntropy.EntropyofaperfectgasPrincipleofIncreaseofEntropy. Entropy Changes in Reversible and Irreversible processes withexamples.Entropy of the Universe. Entropy Changes in Reversible and IrreversibleProcesses.Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot'sCycle.ThirdLawofThermodynamics.UnattainabilityofAbsoluteZero.
(7Lectures)

Unit -III

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy,Enthalpy,Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties andApplications. MagneticWork,Coolingduetoadiabaticdemagnetization,FirstandsecondorderPhaseTransitionswithexamples,ClausiusClapeyronEquationandEhrenfestequations
(6Lectures)

Maxwell's Thermodynamic Relations: Derivations and applications ofMaxwell'sRelations, Maxwell's Relations:(1) ClausiusClapeyron equation, (2) Values ofC_p-C_v,TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases,(5)Energyequations,(6)ChangeofTemperatureduringAdiabaticProcess.
(5Lectures)

Unit -IV

KineticTheoryofGases

DistributionofVelocities:Maxwell-BoltzmannLawofDistributionofVelocitiesinanIdeal Gas and its Experimental Verification. Doppler Broadening of Spectral LinesandStern'sExperiment.Mean,RMSandMostProbableSpeeds.DegreesofFreedom.LawofEquipartitionofEnergy(Noproofrequired).SpecificheatsofGases.
(6Lectures)

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of MeanFreePath. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity**(3Lectures)**

Unit -V

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation.TheVirial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. ContinuityofLiquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van derWaal'sEquation of State for Real Gases. Values of Critical Constants. Law ofCorrespondingStates.ComparisonwithExperimentalCurves.P-VDiagrams.Joule'sExperiment.FreeAdiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment.Joule-ThomsonEffectforRealandVanderWaalGases.TemperatureofInversion.Joule-ThomsonCooling. **(8Lectures)**

Text Books

- HeatandThermodynamics,M.W.Zemansky,RichardDittman,1981,McGraw-Hill.
- Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, TataMcGraw-Hill
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger.1988,Narosa.

ReferenceBooks:

- ATreatiseonHeat,MeghnadSaha,andB.N.Srivastava,1958,IndianPress
- ModernThermodynamicswithStatisticalMechanics,CarlS.Helrich,2009,Springer.
- ConceptsinThermalPhysics,S.J.BlundellandK.M.Blundell,2nd Ed.,2012,Oxford UniversityPress
- ThermalPhysics,A.KumarandS.P.Taneja,2014,R.ChandPublications.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 6: THERMALPHYSICS - LAB

1. TodetermineMechanicalEquivalentofHeat,J,byCallenderandBarne'sconstant flowmethod.
2. TodeterminetheCoefficientofThermalConductivityofCubySearle'sApparatus.
3. TodeterminetheCoefficientofThermalConductivityofCubyAngstrom'sMethod.
4. TodeterminetheCoefficientofThermalConductivityofabadconductorbyLeeand Charlton's discmethod.
5. TodeterminetheTemperatureCoefficientofResistancebyPlatinumResistanceTherm ometer(PRT).
6. TostudythevariationofThermo-EmfofaThermocouplewithDifferenceofTemperature of its TwoJunctions.
7. To calibrate a thermocouple to measure temperature in a specified Rangeusing (1) Null Method, (2) Direct measurement using Op-Amp differenceamplifierand to determine NeutralTemperature.

ReferenceBooks

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishingHouse
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11th Ed.,2011,KitabMahal
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4th Edition,reprinted 1985, Heinemann EducationalPublishers
- ALaboratoryManualofPhysicsforundergraduateclasses,D.P.Khandelwal,1985,VaniPub.

DSC-H- PHY- 7: DIGITAL SYSTEMS AND APPLICATIONS
(Credits:Theory-04,Practicals-02)
Theory: 50Lectures

Digital systems and applications have important applications in virtually all fields of human activity and have a global influence on the performance of modern society. So it is necessary to include the basic knowledge of it as a routine in Physics course and it requires practice by the students.

Unit -I

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection SystemandTime Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform,(2)MeasurementofVoltage,Current,Frequency,andPhaseDifference. **(3Lectures)**

Integrated Circuits (Qualitative treatment only): Active & Passivecomponents.Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scaleofintegration:SSI,MSI,LSIandVLSI(basicideaanddefinitionsonly).ClassificationofICs .ExamplesofLinearandDigitallCs. **(3Lectures)**

Timers:IC555:blockdiagramandapplications:AstablemultivibratorandMonostablemultivibrator. **(3Lectures)**

Unit II

Digital Circuits: Difference between Analog and Digital Circuits. BinaryNumbers.Decimal to Binary and Binary to Decimal Conversion. BCD, Octal andHexadecimalnumbers. AND, OR and NOT Gates (realization using Diodes and Transistor).NANDand NOR Gates as Universal Gates. XOR and XNOR Gates and application asParityCheckers. **(6Lectures)**

Unit-III

Booleanalgebra: DeMorgan'sTheorems.BooleanLaws.SimplificationofLogicCircuitusingBooleanAlgebra.FundamentalProducts.IdeaofMintermsandMaxterms.ConversionofaTruthtableintoEquivalentLogicCircuitby(1)SumofProductsMethod. **(5Lectures)**

Data processing circuits: Basic idea of Multiplexers, De-multiplexers,Decoders,Encoders. **(4Lectures)**

ArithmeticCircuits: BinaryAddition.BinarySubtractionusing2'sComplement.HalfandFull Adders.Half&FullSubtractors,4-bitbinaryAdder/Subtractor. **(5Lectures)**

Unit-IV

Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and EdgeTriggered)Flip-Flops.PresetandClearoperations.Race-aroundconditionsinJKFlip-Flop.M/SJKFlip-Flop. **(6Lectures)**

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-outandParallel-in-Parallel-outShiftRegisters(onlyupto4bits). **(2Lectures)**

Unit-V

ComputerOrganization:Input/OutputDevices.Datastorage(ideaofRAMandROM).Computer memory. Memory organization & addressing. **(4Lectures)**

Intel 8085 Microprocessor Architecture: Main features of 8085. Blockdiagram.Components.Pin-outdiagram.Buses.Registers.ALU.Memory.Stackmemory.Timing &Controlcircuitry.Timingstates. **(5Lectures)**

IntroductiontoAssemblyLanguage:1byte,2byte&3byteinstructions. **(4Lectures)**

Text Books

- Electronics Devices and circuit theory, Robert L. Boylestad, Pearson (10th edition)
- DigitalPrinciplesandApplications,A.P.Malvino,D.P.LeachandSaha, 7thEd.,2011, TataMcGraw
- Microprocessors and Microcontrollers by N.Senthil Kumar, M.Saravanan, and S.Jeevananthan,

ReferenceBooks:

- DigitalPrinciplesandApplications,A.P.Malvino,D.P.LeachandSaha, 7thEd.,2011, TataMcGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2ndEdn, 2009, PHI Learning Pvt.Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGrawHill.
- Digital Electronics G K Kharate ,2010, Oxford UniversityPress
- DigitalSystems:Principles&Applications,R.J.Tocci,N.S.Widmer,2001,PHILearning
- Logic circuit design, Shimon P. Vingron, 2012,Springer.
- Digital Electronics, SubrataGhoshal, 2012, CengageLearning.
- Digital Electronics, S.K. Mandal, 2010, 1stedition, McGrawHill
- Microprocessor Architecture Programming & applications with 8085, 2002,R.S.Goankar, PrenticeHall.

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 7: DIGITAL SYSTEMS AND APPLICATIONS - LAB

1. Tomeasure(a)Voltage,and(b)TimeperiodofaperiodicwaveformusingCRO.
2. To test a Diode and Transistor using aMultimeter.
3. To design a switch (NOT gate) using atransistor.
4. ToverifyanddesignAND,OR,NOTandXORgatesusingNANDgates.
5. Todesignacombinationallogicsystemforaspecified TruthTable.
6. ToconvertaBooleanexpressionintologiccircuitanddesignitusinglogicgateICs.
7. To minimize a given logiccircuit.
8. Half Adder, Full Adder and 4-bit binaryAdder.
9. HalfSubtractor,FullSubtractor,Adder-SubtractorusingFullAdderI.C.
10. TobuildFlip-Flop(RS,ClockedRS,D-typeandJK)circuitsusingNANDgates.
11. To build JK Master-slave flip-flop using Flip-FlopICs
12. Tobuilda4-bitCounterusingD-type/JKFlip-FlopICsandstudytimingdiagram.
13. Tomakea4-bitShiftRegister(serialandparallel)usingD-type/JKFlip-FlopICs.
14. Todesignanastablemultivibratorofgivenspecificationsusing555Timer.
15. Todesignamonostablemultivibratorofgivenspecificationsusing555Timer.
16. Write the following programs using 8085Microprocessor
    a) Additionandsubtractionofnumbersusingdirectaddressingmode
    b) Additionandsubtractionofnumbersusingindirectaddressingmode
    c) Multiplication by repeatedaddition.
    d) Division by repeatedsubtraction.
    e) Handling of 16-bitNumbers.
    f) Use of CALL and RETURNInstruction.
    g) Block datahandling.
    h) Other programs (e.g. Parity Check, using interrupts,etc.).

ReferenceBooks:

- Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGrawHill.
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller,1994,Mc-GrawHill.
- Microprocessor Architecture Programming and applications with 8085,R.S.Goankar, 2002, PrenticeHall.
- Microprocessor 8085:Architecture, Programming and interfacing, A.Wadhwa,2010, PHILearning.

SemesterIV

DSC-H- PHY- 8: MATHEMATICALPHYSICS-III
(Credits:Theory-04,Practicals-02)Theory: 50Lectures

The emphasis of this course is to provide some mathematical methods/tools which are required to understand the various phenomena of nature. These mathematical methods are routine in Physics course and requires practice by the students.

Unit-I

Complex Analysis: Brief Revision of Complex Numbers and theirGraphicalRepresentation. Euler's formula, De Moivre's theorem, Roots of ComplexNumbers.Functions of Complex Variables. Analyticity and Cauchy-RiemannConditions.Examples of analytic functions. Singular functions: poles and branch points, orderofsingularity,branchcuts.

(13 Lecturers)

Unit-II

Integrationofafunctionofacomplexvariable.Cauchy'sInequality. Cauchy's Integral formula. Simply and multiply connected region.**(6 Lectures)**

Unit-III

Laurentand Taylor's expansion. Residues and Residue Theorem. Application insolvingDefiniteIntegrals.

(7Lectures)

Unit-IV

IntegralsTransforms:

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples.Fouriertransform of trigonometric, Gaussian, finite wave train & otherfunctions.RepresentationofDiracdeltafunctionasaFourierIntegral.Fouriertransform ofderivatives, Inverse Fourier transform, Convolution theorem. Properties ofFouriertransforms (translation, change of scale, complex conjugation, etc.). ThreedimensionalFouriertransformswithexamples. **(12 Lectures)**

Unit -V

Laplace Transforms: Laplace Transform (LT) of Elementary functions. PropertiesofLTs: Change of Scale Theorem, Shifting Theorem. LTs of $1^{st}$and 2^{nd}orderDerivativesand Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Stepfunction,Dirac Delta function, Periodic Functions. Convolution Theorem. InverseLT.Application of Laplace Transforms to 2^{nd}order Differential Equations:DampedHarmonic Oscillator, Simple Electrical Circuits. **(12Lectures)**

Text Books

- MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.HobsonandS.J.Benc e, 3rd ed., 2006, Cambridge UniversityPress
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, WileyIndia.

ReferenceBooks:

- MathematicsforPhysicists,P.DenneryandA.Krzywicki,1967,DoverPublications
- Complex Variables, A.S.Fokas&M.J.Ablowitz, 8thEd., 2011, Cambridge Univ.Press
- Complex Variables, A.K. Kapoor, 2014, Cambridge Univ.Press
- ComplexVariablesandApplications,J.W.Brown&R.V.Churchill,7thEd.2003,TataMcGr aw-Hill
- First course in complex analysis with applications, D.G. Zill and P.D.Shanahan,1940, Jones &Bartlett

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Scheme of Examination:

Duration: 2 Hours

Marks: 50

Six problems/proofs to be solved out of 8 problems/proofs asked (2 from each units)

DSC-H- PHY- 8: MATHEMATICALPHYSICS-III - LAB

Scilab/C++ based simulations experiments based on Mathematical Physicsproblemslike

1. Solve differentialequations:

   dy/dx = e^{-x} with y = 0 for x =0dy/dx

   + $e^{-x}y = x^2$

   $d^2y/dt^2+2dy/dt=-yd^2y/dt^2$

   + e^{-t}dy/dt =-y

2. Dirac DeltaFunction:

   Evaluate $\frac{1}{\sqrt{27r()^2}} f e^{\frac{-(x-2)^2}{20"^2}} (x+3)dx$, for a = 1, 0.1,0.01andshowit tends to5.

3. FourierSeries:

   Program to sum $\sum_{n=1}^{oo} (0.2)^n$

   EvaluatetheFouriercoefficientsofagivenperiodicfunction(squarewave)

4. Frobenius method and Specialfunctions:

   $f_{-1}^{+1} P_n(\mu)P_m(\mu)d\mu = o_{n,m}$

   Plot $P_n(x), j_v(x)$

   Showrecursionrelation

5. Calculation of error for each data point of observations recorded inexperimentsdone in previous semesters (choose anytwo).

6. Calculation of least square fitting manually without giving weightage toerror.Confirmationofleastsquarefittingofdatathroughcomputerprogram.

7. Evaluationoftrigonometricfunctionse.g.$sin\theta$,GivenBessel'sfunctionatNpoints find its value at an intermediate point. Complex analysis:Integrate$1/(x^2+2)$ numerically and check with computerintegration.

8. Compute the n^{th}roots of unity for n = 2, 3, and4.

9. Find the two square roots of$-5+12j$.

10. Integral transform: FFT ofe^{-x^2}

11. SolveKirchoff'sCurrentlawforanynodeofanarbitrarycircuitusingLaplace'stransform.

12. SolveKirchoff'sVoltagelawforanyloopofanarbitrarycircuitusingLaplace'stransform.

13. PerformcircuitanalysisofageneralLCRcircuitusingLaplace'stransform.

ReferenceBooks:

- MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.HobsonandS.J.Bence, 3rded., 2006, Cambridge UniversityPress
- MathematicsforPhysicists,P.DenneryandA.Krzywicki,1967,DoverPublications
- SimulationofODE/PDEModelswithMATLAB®,OCTAVEandSCILAB:Scientificand EngineeringApplications:A.VandeWouwer,P.Saucez,C.V.Fernández. 2014 Springer ISBN:978-3319067896
- AGuidetoMATLAB,B.R.Hunt,R.L.Lipsman,J.M.Rosenberg,2014,3rdEdn.,Cambridge UniversityPress
- Scilab by example: M. Affouf, 2012. ISBN:978-1479203444
- Scilab(AfreesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand&Company
- ScilabImageProcessing:LambertM.Surhone.2010BetascriptPublishing
- https://web.stanford.edu/~boyd/ee102/**laplace**_ckts.pdf
- ocw.nthu.edu.tw/ocw/upload/12/244/12handout.pdf

DSC-H- PHY- 9: ELEMENTS OF MODERN PHYSICS
(Credits:Theory-04,Practicals-02)Theory: 50Lectures

Modern physics, the post-Newtonian conception of physics, implies that classical descriptions of phenomena are not able to describe various physical phenomena and "modern", description of nature requires to understand these theories.In a literal sense, the term *modern physics*, means up-to-date physics and is *routine in Physics course and requires practice by the students.*

Unit-I

Planck'squantum,Planck'sconstantandlightasacollectionofphotons;BlackbodyRadiation: Quantum theory of Light; Photo-electric effect and Compton scattering.DeBrogliewavelengthandmatterwaves;Davisson-Germerexperiment.Wavedescriptionofparticlesbywavepackets.GroupandPhasevelocitiesandrelationbetweenthem.Two-Slitexperimentwithelectrons.Probability.Waveamplitudeandwavefunctions.

(14Lectures)

Unit-II

Wave-particleduality,Heisenberguncertaintyprinciple(UncertaintyrelationsinvolvingCanonicalpairofvariables):DerivationfromWavePacketsimpossibilityofaparticlefollowingatrajectory; Estimating minimum energy of a confined particle usinguncertaintyprinciple;Energy-timeuncertaintyprinciple-applicationtovirtualparticlesandrangeofaninteraction.

(4Lectures)

Twoslitinterferenceexperimentwithphotons,atomsandparticles;linearsuperpositionprincipleasaconsequence;Matterwavesandwaveamplitude;Schrodingerequationfornon-relativistic particles; Momentum and Energy operators; stationary states;physicalinterpretationofawavefunction,probabilitiesandnormalization;Probabilityanddprobabilitycurrentdensitiesinonedimension. **(8Lectures)**

Unit-III

One dimensional infinitely rigid box- energy eigenvalues andeigenfunctions,normalization;Quantumdotasexample;Quantummechanicalscatteringandtunnellinginonedimension-acrossasteppotential&rectangularpotentialbarrier.

(6Lectures)

UNIT-IV

Sizeandstructureofatomicnucleusanditsrelationwithatomicweight;Impossibilityofanelectronbeinginthenucleusasaconsequenceoftheuncertaintyprinciple.Natureofnuclearforce,NZgraph,LiquidDropmodel:semi-empiricalmassformulaandbindingenergy. **(6 Lectures)**

Radioactivity:stabilityofthenucleus;Lawofradioactivedecay;Meanlifeandhalf-life;Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction ofneutrino;Gamma ray emission. **(6Lectures)**

UNIT-V

Fission and fusion- mass deficit, relativity and generation of energy; Fission - natureoffragmentsandemissionofneutrons.Nuclearreactor:slowneutronsinteractingwithUranium 235. **(3Lectures)**

Lasers: Einstein'sAandBcoefficients.Metastablestates.SpontaneousandStimulatedemissions. Optical Pumping and Population Inversion. **(3Lectures)**

Text Books

- Quantum Mechanics, NouredineZettli, 2nd edition, (Wiley)
- IntroductiontoQuantumMechanics,DavidJ.Griffith,2005,(PearsonEducation)
- Nuclear Physics, S. N. Ghosal (S.Chand)
- Nuclear Physics, D.C. Tayal (Himalaya Publishing House)

ReferenceBooks:

- Concepts of Modern Physics, Arthur Beiser, 2002,McGraw-Hill.
- IntroductiontoModernPhysics,RichMeyer,Kennard,Coop,2002,TataMcGrawHill
- PhysicsforscientistsandEngineerswithModernPhysics,JewettandSerway,2010, CengageLearning.
- Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGrawHill
- QuantumMechanics:Theory&Applications,A.K.Ghatak&S.Lokanathan,2004,Macmillan
- ModernPhysics,J.R.Taylor,C.D.Zafiratos,M.A.Dubson,2004,PHILearning.
- Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau andW.Savin, 2ndEdn, Tata McGraw-Hill Publishing Co.Ltd.
- QuantumPhysics,BerkeleyPhysics,Vol.4.E.H.Wichman,1971,TataMcGraw-HillCo.
- BasicideasandconceptsinNuclearPhysics,K.Heyde,3rdEdn.,InstituteofPhysicsPub.
- SixIdeasthatShapedPhysics:ParticleBehavelikeWaves,T.A.Moore,2003,McGrawHill

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 9: ELEMENTS OF MODERN PHYSICS - LAB

1. MeasurementofPlanck'sconstantusingblackbodyradiationandphoto-detector
2. Photo-electric effect: photo current versus intensity and wavelength oflight;maximum energy of photo-electrons versus frequency oflight
3. To determine work function of material of filament of directly heatedvacuumdiode.
4. TodeterminethePlanck'sconstantusingLEDsofatleast4differentcolours.
5. TodeterminethewavelengthofH-alphaemissionlineofHydrogenatom.
6. To determine the ionization potential ofmercury.
7. Todeterminetheabsorptionlinesintherotationalspectrumof Iodinevapour.
8. Todeterminethevalueofe/mby(a)Magneticfocusingor(b)Barmagnet.
9. TosetuptheMillikanoildropapparatusanddeterminethechargeofanelectron.
10. Toshowthetunnelingeffectintunneldiodeusing I-Vcharacteristics.
11. Todeterminethewavelengthoflasersourceusingdiffractionofsingleslit.
12. Todeterminethewavelengthoflasersourceusingdiffractionofdoubleslits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser usingplanediffractiongrating

ReferenceBooks

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971,AsiaPublishingHouse
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4thEdition,reprinted 1985, Heinemann EducationalPublishers
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11thEdn,2011,KitabMahal

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DSC-H- PHY- 10: ANALOG SYSTEMS AND APPLICATIONS
(Credits:Theory-04,Practicals-02)Theory: 50Lectures

Analog systems and applications have important applications in all fields of human activity and have a global influence on the performance of modern society.. So it is necessary to include the basic knowledge of it as a routine in Physics course .It requires practice by the students.

Unit-I

Semiconductor Diodes: P and N type semiconductors. Energy LevelDiagram.Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication(SimpleIdea).BarrierFormationinPNJunctionDiode.StaticandDynamic Resistance.CurrentFlow Mechanism in Forward and Reverse Biased Diode. Drift Velocity.
DerivationforBarrierPotential,BarrierWidthandCurrentforStepJunction.CurrentFlowMechanisminForwardandReverseBiasedDiode. **(10Lectures)**

Unit-II

Two-terminal Devices and their Applications: (1) Rectifier Diode:Half-waveRectifiers.Centre-tappedandBridgeFull-waveRectifiers,CalculationofRippleFactorandRectificationEfficiency,C-filter(2)ZenerDiodeandVoltageRegulation.Principleandstructureof(1)LEDs,(2)Photodiodeand(3)SolarCell
(6Lectures)

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB,CEandCCConfigurations.CurrentgainsαandβRelationsbetweenαandβ.LoadLine analysisofTransistors.DCLoadlineandQ-point.PhysicalMechanismofCurrentFlow.Active,CutoffandSaturationRegions.**(6Lectures)**

Unit - III

Amplifiers: TransistorBiasingandStabilizationCircuits.FixedBiasandVoltageDividerBias.Transistoras2-portNetwork.h-parameterEquivalentCircuit.Analysisofasingle-stageCEamplifierusingHybridModel.InputandOutputImpedance.Current,VoltageandPowerGains.ClassificationofClassA,B&CAmplifiers. **(8Lectures)**

Coupled Amplifier: Two stage RC-coupled amplifier and its frequencyresponse. **(3Lectures)**

Unit-IV

Feedback in Amplifiers: Effects of Positive and Negative Feedback onInputImpedance,OutputImpedance,Gain,Stability.
(3Lectures)

SinusoidalOscillators: Barkhausen'sCriterionforself-sustainedoscillations.RCPhaseshiftoscillator,determinationofFrequency.Hartley&Colpittsoscillators.**(4Lectures)**

Unit-V

Operational Amplifiers (Black Box approach): Characteristics of an IdealandPractical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. FrequencyResponse.CMRR.SlewRateandconceptofVirtualground. **(4Lectures)**

Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder,(3)Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zerocrossingdetector(8)Weinbridgeoscillator. **(8Lectures)**

Text Books

- Electronics Devices and circuit theory, Robert L. Boylestad, Pearson (10th edition)
- IntegratedElectronics,J.MillmanandC.C.Halkias,1991,TataMc-GrawHill.

ReferenceBooks:

- Electronics:FundamentalsandApplications,J.D.Ryder,2004,PrenticeHall.
- Solid State Electronic Devices, B.G.Streetman&S.K.Banerjee, 6thEdn.,2009, PHILearning
- Electronic Devices & circuits, S.Salivahanan&N.S.Kumar, 3rdEd., 2012, Tata Mc-GrawHill
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4thedition, 2000, PrenticeHall
- Microelectroniccircuits,A.S.Sedra,K.C.Smith,A.N.Chandorkar,2014,6thEdn.,Oxford UniversityPress.
- Electroniccircuits:Handbookofdesign&applications,U.Tietze,C.Schenk,2008,Springer
- Semiconductor Devices: Physics and Technology, S.M. Sze, 2ndEd., 2002, WileyIndia
- Microelectronic Circuits, M.H. Rashid, 2ndEdition, CengageLearning
- Electronic Devices, 7/e Thomas L. Floyd, 2008, PearsonIndia

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Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 10: ANALOG SYSTEMS AND APPLICATIONS – LAB

1. TostudyV-IcharacteristicsofPNjunctiondiode,andLightemittingdiode.
2. TostudytheV-IcharacteristicsofaZenerdiodeanditsuseasvoltageregulator.
3. StudyofV-I&powercurvesofsolarcells,andfindmaximumpowerpoint&efficiency.
4. TostudythecharacteristicsofaBipolarJunctionTransistorinCEconfiguration.
5. TostudythevariousbiasingconfigurationsofBJTfornormalclassAoperation.
6. TodesignaCEtransistoramplifierofagivengain(mid-gain)usingvoltagedividerbias.
7. Tostudythefrequencyresponseofvoltagegainofa RC-coupledtransistoramplifier.
8. TodesignaWienbridgeoscillatorforgivenfrequencyusinganop-amp.
9. Todesignaphaseshiftoscillatorofgivenspecificationsusing BJT.
10. To study the Colpitt`soscillator.
11. Todesignadigitaltoanalogconverter(DAC)ofgivenspecifications.
12. To study the analog to digital convertor (ADC)IC.
13. Todesignaninvertingamplifierusing Op-amp(741,351)fordcvoltageofgivengain
14. Todesigninvertingamplifierusing Op-amp(741,351)andstudyitsfrequencyresponse
15. Todesignnon-invertingamplifierusing Op-amp(741,351)&studyitsfrequencyresponse
16. To study the zero-crossing detector andcomparator
17. Toaddtwodcvoltagesusing Op-ampininvertingandnon-invertingmode
18. TodesignaprecisionDifferentialamplifierofgivenI/OspecificationusingOp-amp.
19. To investigate the use of an op-amp as anIntegrator.
20. To investigate the use of an op-amp as aDifferentiator.
21. Todesignacircuittosimulatethesolutionofa1st/2ndorderdifferentialequation.

ReferenceBooks:

- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller,1994,Mc-GrawHill.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, PrenticeHall.
- Electronic Principle, Albert Malvino, 2008, Tata Mc-GrawHill.
- ElectronicDevices&circuitTheory,R.L.Boylestad&L.D.Nashelsky,2009,Pearson

SemesterV

DSC-H- PHY- 11: QUANTUM MECHANICS AND APPLICATIONS (Credits:Theory-04,Practicals-02)Theory: 50Lectures

Quantum mechanics and its applications are required to understand the various physical phenomena. These are very important part of modern physics and hence, are routine in Physics course and requires practice by the students.

Unit -I

Time dependent Schrodinger equation: Time dependent Schrodinger equationanddynamical evolution of a quantum state; Properties of Wave Function. InterpretationofWave Function Probability and probability current densities in threedimensions;ConditionsforPhysicalAcceptabilityofWaveFunctions.Normalization.LinearityandSuperposition Principles. Eigenvalues and Eigenfunctions. Position, momentumandEnergyoperators;commutatorofpositionandmomentumoperators;Expectationvaluesofpositionandmomentum.WaveFunctionofaFreeParticle. **(6Lectures)**

Unit-II

Time independent Schrodinger equation-Hamiltonian, stationary states andenergyeigenvalues; expansion of an arbitrary wavefunction as a linear combination ofenergyeigenfunctions;GeneralsolutionofthetimedependentSchrodingerequationintermsoflinearcombinationsofstationarystates;ApplicationtospreadofGaussianwave-packetfor a free particle in one dimension; wave packets, Fourier transforms andmomentumspace wavefunction; Position-momentum uncertainty principle. **(8Lectures)**

Generaldiscussionofboundstatesinanarbitrarypotential-continuityofwavefunction, boundary condition and emergence of discrete energy levels; applicationtoone-dimensionalproblem-squarewellpotential;Quantummechanicsofsimpleharmonicoscillator-energy levels and energy eigenfunctions using Frobenius method;Hermitepolynomials;groundstate,zeropointenergy&uncertaintyprinciple.
(8Lectures)

Unit-III

Quantum theory of hydrogen-like atoms: time independent Schrodinger equationinspherical polar coordinates; separation of variables for second order partialdifferentialequation;angularmomentumoperator&quantumnumbers;Radialwavefunctionsfrom Frobenius method; shapes of the probability densities for ground & first excitedstates;Orbitalangularmomentumquantumnumberslandm;s,p,d,..shells.
(8Lectures)

Unit-IV

Atoms in Electric & Magnetic Fields: Electron angular momentum.Spacequantization.ElectronSpinandSpinAngularMomentum.Larmor'sTheorem.SpinMagnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: ElectronMagneticMomentandMagneticEnergy,GyromagneticRatioandBohrMagneton.
(8Lectures)

AtomsinExternalMagneticFields:-
NormalandAnomalousZeemanEffect.PaschenBackandStarkEffect(QualitativeDiscussion only). **(4Lectures)**

Unit - V

Manyelectronatoms:Pauli'sExclusionPrinciple.Symmetric&AntisymmetricWaveFunctions. Periodic table. Fine structure. Spin orbit coupling. Spectral NotationsforAtomic States. Total angular momentum. Vector Model. Spin-orbit coupling inatoms-L-SandJ-Jcouplings.Hund'sRule.Termsymbols.SpectraofHydrogenandAlkaliAtoms (Naetc.).

(8Lectures)

Text Books

- Quantum Mechanics, NouredineZettili, 2nd edition, 2016,Wiley
- ATextbookofQuantumMechanics,P.M.MathewsandK.Venkatesan,2nd Ed.,2010, McGrawHill
- Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, PearsonEducation

ReferenceBooks:

- ATextbookofQuantumMechanics,P.M.MathewsandK.Venkatesan,2nd Ed.,2010, McGrawHill
- Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002,Wiley.
- Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGrawHill.
- Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning ofIndia.
- QuantumMechanics,BruceCameronReed,2008,JonesandBartlettLearning.
- Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993,Springer
- Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008,CambridgeUniversityPress
- QuantumMechanics,EugenMerzbacher,2004,JohnWileyandSons,Inc.
- Quantum Mechanics, Walter Greiner, 4th Edn., 2001,Springer

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 11: QUANTUM MECHANICS AND APPLICATIONS - LAB

UseC/C^{++}/Scilabforsolvingthefollowingproblemsbasedon QuantumMechanicslike

1. Solvethes-waveSchrodingerequationforthegroundstateandthefirstexcitedstate of the hydrogenatom:

$$\frac{d^2y}{dr^2} = A(r)u(r),\ A(r) = \frac{2m}{h^2}[V(r) - E] \text{ where } V(r) = -\frac{e^2}{r}$$

Here,misthereducedmassoftheelectron.Obtaintheenergyeigenvaluesandplotthecorresponding wavefunctions.Rememberthatthegroundstateenergyofthehydrogenatomis≈ -13.6eV.Takee=3.795(eVÅ)$^{1/2}$,ħc=1973(eVÅ)andm=0.511x10^6 eV/c^2.

2. Solve the s-wave radial Schrodinger equation for anatom:

$$\frac{d^2y}{dr^2} = A(r)u(r),\ A(r) = \frac{2m}{h^2}[V(r) - E]$$

wheremisthereducedmassofthesystem(whichcanbechosentobethemassofanelectron),forthescreenedcoulombpotential

$$V(r) = -\frac{e^2}{r}e^{-r/a}$$

Find the energy (in eV) of the ground state of the atom to an accuracy ofthreesignificant digits. Also, plot the corresponding wavefunction. Take e =3.795(eVÅ)$^{1/2}$,m=0.511x10^6 eV/c^2,anda=3Å,5Å,7Å.Intheseunitsħc=1973(eVÅ).Thegroundstateenergyisexpectedtobeabove-12eVinallthreecases.

3. Solvethes-waveradialSchrodingerequationforaparticleofmassm:

$$\frac{d^2y}{dr^2} = A(r)u(r),\ A(r) = \frac{2m}{h^2}[V(r) - E]$$

For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{-}br^3$$

for the ground state energy (in MeV) of particle to an accuracy of threesignificantdigits.Also,plotthecorrespondingwavefunction.Choosem=940MeV/c^2,k=100

MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3}In these units, cħ = 197.3 MeV fm. ThegroundstateenergyIexpectedtoliebetween90and110MeVforallthreecases.

4. Solvethes-waveradialSchrodingerequationforthevibrationsofhydrogenmolecule:
   $\frac{d^2y}{dr^2} = A(r)u(r),\ A(r) = \frac{2\mu}{\hbar^2}[V(r) - E]$
   Whereμ isthereducedmassofthetwo-atomsystemfortheMorsepotential
   $$V(r) = D(e^{-2ar^r} - e^{-ar^r}), \qquad r = \frac{r - r_o}{r}$$
   Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of threesignificantdigits.Alsoplotthecorrespondingwavefunction.Take:m =$940x10^6$eV/C^2,D=0.755501eV,α=1.44,r_o=0.131349Å

Laboratory basedexperiments:

1. Study of Electron spin resonance- determine magnetic field as a function oftheresonancefrequency
2. StudyofZeemaneffect:withexternalmagneticfield;Hyperfinesplitting
3. ToshowthetunnelingeffectintunneldiodeusingI-Vcharacteristics.
4. Quantum efficiency ofCCDs

ReferenceBooks:

- Schaum'soutlineofProgrammingwithC++.J.Hubbard,2000,McGraw-HillPublication
- NumericalRecipesinC:TheArtofScientificComputing,W.H.Pressetal.,3rdEdn.,2007, Cambridge UniversityPress.
- AnintroductiontocomputationalPhysics,T.Pang,2ndEdn.,2006,CambridgeUniv.Press
- SimulationofODE/PDEModelswithMATLAB®,OCTAVEandSCILAB:Scientific&EngineeringApplications:A.VandeWouwer,P.Saucez,C.V.Fernández.2014Springer.
- Scilab(AFreeSoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand&Co.
- AGuidetoMATLAB,B.R.Hunt,R.L.Lipsman,J.M.Rosenberg,2014,3rdEdn.,Cambridge UniversityPress
- ScilabImageProcessing:L.M.Surhone.2010BetascriptPublishingISBN:978-6133459274

DSC-H- PHY- 12: SOLID STATEPHYSICS
(Credits:Theory-04,Practicals-02)Theory: 50Lectures

Solid state physics is one of the most dynamical fields of physics and hence, is routine in Physics course and requires practice by the students.

Unit-I

Crystal Structure: Solids: Amorphous and Crystalline Materials. LatticeTranslationVectors.LatticewithaBasis–CentralandNon-CentralElements.UnitCell.MillerIndices.ReciprocalLattice.TypesofLattices.BrillouinZones.DiffractionofX-raysbyCrystals.Bragg'sLaw.AtomicandGeometricalFactor. **(9Lectures)**

Unit -II

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: LinearMonoatomicand Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of thePhononSpectruminSolids.DulongandPetit'sLaw,EinsteinandDebyetheoriesofspecificheatofsolids.T^3law **(8Lectures)**

Unit-III

Magnetic Properties of Matter: Dia-, Para-, Ferri- and FerromagneticMaterials.Classical Langevin Theory of dia– and Paramagnetic Domains. QuantumMechanicalTreatment of Paramagnetism. Curie's law, Weiss's Theory of FerromagnetismandFerromagneticDomains.DiscussionofB-HCurve.HysteresisandEnergyLoss.

(7Lectures)

Dielectric Properties of Materials: Polarization. Local Electric Field at anAtom.DepolarizationField.ElectricSusceptibility.Polarizability.ClausiusMosottiEquation.ClassicalTheoryofElectricPolarizability.NormalandAnomalousDispersion.CauchyandSellmeirrelations.Langevin-Debyeequation.ComplexDielectricConstant.OpticalPhenomena.Application:PlasmaOscillations,PlasmaFrequency.

(7Lectures)

Unit-IV

Ferroelectric Properties of Materials: Structural phase transition, Classificationofcrystals, Piezoelectric effect, Pyroelectric effect, Ferroelectric effect,Electrostrictiveeffect,Curie-WeissLaw,Ferroelectricdomains,PEhysteresisloop.

(6lectures)

Elementarybandtheory: KronigPennymodel.BandGap.Conductor,Semiconductor(PandNtype)andinsulator.ConductivityofSemiconductor,mobility,HallEffect.Measurementofconductivity(04probemethod)&Hallcoefficient. **(7Lectures)**

Unit-V

Superconductivity: ExperimentalResults.CriticalTemperature.Criticalmagneticfield.Meissnereffect.TypeIandtypeIISuperconductors,London'sEquationandPenetrationDepth.Isotopeeffect.IdeaofBCStheory(Noderivation) **(6Lectures)**

Text Books

- IntroductiontoSolidStatePhysics,CharlesKittel,8th Edition,2004,WileyIndiaPvt.Ltd.
- ElementsofSolidStatePhysics,J.P.Srivastava,4th Edition,2015,Prentice-Hallof India

ReferenceBooks:

- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-GrawHill
- SolidStatePhysics,N.W.AshcroftandN.D.Mermin,1976,CengageLearning
- Solid-state Physics, H. Ibach and H. Luth, 2009,Springer
- Solid State Physics, Rita John, 2014, McGrawHill
- ElementarySolidStatePhysics,1/eM.AliOmar,1999,PearsonIndia
- Solid State Physics, M.A. Wahab, 2011, NarosaPublications

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 12: SOLID STATEPHYSICS - LAB

1. Measurementofsusceptibilityofparamagneticsolution(Quinck`sTubeMethod)
2. To measure the Magnetic susceptibility ofSolids.
3. TodeterminetheCouplingCoefficientofaPiezoelectriccrystal.
4. TomeasuretheDielectricConstantofadielectricMaterialswithfrequency
5. Todeterminethecomplexdielectricconstantandplasmafrequencyofmetalusing Surface Plasmon resonance(SPR)
6. Todeterminetherefractiveindexofadielectriclayerusing SPR
7. To study the PE Hysteresis loop of a FerroelectricCrystal.
8. TodrawtheBHcurveofFeusingSolenoid&determineenergylossfromHysteresis.
9. Tomeasuretheresistivityofasemiconductor(Ge)withtemperaturebyfour-probemethod(roomtemperatureto150^{o}C)andtodetermineitsbandgap.
10. To determine the Hall coefficient of a semiconductorsample.

ReferenceBooks

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971,AsiaPublishingHouse.
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4thEdition,reprinted 1985, Heinemann EducationalPublishers.
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11thEd.,2011,KitabMahal
- Elements of Solid State Physics, J.P. Srivastava, 2ndEd., 2006, Prentice-Hall ofIndia.

SemesterVI

DSC-H- PHY- 13: ELECTROMAGNETIC THEORY

(Credits:Theory-04,Practicals-02)Theory:

50Lectures

Electromagnetic theory is one of the important part of physics which has direct influence on modern society. It is a routine in Physics course and requires practice by the students.

Unit-I

Maxwell Equations: Review of Maxwell's equations. Displacement Current.VectorandScalarPotentials.GaugeTransformations:LorentzandCoulombGauge. BoundaryConditionsatInterfacebetweenDifferentMedia.WaveEquations.PlaneWavesin Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic(EM)EnergyDensity.PhysicalConceptofElectromagneticFieldEnergyDe nsity. **(10Lectures)**

Unit -II

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuumandisotropic dielectric medium, transverse nature of plane EM waves, refractive indexanddielectricconstant,waveimpedance.Propagationthroughconductingmedia,relaxa tiontime,skindepth.Wavepropagationthroughdiluteplasma,electricalconductivityofionize dgases,plasmafrequency,refractiveindex,skindepth,applicationtopropagationthroughiono sphere. **(10Lectures)**

Unit -III

EM Wave in Bounded Media: Boundary conditions at a plane interface betweentwomedia.Reflection&Refractionofplanewavesatplaneinterfacebetweentwodielect ricmedia-
LawsofReflection&Refraction.Fresnel'sFormulaeforperpendicular&parallelpolarization cases, Brewster's law. Reflection & Transmission coefficients.Totalinternalreflection. **(8Lectures)**

Unit -IV

PolarizationofElectromagneticWaves: DescriptionofLinear,CircularandEllipticalPolariz ation. Propagation of E.M. Waves in Anisotropic Media. Symmetric NatureofDielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. LightPropagationinUniaxialCrystal.DoubleRefraction.PolarizationbyDoubleRefraction.Ni colPrism.Ordinary&extraordinaryrefractiveindices.Production&detectionofPlane,Circularl yandEllipticallyPolarizedLight.PhaseRetardationPlates:Quarter-WaveandHalf-
WavePlates.BabinetCompensatoranditsUses.AnalysisofPolarizedLight **(10Lectures)**

RotatoryPolarization:OpticalRotation.Biot'sLawsforRotatoryPolarization.Fresnel'sTheory ofopticalrotation.Calculationofangleofrotation.ExperimentalverificationofFresnel'stheory. Specificrotation.Laurent'shalf-shadepolarimeter. **(5Lectures)**

Unit -V

Wave Guides: Planar optical wave guides. Planar dielectric wave guide. Conditionofcontinuity at interface. Phase shift on total reflection. Eigenvalue equations. Phaseandgroupvelocityofguidedwaves.FieldenergyandPowertransmission. **(6Lectures)**

OpticalFibres:-
NumericalAperture.StepandGradedIndices(DefinitionsOnly).SingleandMultipleModeFibr es(ConceptandDefinitionOnly). **(3Lectures)**

Text Books

- Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, BenjaminCummings.
- ElementsofElectromagnetics,M.N.O.Sadiku,2001,OxfordUniversityPress.
- IntroductiontoElectromagneticTheory,T.L.Chow,2006,Jones&BartlettLearning

ReferenceBooks:

- FundamentalsofElectromagnetics,M.A.W.Miah,1982,TataMcGrawHill
- ElectromagneticfieldTheory,R.S.Kshetrimayun,2012,CengageLearning
- Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGrawHill.
- ElectromagneticFieldTheoryforEngineers&Physicists,G.Lehner,2010,Springer
- ElectromagneticFields&Waves,P.Lorrain&D.Corson,1970,W.H.Freeman&Co.
- Electromagnetics,J.A.Edminster,SchaumSeries,2006,TataMcGrawHill.
- Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu,2004,Cambridge UniversityPress

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Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 13: ELECTROMAGNETIC THEORY- LAB

1. To verify the law of Malus for plane polarizedlight.
2. Todeterminethespecificrotationofsugarsolutionusing Polarimeter.
3. ToanalyzeellipticallypolarizedLightbyusingaBabinet'scompensator.
4. Tostudydependenceofradiationonangleforasimple Dipoleantenna.
5. Todeterminethewavelengthandvelocityofultrasonicwavesinaliquid(KeroseneOil,Xylene,etc.) bystudyingthediffractionthroughultrasonicgrating.
6. To study the reflection, refraction ofmicrowaves
7. To study Polarization and double slit interference inmicrowaves.
8. Todeterminetherefractiveindexofliquidbytotalinternalreflectionusing Wollaston'sair-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by totalinternalreflection using a Gaussianeyepiece.
10. Tostudythepolarizationoflightbyreflectionanddeterminethepolarizinganglefor air-glassinterface.
11. ToverifytheStefan`slawofradiationandtodetermineStefan'sconstant.
12. To determine the Boltzmann constant using V-I characteristics of PNjunctiondiode.

ReferenceBooks

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971,AsiaPublishingHouse.
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4th Edition,reprinted 1985, Heinemann EducationalPublishers
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11th Ed.,2011,KitabMahal
- ElectromagneticFieldTheoryforEngineers&Physicists,G.Lehner,2010,Springer

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DSC-H- PHY- 14: STATISTICALMECHANICS

(Credits:Theory-04,Practicals-02)

Theory: 50Lectures

Statistical mechanics is an important branch of theoretical physics that uses probability theory to study the average behavior of a mechanical system whose exact state is uncertain .It, is routine in Physics course and requires practice by the students.

Unit - I

ClassicalStatistics: Macrostate&Microstate,ElementaryConceptofEnsemble,PhaseSpace ,EntropyandThermodynamicProbability,Maxwell-BoltzmannDistributionLaw,Partition Function, Thermodynamic Functions of an Ideal Gas, ClassicalEntropyExpression, Gibbs Paradox, Sackur Tetrode equation, Law of Equipartition ofEnergy(with proof) – Applications to Specific Heat and its Limitation. **(15 Lectures)**

Unit-II

ClassicalTheoryofRadiation: PropertiesofThermalRadiation.BlackbodyRadiation.Puret emperaturedependence.Kirchhoff'slaw.Stefan-Boltzmannlaw:Thermodynamicproof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law.**(8Lectures)**

Unit -III

Quantum Theory of Radiation: Spectral Distribution of Black BodyRadiation.Planck'sQuantumPostulates.Planck'sLawofBlackbodyRadiation:Experi mentalVerification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law,(3)Stefan-BoltzmannLaw,(4)Wien'sDisplacementlawfromPlanck'slaw. **(5Lectures)**

Unit -IV

Bose-EinsteinStatistics: B-Edistributionlaw,Thermodynamicfunctionsofastronglydegenerate Bose Gas, Radiation as a photon gas and Thermodynamic functions of photongas.BosederivationofPlanck'slaw.**(10Lectures)**

Unit-V

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions ofaCompletelyandstronglyDegenerateFermiGas,FermiEnergy,ElectrongasinaMetal,Specif icHeatofMetals,RelativisticFermigas. **(12Lectures)**

Text Books

- StatisticalMechanics,R.K.Pathria,ButterworthHeinemann:2nd Ed.,1996,OxfordUniversityP ress.
- StatisticalPhysics,BerkeleyPhysicsCourse,F.Reif,2008,TataMcGraw-Hill

ReferenceBooks:

- StatisticalandThermalPhysics,S.LokanathanandR.S.Gambhir.1991,PrenticeHall
- Thermodynamics, Kinetic Theory and Statistical Thermodynamics, FrancisW.Sears and Gerhard L. Salinger, 1986,Narosa.
- ModernThermodynamicswithStatisticalMechanics,CarlS.Helrich,2009,Springer
- AnIntroductiontoStatisticalMechanics&Thermodynamics,R.H.Swendsen,2012, Oxford Univ.Press

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Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSC-H- PHY- 14: STATISTICALMECHANICS -LAB

UseC/C^{++}/Scilab/othernumericalsimulationsforsolvingtheproblemsbasedonStatisticalMechanics like

1. Computational analysis of the behavior of a collection of particles in a boxthatsatisfy Newtonian mechanics and interact via the Lennard-Jonespotential,varyingthetotalnumberofparticlesNandtheinitialconditions:
   a) Study of local number density in the equilibrium state (i) average;(ii)fluctuations
   b) Studyoftransientbehaviorofthesystem(approachtoequilibrium)
   c) Relationship of large N and the arrow oftime
   d) Computation of the velocity distribution of particles for the systemandcomparison with the Maxwell velocitydistribution
   e) Computationandstudyofmeanmolecularspeedanditsdependenceonparticlemass
   f) Computation of fraction of molecules in an ideal gas having speednearthe most probablespeed
2. ComputationofthepartitionfunctionZ(β)forexamplesofsystemswithafinitenumberofsinglep articlelevels(e.g.,2level,3level,etc.)andafinitenumberofnon-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac andBose-Einsteinstatistics:
   a) Study of how Z(□), average energy <E>, energy fluctuation □E,specificheatatconstantvolumeCv,dependuponthetemperature,totalnumberofparti cles N and the spectrum of single particlestates.
   b) Ratiosofoccupationnumbersofvariousstatesforthesystemsconsideredabove
   c) Computation of physical quantities at large and small temperature TandcomparisonofvariousstatisticsatlargeandsmalltemperatureT.
3. Plot Planck's law for Black Body radiation and compare it withRaleigh-JeansLaw at high temperature and lowtemperature.
4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einsteindistributionfunction, (c) Debye distribution function for high temperature andlowtemperature and compare them for these twocases.
5. Plot the following functions with energy at differenttemperatures
   a) Maxwell-Boltzmanndistribution
   b) Fermi-Diracdistribution
   c) Bose-Einsteindistribution

ReferenceBooks:

- ElementaryNumericalAnalysis,K.E.Atkinson,3rdEdn.2007,WileyIndiaEdition
- StatisticalMechanics,R.K.Pathria,ButterworthHeinemann:2ndEd.,1996,OxfordUniversityP ress.
- IntroductiontoModernStatisticalMechanics,D.Chandler,OxfordUniversityPress,1 987
- Thermodynamics,KineticTheoryandStatisticalThermodynamics,FrancisW.Sears and Gerhard L. Salinger, 1986,Narosa.
- ModernThermodynamicswithStatisticalMechanics,CarlS.Helrich,2009,Springer
- StatisticalandThermalPhysicswithcomputerapplications,HarveyGouldandJanToboch nik, Princeton University Press,2010.
- SimulationofODE/PDEModelswithMATLAB®,OCTAVEandSCILAB:ScientificandEng ineeringApplications:A.VandeWouwer,P.Saucez,C.V.Fernández.2014Springer ISBN:978-3319067896
- Scilab by example: M. Affouf, 2012. ISBN:978-1479203444
- ScilabImageProcessing:L.M.Surhone.2010,BetascriptPub.,ISBN:978-6133459274

DISCIPLINE SPECIFIC ELECTIVE (4 PAPERS)

Semester-V

DSE-H- PHY-1: CLASSICALDYNAMICS

(Credits:Theory-05,Tutorials-01)

Theory: 60Lectures

Classical dynamics is a routine in Physics course and play an important role to explore the various phenomena of nature. It requires practice by the student.

Unit -I

ClassicalMechanicsofPointParticles:ReviewofNewtonianMechanics;Generalized coordinates and velocities,Hamilton'sprinciple, Lagrangian and the Euler-Lagrange equations, one-dimensional examplesofthe Euler-Lagrange equations- one-dimensional Simple Harmonic Oscillationsandfalling body in uniform gravity.

(12Lecturers)

Unit -II

Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications:Hamiltonianforaharmonicoscillator,solutionofHamilton'sequationforSimple Harmonic Oscillations; particle in a central force field- conservation ofangularmomentumandenergy. **(10 Lectures)**

Unit-III

Small Amplitude Oscillations: Minima of potential energy and points ofstableequilibrium,expansionofthepotentialenergyaroundaminimum,smallamplitudeos cillations about the minimum, normal modes of oscillations example of Nidenticalmassesconnectedinalinearfashionto(N-1)-identicalsprings.**(9Lectures)**

Unit-IV

Special Theory of Relativity: Postulates of Special Theory of Relativity.LorentzTransformations. Minkowski space. The invariant interval, light cone and worldlines.Space-timediagrams.Time-dilation,lengthcontractionandtwinparadox.Four-vectors:space-like, time-like and light-like. Four-velocity and acceleration. Metricandalternating tensors. Four-momentum and energy-momentum relation.(**15 lecturers)**

Unit- V

Fluid Dynamics: Density ρ and pressure P in a fluid, an element of fluid anditsvelocity,continuityequationandmassconservation,stream-linedmotion,laminarflow,Poiseuille'sequationforflowofaliquidthroughapipe,Navier-Stokesequation

(14Lectures)

Text books

- Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,PearsonEducation.
- Mechanics, L. D. Landau and E. M. Lifshitz, 1976,Pergamon.
- Classical Mechanics, J.C Upadhyaya (Himalay Publishing)

ReferenceBooks:.

- Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998,Wiley.
- The Classical Theory of Fields, L.D Landau, E.M Lifshitz, 4th Edn., 2003,Elsevier.
- IntroductiontoElectrodynamics,D.J.Griffiths,2012,PearsonEducation.
- Classical Mechanics, P.S. Joag, N.C. Rana, 1st Edn., McGrawHall.

- ClassicalMechanics,R.DouglasGregory,2015,CambridgeUniversityPress.
- Classical Mechanics: An introduction, Dieter Strauch, 2009,Springer.
- SolvedProblemsinclassicalMechanics,O.L.DelangeandJ.Pierrus,2010,OxfordPress

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Scheme of Examination:

Duration: 3 hours

Marks: 50

Five questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSE-H- PHY-2: PHYSICS OF DEVICES AND INSTRUMENTS
(Credits:Theory-04,Practicals-02)
Theory: 50Lectures

Physics of devices and instruments is a routine in Physics course and play an important role to explore the various phenomena of nature. It requires practice by the student.

Unit -I

Devices: Characteristic and small signal equivalent circuits of UJT and JFET.Metal-semiconductorJunction.Metaloxidesemiconductor(MOS)device.IdealMOSandFlatBand voltage.SiO_2-SibasedMOS.MOSFET–theirfrequencylimits.EnhancementandDepletionModeMOSFETS,CMOS.Chargecoupleddevices.Tunneldiode.**(9Lectures)**

Unit -II

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C andLFilters.ICRegulators,Lineandloadregulation,Shortcircuitprotection**(3Lectures)**
ActiveandPassiveFilters,LowPass,HighPass,BandPassandbandRejectFilters.
(3Lectures)
Multivibrators:AstableandMonostableMultivibratorsusingtransistors.**(3Lectures)**

PhaseLockedLoop(PLL):BasicPrinciples,Phasedetector(XOR&edgetriggered),VoltageControlled Oscillator (Basics, varactor). Loop Filter– Function, Loop FilterCircuits,transientresponse,lockandcapture.BasicideaofPLLIC(565or4046).

(5Lectures)

Unit -III

Processing of Devices: Basic process flow for IC fabrication, Electronic gradesilicon.Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation TechniqueforSi. Metallization technique. Positive and Negative Masks. Optical lithography.Electronlithography.Featuresizecontrolandwetanisotropicetching.LiftoffTechnique.Diffusionandimplantation. **(10Lectures)**

Unit -IV

Digital Data CommunicationStandards:
Serial Communications: RS232, Handshaking, Implementation of RS232 on PC.
UniversalSerialBus(USB):USBstandards,TypesandelementsofUSBtransfers.Devices(Basic idea ofUART).
Parallel Communications: General Purpose Interface Bus (GPIB), GPIB signals andlines,Handshakingandinterfacemanagement,ImplementationofaGPIBonaPC.Basicideaofsending data through a COM port. **(5Lectures)**

Unit -V

Introduction to communication systems: Block diagram of electroniccommunicationsystem, Need for modulation. Amplitude modulation. Modulation Index. AnalysisofAmplitudeModulatedwave.SidebandfrequenciesinAMwave.CEAmplitudeModulator.DemodulationofAMwaveusingDiodeDetector.basicideaofFrequency,Phase,PulseandDigitalModulationincludingASK,PSK,FSK.**(12lectures)**

Text books

- Principles of Communication Systems by Taub&Schiling, 2nd Edition, Tata Mc Graw Hill.

- Modern Digital and Analogue Communication Systems by B.P.Lathi, 3rd Edition, Oxford University
  - PhysicsofSemiconductorDevices,S.M.Sze&K.K.Ng,3rdEd.2008,JohnWiley&Sons
  - Electronicdevicesandintegratedcircuits,A.K.Singh,2011,PHILearningPvt.Ltd.
  - Op-Amps&LinearIntegratedCircuits,R.A.Gayakwad,4Ed.2000,PHILearningPvt.Ltd

ReferenceBooks:

- ElectronicDevicesandCircuits,A.Mottershead,1998,PHILearningPvt.Ltd.
- ElectronicCommunicationsystems,G.Kennedy,1999,TataMcGrawHill.
- IntroductiontoMeasurements&Instrumentation,A.K.Ghosh,3rdEd.,2009,PHILearning Pvt.Ltd.
- Semiconductor Physics and Devices, D.A. Neamen, 2011, 4thEdition, McGrawHill
- PCbasedinstrumentation;Concepts&Practice,N.Mathivanan,2007,Prentice-HallofIndia

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Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSE-H- PHY-2: PHYSICS OF DEVICES AND INSTRUMENTS -LAB

ExperimentsfrombothSectionAandSectionB:S
ection-A

1. Todesignapowersupplyusingbridgerectifierandstudyeffectof C-filter.
2. TodesigntheactiveLowpassandHighpassfiltersofgivenspecification.
3. Todesigntheactivefilter(widebandpassandbandreject)ofgivenspecification.
4. To study the output and transfer characteristics of aJFET.
5. TodesignacommonsourceJFETAmplifierandstudyitsfrequencyresponse.
6. To study the output characteristics of aMOSFET.
7. TostudythecharacteristicsofaUJTanddesignasimpleRelaxationOscillator.
8. To design an Amplitude Modulator usingTransistor.
9. TodesignPWM,PPM,PAMandPulsecodemodulationusingICs.
10. TodesignanAstablemultivibratorofgivenspecificationsusingtransistor.
11. To study a PLL IC (Lock and capturerange).
12. To study envelope detector for demodulation of AMsignal.
13. Study of ASK and FSKmodulator.
14. Glow an LED via USB port ofPC.
15. SensetheinputvoltageatapinofUSBportandsubsequentlyglowtheLEDconnected with another pin of USBport.

Section-B:
SPICE/MULTISIMsimulationsforelectricalnetworksandelectroniccircuits

1. To verify the Thevenin and NortonTheorems.
2. Design and analyze the series and parallel LCRcircuits
3. Designtheinvertingandnon-invertingamplifierusinganOp-Ampofgivengain
4. Design and Verification of op-amp as integrator anddifferentiator
5. Designthe1storderactivelowpassandhighpassfiltersofgivencutofffrequency
6. Design a Wein`s Bridge oscillator of givenfrequency.
7. Design clocked SR and JK Flip-Flop`s using NANDGates

8. Design 4-bit asynchronous counter using Flip-FlopICs
9. DesigntheCEamplifierofagivengainanditsfrequencyresponse.
10. Design an Astablemultivibrator using IC555 of given dutycycle.

ReferenceBooks:

- Basic Electronics:A text lab manual, P.B. Zbar, A.P. Malvino, M.A.Miller,1994,Mc-GrawHill
- IntegratedElectronics,J.MillmanandC.C.Halkias,1991,TataMc-GrawHill.
- Electronics:FundamentalsandApplications,J.D.Ryder,2004,PrenticeHall.
- OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4thedn., 2000, PrenticeHall.
- IntroductiontoPSPICEusingORCADforcircuits&Electronics,M.H.Rashid,2003, PHILearning.
- PCbasedinstrumentation;Concepts&Practice,N.Mathivanan,2007,Prentice-HallofIndia

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Semester –VI

DSE-H- PHY-3:NuclearandParticlePhysics(Credits: Theory-05, Tutorials-01)Theory: 60Lectures

Nuclear and Particle physicsis a routine in Physics course and play an important role to explore the various phenomena of nature. It requires practice by the student.

Unit-I

General Properties of Nuclei: Constituents of nucleus and their Intrinsicproperties,quantitative facts about mass, radii, charge density (matter density), bindingenergy,average binding energy and its variation with mass number, main features ofbindingenergyversusmassnumbercurve,N/Aplot,angularmomentum,parity,magnetic moment,electricmoments,nuclearexcitesstates.**(10Lectures)**

Unit -II

Nuclear Models: Liquid drop model approach, semi empirical mass formulaandsignificance of its various terms, condition of nuclear stability, two nucleonseparationenergies,Fermigasmodel(degeneratefermiongas,nuclearsymmetrypotentialinFermigas).

(9Lectures)

Unit -III

Radioactivity decay:(a) Alpha decay: basics of α-decay processes, theory ofα-emission,Gamowfactor,GeigerNuttalllaw,α-decayspectroscopy.(b)β-decay:energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.(c)Gammadecay:Gammaraysemission&kinematics.
(**10Lectures)**

Unit -IV

Interaction of Nuclear Radiation with matter: Energy loss due to ionization(Bethe-Block formula), energy loss of electrons, Cerenkov radiation. Gamma rayinteractionthrough matter, photoelectric effect, Compton scattering, pair production,neutroninteractionwithmatter. **(8Lectures)**

Detector for Nuclear Radiations: Gas detectors: estimation of electric field,mobilityofparticle,forionizationchamberandGMCounter.BasicprincipleofScintillationDetectorsandconstructionofphoto-multipliertube(PMT).SemiconductorDetectors(Siand Ge) for charge particle and photon detection **(8Lectures)**

Unit -V

Particle Accelerators: Accelerator facility available in India: Van-de Graaffgenerator(Tandemaccelerator),Linearaccelerator,Cyclotron,Synchrotrons.

(5Lectures)

Particlephysics: Particleinteractions;basicfeatures,typesofparticlesanditsfamilies.SymmetriesandConservationLaws:energyandmomentum,angularmomentum,parity,baryonnumber,Leptonnumber,Isospin,Strangenessandcharm,conceptofquarkmodel,colorquantumnumberandgluons. **(10Lectures)**

Text Books

- IntroductiontoHighEnergyPhysics,D.H.Perkins,CambridgeUniv.Press
- IntroductiontoElementaryParticles,D.Griffith,JohnWiley&Sons
- Nuclear Physics, S. N. Ghosal (S.Chand)
- Nuclear Physics, D.C. Tayal (Himalaya Publishing House)

ReferenceBooks:

- IntroductorynuclearPhysicsbyKennethS.Krane(WileyIndiaPvt.Ltd.,2008).
- ConceptsofnuclearphysicsbyBernardL.Cohen.(TataMcgrawHill,1998).
- Introductiontothephysicsofnuclei&particles,R.A.Dunlap.(ThomsonAsia,2004).
- QuarksandLeptons,F.HalzenandA.D.Martin,WileyIndia,NewDelhi
- BasicideasandconceptsinNuclearPhysics-AnIntroductoryApproachby K.Heyde(IOP-InstituteofPhysicsPublishing,2004).
- Radiationdetectionandmeasurement,G.F.Knoll(JohnWiley&Sons,2000).
- PhysicsandEngineeringofRadiationDetection,SyedNaeemAhmed(AcademicPres s, Elsevier,2007).
- TheoreticalNuclearPhysics,J.M.Blatt&V.F.Weisskopf(DoverPub.Inc.,1991)

Scheme of Examination:

Duration: 3 hours

Marks: 50

Five questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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DSE-H- PHY-4:Astronomy&Astrophysics(Credits:

Theory-05, Tutorials-01)

Theory: 60Lectures

The emphasis of the course is on applications in solving problems of interesttophysicistsand requires practice by the students

Unit -I

Astronomical Scales: Astronomical Distance, Mass and Time, Scales,Brightness,Radiant Flux and Luminosity, Measurement of Astronomical QuantitiesAstronomicalDistances, Stellar Radii, Masses of Stars, Stellar Temperature. **Basic conceptsofpositional astronomy:** Celestial Sphere, Geometry of a Sphere, Spherical Triangle,

AstronomicalCoordinateSystems,GeographicalCoordinateSystems,HorizonSystem,Equatorial System, Diurnal Motion of the Stars, Conversion ofCoordinates.MeasurementofTime,SiderealTime,ApparentSolarTime,MeanSolarTime, Equationof Time, Calendar. (**12 lecturers)**

Unit -II

Basic Parameters of Stars: Determination of Distance byParallaxMethod; Brightness, Radiant Flux and Luminosity, Apparent and Absolutemagnitudescale, Distance Modulus; Determination of Temperature and Radius of astar;Determination of Masses from Binary orbits; Stellar SpectralClassification,Hertzsprung-Russell Diagram. **(10Lectures)**

Unit -III

Astronomical techniques: Basic Optical Definitions for Astronomy(MagnificationLight Gathering Power, Resolving Power and Diffraction Limit,AtmosphericWindows), Optical Telescopes (Types of Reflecting Telescopes, TelescopeMountings,Space Telescopes, Detectors and Their Use with Telescopes (Types ofDetectors,detectionLimitswithTelescopes).

Physical principles: Gravitation in Astrophysics (Virial Theorem, NewtonversusEinstein),SystemsinThermodynamicEquilibrium. **(10Lectures)**

The sun (Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere.Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics.Helioseismology).

StellarspectraandclassificationStructure(AtomicSpectraRevisited,StellarSpectra,Spectral Types and Their Temperature Dependence, Black Body Approximation, HRDiagram, LuminosityClassification) **(8Lectures)**

Unit -IV

Themilkyway:BasicStructureandPropertiesoftheMilkyWay,NatureofRotationoftheMilkyWay(DifferentialRotationoftheGalaxyandOortConstant,RotationCurveoftheGalaxyandtheDarkMatter,NatureoftheSpiralArms),StarsandStarClustersoftheMilkyWay,PropertiesofandaroundtheGalacticNucleus. **(12Lectures)**

Unit -V

Large scale structure & expanding universe: Cosmic Distance Ladder (AnExamplefrom Terrestrial Physics, Distance Measurement using Cepheid Variables),Hubble'sLaw(Distance-VelocityRelation), **(8Lectures)**

Text Books

- ModernAstrophysics,B.W.Carroll&D.A.Ostlie,Addison-WesleyPublishingCo.
- Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory,4thEdition, Saunders CollegePublishing.
- The physical universe: An introduction to astronomy, F.Shu, MillValley:University ScienceBooks.

ReferenceBooks:

- FundamentalofAstronomy(FourthEdition),H.Karttunenetal.Springer
- K.S.Krishnasamy,'AstroPhysicsamodernperspective,'Reprint,NewAgeInternational (p) Ltd, NewDelhi,2002.
- BaidyanathBasu, 'An introduction to Astro physics', Second printing, Prentice-HallofIndiaPrivatelimited,NewDelhi,2001.
- TextbookofAstronomyandAstrophysicswithelementsofcosmology,V.B.Bhatia, NarosaPublication.

Scheme of Examination:

Duration: 3 hours

Marks: 50

Five questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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GENERIC ELECTIVE (4 PAPERS)

1st Semester

GE-H-PHY-1: MECHANICS
(Credits:Theory-04,Practicals-02)
Theory: 50Lectures

It is concerned with set of physical laws describing the motion of bodies. It is a routine in Physics course and plays an important role to explore the various phenomena of nature.It requires practice by the students.

Unit-I

Fundamentals of Dynamics: Reference frames. Inertial frames; Review ofNewton'sLawsofMotion.Galileantransformations;Galileaninvariance.Momentumofvariable-masssystem:motionofrocket.MotionofaprojectileinUniformgravitationalfieldDynamics of a system of particles. Centre of Mass. Principle of conservationofmomentum.Impulse. **(6Lectures)**

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non- orces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. **(4Lectures)**

Collisions: Elastic and inelastic collisions between particles. Centre of MassandLaboratoryframes. **(3Lectures)**

Unit -II

Rotational Dynamics: Angular momentum of a particle and system ofparticles.Torque. Principle of conservation of angular momentum. Rotation about a fixedaxis.MomentofInertia.Calculationofmomentofinertiaforrectangular,cylindricalandsphericalbodies.Kineticenergyofrotation.Motioninvolvingbothtranslationandrotation.

(11 Lectures)

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder orWire.

(3Lectures)

FluidMotion: KinematicsofMovingFluids:Poiseuille'sEquationforFlowofaLiquidthroughaCapillaryTube. **(2Lectures)**

Unit -III

Gravitation and Central Force Motion: Law of gravitation. Gravitationalpotentialenergy.Inertialandgravitationalmass.Potentialandfieldduetosphericalshellandsolidsphere. **(3Lectures)**

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications. Geosynchronous orbits. **(5 Lectures)**

Unit-IV

Oscillations:SHM:SimpleHarmonicOscillations.DifferentialequationofSHManditssolution. Kinetic energy, potential energy, total energy and their time-averagevalues.Damped oscillation. Forced oscillations: **(5Lectures)**

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformlyrotatingframe.LawsofPhysicsinrotatingcoordinatesystems.Centrifugalforce.Coriolisforceand its applications.

(3Lectures)

Unit-V

Special Theory of Relativity: Michelson-Morley Experiment and its outcome.Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneityandorder of events. Lorentz contraction. Time dilation. Relativistic transformationofvelocity, frequency and wave number. Relativistic addition of velocities. Variationofmass with velocity. **(10 Lectures)**

Text Books

- Classical Mechanics, third edition, H. Goldstein,Pearson edition
- Classical mechanics, J.C. Upadhyaya, Himalaya Publishing House
- Mechanics by D S Mathur (S. Chand & Company Limited, 2000)

ReferenceBooks:

- Anintroductiontomechanics,D.Kleppner,R.J.Kolenkow,1973,McGraw-Hill.
- Mechanics,BerkeleyPhysics,vol.1,C.Kittel,W.Knight,et.al.2007,TataMcGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008,Wiley.
- AnalyticalMechanics,G.R.FowlesandG.L.Cassiday.2005,CengageLearning.
- FeynmanLectures,Vol.I,R.P.Feynman,R.B.Leighton,M.Sands,2008,PearsonEducation
- IntroductiontoSpecialRelativity,R.Resnick,2005,JohnWileyandSons.
- University Physics, Ronald Lane Reese, 2003, ThomsonBrooks/Cole.
- UniversityPhysics.F.WSears,M.WZemansky,H.DYoung13/e,1986,AddisonWesley
- PhysicsforscientistsandEngineerswithModernPhys.,J.W.Jewett,R.A.Serway,2010 , CengageLearning
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGrawHill.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a short problem of 3/4 marks minimum.

GE-H-PHY-1: Mechanics-LAB

1. Measurements of length (or diameter) using vernier caliper, screw gaugeandtravellingmicroscope.
2. To study the random error inobservations.
3. To determine the height of a building using aSextant.
4. TostudytheMotionofSpringandcalculate(a)Springconstant,(b)**g**and(c)Modulus ofrigidity.
5. To determine the Moment of Inertia of aFlywheel.
6. Todetermine**g**andvelocityforafreelyfallingbodyusingDigitalTimingTechnique
7. To determine Coefficient of Viscosity of water by Capillary FlowMethod(Poiseuille'smethod).
8. TodeterminetheYoung'sModulusofaWirebyOpticalLeverMethod.
9. TodeterminetheModulusofRigidityofaWirebyMaxwell'sneedle.
10. To determine the elastic Constants of a wire by Searle'smethod.
11. To determine the value of g using BarPendulum.
12. To determine the value of g using Kater'sPendulum.

ReferenceBooks

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishingHouse
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4th Edition,reprinted 1985, Heinemann EducationalPublishers
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11th Edn,2011,KitabMahal
- Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, CengageLearningIndia Pvt.Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge UniversityPress.

Semester -2

GE-H-PHY-2: ELECTRICITY ANDMAGNETISM
(Credits:Theory-04,Practicals-02)
Theory: 50 Lectures

Electricity and magnetism are two very important topics in Physics. It is difficult to imagine the present society without the knowledge of it. These are routine in Physics course and plays an important role to understand the beauty of natureand requires practice by the students.

Unit-I

ElectricFieldandElectricPotential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications tochargedistributionswithspherical,cylindricalandplanarsymmetry. **(4Lectures)**

ConservativenatureofElectrostaticField.ElectrostaticPotential.Laplace'sandPoissonequations.TheUniquenessTheorem.PotentialandElectricFieldofadipole.ForceandTorqueonadipole. **(5Lectures)**

Electrostaticenergyofsystemofcharges.Electrostaticenergyofachargedsphere.Conductors in an electrostatic Field. Surface charge and force on aconductor.Capacitanceofasystemofchargedconductors.Parallel-platecapacitor.Capacitanceofan isolated conductor. Method of Images and its application. **(8 Lectures)**

Unit-II

Dielectric Properties of Matter: Electric Field in matter. Polarization,PolarizationCharges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallelplate,spherical, cylindrical) filled with dielectric. Displacement vector **D**. RelationsbetweenE,PandD.Gauss'Lawindielectrics. **(7 Lectures)**

Unit-III

Magnetic Field: Magnetic force between current elements and definition ofMagneticField**B**. Biot-Savart's Law and its simple applications: straight wire and circularloop.CurrentLoopasaMagneticDipoleanditsDipoleMoment(AnalogywithElectricDipole).Ampere'sCircuitalLawanditsapplicationtoSolenoid.Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1)pointcharge(2)currentcarryingwire(3)betweencurrentelements. **(7 Lectures)**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer:CurrentandChargeSensitivity.Electromagnetic damping. **(2Lectures)**

Unit- IV

MagneticPropertiesofMatter: Magnetizationvector(**M**).MagneticIntensity(**H**).Magnetic Susceptibilityandpermeability.RelationbetweenB,H,M.Ferromagnetism.B-Hcurveandhysteresis. **(4Lectures)**

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance andMutualInductance. Reciprocity Theorem. Energy stored in a Magnetic Field. IntroductiontoMaxwell's Equations.

(5Lectures)

Unit -V

ElectricalCircuits:ACCircuits:Kirchhoff'slawsforACcircuits.ComplexReactanceandImp

edance.SeriesLCRCircuit:(1)Resonance,(2)PowerDissipationand(3) QualityFactor,andParallelLCRCircuit. **(4Lectures)**

Network theorems: Ideal Constant-voltage and Constant-current Sources.NetworkTheorems:Thevenintheorem,Nortontheorem,Superpositiontheorem,Reciprocitytheorem,MaximumPowerTransfertheorem.Applicationstodccircuits.
(4Lectures)

Text Books

- ElementsofElectromagnetics,M.N.O.Sadiku,2010,OxfordUniversityPress.
- Circuit Theory: Analysis and Synthesis, by A. K. Chakraborty, Dhanpat rai publication.
- Introduction to Electrodynamics, D.J.Griffiths,3rdEdn.,1998,BenjaminCummings
- Electricity and Magnetism, D.C. Tayal, 3rdEdn, Himalaya Publishing House

ReferenceBooks:

- Electricity,Magnetism&ElectromagneticTheory,S.MahajanandChoudhury,2012, TataMcGraw
- ElectricityandMagnetism,EdwardM.Purcell,1986McGraw-HillEducation
- FeynmanLecturesVol.2,R.P.Feynman,R.B.Leighton,M.Sands,2008,PearsonEducation
- ElectricityandMagnetism,J.H.Fewkes&J.Yarwood.Vol.I,1991,OxfordUniv.Press.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a short problem of 3/ 4 marks minimum.

GE-H-PHY-2:ELECTRICITY ANDMAGNETISMLAB

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c)DCCurrent, (d) Capacitances, and (e) Checking electricalfuses.
2. To study the characteristics of a series RCCircuit.
3. To determine an unknown Low Resistance usingPotentiometer.
4. TodetermineanunknownLowResistanceusingCareyFoster'sBridge.
5. To compare capacitances using De'Sauty'sbridge.
6. MeasurementoffieldstrengthBanditsvariationinasolenoid(determinedB/dx)
7. To verify the Thevenin and Nortontheorems.
8. ToverifytheSuperposition,andMaximumpowertransfertheorems.
9. TodetermineselfinductanceofacoilbyAnderson'sbridge.
10. To study response curve of a Series LCR circuit and determine its (a)Resonantfrequency,(b)Impedanceatresonance,(c)QualityfactorQ,and(d)Bandwidth.
11. TostudytheresponsecurveofaparallelLCRcircuitanddetermineits(a)Anti-resonant frequency and (b) Quality factorQ.
12. Measurement of charge and current sensitivity and CDR ofBallisticGalvanometer
13. DetermineahighresistancebyleakagemethodusingBallisticGalvanometer.
14. To determine self-inductance of a coil by Rayleigh'smethod.
15. TodeterminethemutualinductanceoftwocoilsbyAbsolutemethod.

ReferenceBooks

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971,AsiaPublishingHouse

- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11th Ed.,2011,KitabMahal
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4th Edition,reprinted 1985, Heinemann EducationalPublishers
- EngineeringPracticalPhysics,S.PanigrahiandB.Mallick,2015,CengageLearning.
- ALaboratoryManualofPhysicsforundergraduateclasses,D.P.Khandelwal,1985,VaniPub.

Semester -3

GE-H-PHY-3: THERMALPHYSICS
(Credits: Theory-04,Practicals-02)
Theory: 50Lectures

Thermal physics is the combined study of thermodynamics, statistical mechanics, and kinetic theory. It has played an important role in the development of our current technology and is an essential element of our understanding of the environment and hence is a routine in Physics course and requires practice by the students.

Unit-I

Introduction toThermodynamics

ZerothandFirstLawofThermodynamics:ExtensiveandintensiveThermodynamicVariables,ThermodynamicEquilibrium,ZerothLawofThermodynamics&ConceptofTemperature,ConceptofWork&Heat,StateFunctions,FirstLawofThermodynamicsanditsdifferentialform,InternalEnergy,FirstLaw&variousprocesses,ApplicationsofFirstLaw:GeneralRelationbetween$C_P$andC_V,WorkDoneduringIsothermalandAdiabaticProcesses,CompressibilityandExpansionCo-efficient. **(8Lectures)**

Unit -II

SecondLawofThermodynamics:ReversibleandIrreversibleprocesswithexamples.ConversionofWorkintoHeatandHeatintoWork.HeatEngines.Carnot'sCycle,Carnotengine&efficiency.Refrigerator&coefficientofperformance,2ndLawofThermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence.
Carnot's Theorem. Applications of Second Law of Thermodynamics: **(7Lectures)**

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second LawofThermodynamicsintermsofEntropy.EntropyofaperfectgasPrincipleofIncreaseof Entropy. Entropy Changes in Reversible and Irreversible processes withexamples.Entropy of the Universe. Entropy Changes in Reversible and IrreversibleProcesses.Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot'sCycle.ThirdLawofThermodynamics.UnattainabilityofAbsoluteZero. **(7Lectures)**

Unit -III

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy,Enthalpy,Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties andApplications. MagneticWork,Coolingduetoadiabaticdemagnetization,FirstandsecondorderPhaseTransitionswithexamples,ClausiusClapeyronEquationandEhrenfestequations **(6Lectures)**

Maxwell's Thermodynamic Relations: Derivations and applications ofMaxwell'sRelations, Maxwell's Relations:(1) ClausiusClapeyron equation, (2) Values ofC_p-C_v,
(3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases,(5)Energyequations,(6)ChangeofTemperatureduringAdiabaticProcess. **(5Lectures)**

Unit -IV

KineticTheoryofGases

DistributionofVelocities:Maxwell-BoltzmannLawofDistributionofVelocitiesinanIdeal Gas and its Experimental Verification. Doppler Broadening of Spectral LinesandStern'sExperiment.Mean,RMSandMostProbableSpeeds.DegreesofFreedom.LawofEquipartitionofEnergy(Noproofrequired).SpecificheatsofGases. **(6Lectures)**

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of MeanFreePath. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity **(3Lectures)**

Unit V

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation.TheVirial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. ContinuityofLiquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van derWaal'sEquation of State for Real Gases. Values of Critical Constants. Law ofCorrespondingStates.ComparisonwithExperimentalCurves.P-VDiagrams.Joule'sExperiment.FreeAdiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment.Joule-ThomsonEffectforRealandVanderWaalGases.TemperatureofInversion.Joule-ThomsonCooling. **(8Lectures)**

Text Books

- HeatandThermodynamics,M.W.Zemansky,RichardDittman,1981,McGraw-Hill.
- Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, TataMcGraw-Hill
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger.1988,Narosa.

ReferenceBooks:

- HeatandThermodynamics,M.W.Zemansky,RichardDittman,1981,McGraw-Hill.
- ATreatiseonHeat,MeghnadSaha,andB.N.Srivastava,1958,IndianPress
- Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, TataMcGraw-Hill
- ModernThermodynamicswithStatisticalMechanics,CarlS.Helrich,2009,Springer.
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger.1988,Narosa.
- ConceptsinThermalPhysics,S.J.BlundellandK.M.Blundell,2nd Ed.,2012,OxfordUniversityPress
- ThermalPhysics,A.KumarandS.P.Taneja,2014,R.ChandPublications.

Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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GE-H-PHY-3: THERMALPHYSICS - LAB

1. TodetermineMechanicalEquivalentofHeat,J,byCallenderandBarne'sconstant flowmethod.
2. TodeterminetheCoefficientofThermalConductivityofCubySearle'sApparatus.
3. TodeterminetheCoefficientofThermalConductivityofCubyAngstrom'sMethod.
4. TodeterminetheCoefficientofThermalConductivityofabadconductorbyLeeand Charlton's discmethod.
5. TodeterminetheTemperatureCoefficientofResistancebyPlatinumResistanceThermometer(PRT).
6. TostudythevariationofThermo-EmfofaThermocouplewithDifferenceofTemperature of its TwoJunctions.
7. To calibrate a thermocouple to measure temperature in a specified Rangeusing
   a. Null Method, (2) Direct measurement using Op-Amp differenceamplifierand to determine NeutralTemperature.

ReferenceBooks

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishingHouse
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11th Ed.,2011,KitabMahal
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4th Edition,reprinted 1985, Heinemann EducationalPublishers
- ALaboratoryManualofPhysicsforundergraduateclasses,D.P.Khandelwal,1985,VaniPub.

Semester -4

GE-H-PHY-4: ELEMENTS OF MODERN PHYSICS
(Credits:Theory-04,Practicals-02)
Theory: 50Lectures

Modern physics, the post-Newtonian conception of physics, implies that classical descriptions of phenomena are not able to describe various physical phenomena and "modern", description of nature requires to understand these theories.In a literal sense, the term *modern physics*, means up-to-date physics and is*routine in Physics course and requires practice by the students.*

Unit-I

Planck'squantum,Planck'sconstantandlightasacollectionofphotons;BlackbodyRadiation: Quantum theory of Light; Photo-electric effect and Compton scattering.DeBrogliewavelengthandmatterwaves;Davisson-Germerexperiment.Wavedescriptionofparticlesbywavepackets.GroupandPhasevelocitiesandrelationbetweenthem.Two-Slitexperimentwithelectrons.Probability.Waveamplitudeandwavefunctions.

(14Lectures)

Unit-II

Wave-particleduality,Heisenberguncertaintyprinciple(UncertaintyrelationsinvolvingCanonicalpairofvariables):DerivationfromWavePacketsimpossibilityofaparticlefollowingatrajectory; Estimating minimum energy of a confined particle usinguncertaintyprinciple;Energy-timeuncertaintyprinciple-applicationtovirtualparticlesandrangeofaninteraction.

(4Lectures)

Twoslitinterferenceexperimentwithphotons,atomsandparticles;linearsuperpositionprincipleasaconsequence;Matterwavesandwaveamplitude;Schrodingerequationfornon-relativistic particles; Momentum and Energy operators; stationary states;physicalinterpretationofawavefunction,probabilitiesandnormalization;Probabilityandprobabilitycurrentdensitiesinonedimension. **(8Lectures)**

Unit-III

One dimensional infinitely rigid box- energy eigenvalues andeigenfunctions,normalization;Quantumdotasexample;Quantummechanicalscatteringandtunnellinginonedimension-acrossasteppotential&rectangularpotentialbarrier.

(6Lectures)

UNIT-IV

Sizeandstructureofatomicnucleusanditsrelationwithatomicweight;Impossibilityofanelectronbeinginthenucleusasaconsequenceoftheuncertaintyprinciple.Natureofnuclearforce,NZgraph,LiquidDropmodel:semi-empiricalmassformulaandbindingenergy. **(6 Lectures)**

Radioactivity:stabilityofthenucleus;Lawofradioactivedecay;Meanlifeandhalf-life;Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction ofneutrino;Gamma ray emission. **(6Lectures)**

UNIT-V

Fission and fusion- mass deficit, relativity and generation of energy; Fission -

natureoffragmentsandemissionofneutrons.Nuclearreactor:slowneutronsinteractingwithUranium 235. **(3Lectures)**

Lasers: Einstein'sAandBcoefficients.Metastablestates.SpontaneousandStimulatedemissions. Optical Pumping and Population Inversion. **(3Lectures)**

Text Books

- Quantum Mechanics, NouredineZettli, 2nd edition, (Wiley)
- IntroductiontoQuantumMechanics,DavidJ.Griffith,2005,(PearsonEducation)
- Nuclear Physics, S. N. Ghosal (S.Chand)
- Nuclear Physics, D.C. Tayal (Himalaya Publishing House)

ReferenceBooks:

- Concepts of Modern Physics, Arthur Beiser, 2002,McGraw-Hill.
- IntroductiontoModernPhysics,RichMeyer,Kennard,Coop,2002,TataMcGrawHill
- IntroductiontoQuantumMechanics,DavidJ.Griffith,2005,PearsonEducation.
- PhysicsforscientistsandEngineerswithModernPhysics,JewettandSerway,2010, CengageLearning.
- Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGrawHill
- QuantumMechanics:Theory&Applications,A.K.Ghatak&S.Lokanathan,2004,Macmillan

AdditionalBooksforReference

- ModernPhysics,J.R.Taylor,C.D.Zafiratos,M.A.Dubson,2004,PHILearning.
- Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau andW.Savin, 2ndEdn, Tata McGraw-Hill Publishing Co.Ltd.
- QuantumPhysics,BerkeleyPhysics,Vol.4.E.H.Wichman,1971,TataMcGraw-HillCo.
- BasicideasandconceptsinNuclearPhysics,K.Heyde,3rdEdn.,InstituteofPhysicsPub.
- SixIdeasthatShapedPhysics:ParticleBehavelikeWaves,T.A.Moore,2003,McGrawHill

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Scheme of Examination:

Duration: 2 hours
Marks: 50
Four questions with alternatives from each Unit. Each question must carry a problem of 3/4 marks minimum

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GE-H-PHY-4: ELEMENTS OF MODERN PHYSICS - LAB

1. MeasurementofPlanck'sconstantusingblackbodyradiationandphoto-detector
2. Photo-electric effect: photo current versus intensity and wavelength oflight;maximum energy of photo-electrons versus frequency oflight
3. To determine work function of material of filament of directly heatedvacuumdiode.
4. TodeterminethePlanck'sconstantusingLEDsofatleast4differentcolours.
5. TodeterminethewavelengthofH-alphaemissionlineofHydrogenatom.
6. To determine the ionization potential ofmercury.
7. Todeterminetheabsorptionlinesintherotationalspectrumof Iodinevapour.
8. Todeterminethevalueofe/mby(a)Magneticfocusingor(b)Barmagnet.
9. TosetuptheMillikanoildropapparatusanddeterminethechargeofanelectron.
10. Toshowthetunnelingeffectintunneldiodeusing I-Vcharacteristics.
11. Todeterminethewavelengthoflasersourceusingdiffractionofsingleslit.

12. Todeterminethewavelengthoflasersourceusingdiffractionofdoubleslits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser usingplanediffractiongrating

ReferenceBooks

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971,AsiaPublishingHouse
- AdvancedlevelPhysicsPracticals,MichaelNelsonandJonM.Ogborn,4th Edition,reprinted 1985, Heinemann EducationalPublishers
- ATextBookofPracticalPhysics,I.Prakash&Ramakrishna,11th Edn,2011,KitabMahal

Skill Enhancement Course (any one) (Credit: 02 each)

3rd Semester

SEC- PHY -1: ELECTRICAL CIRCUITS AND NETWORK SKILLS (Credits:02)

Theory: 25Lectures

Theaimofthiscourseistoenablethestudentstodesignandtroubleshootstheelectricalcircuits,networksandappliancesthroughhands-onmode.It requires practice by the student.

BasicElectricityPrinciples:Voltage,Current,Resistance,andPower.Ohm'slaw.Series,parallel,andseries-parallelcombinations.ACElectricityandDCElectricity.Familiarizationwithmultimeter,voltmeterandammeter. **(3Lectures)**

Understanding Electrical Circuits: Main electric circuit elements andtheircombination. Rules to analyze DC sourced electrical circuits. Current and voltagedropacrosstheDCcircuitelements.Single-phaseandthree-phasealternatingcurrentsources.RulestoanalyzeACsourcedelectricalcircuits.Real,imaginaryandcomplexpowercomponentsofACsource.Powerfactor.Savingenergyandmoney. **(3Lectures)**

ElectricalDrawingandSymbols:Drawingsymbols.Blueprints.ReadingSchematics.Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Readingofcircuit schematics. Tracking the connections of elements and identify current flowandvoltagedrop. **(3Lectures)**

Generators and Transformers: DC Power sources. AC/DC generators.Inductance,capacitance,andimpedance.Operationoftransformers. **(3Lectures)**

ElectricMotors:Single-phase,three-phase&DCmotors.Basicdesign.InterfacingDCorACsourcestocontrolheaters&motors.Speed&powerofacmotor. **(3Lectures)**

Solid-State Devices: Resistors, inductors and capacitors. Diode andrectifiers.ComponentsinSeriesorinshunt.ResponseofinductorsandcapacitorswithDCorACsources **(3Lectures)**

Electrical Protection: Relays. Fuses and disconnect switches. Circuitbreakers.Overloaddevices.Ground-faultprotection.Groundingandisolating.Phasereversal.Surge protection. Interfacing DC or AC sources to control elements (relayprotectiondevice) **(3Lectures)**

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Staranddelta connection. Voltage drop and losses across cables and conductors. Instrumentstomeasure current, voltage, power in DC and AC circuits. Insulation. Solid andstrandedcable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts,andsolder.Preparationofextensionboard. **(4Lectures)**

TextBooks:

- AtextbookinElectricalTechnology-BLTheraja-SChand&Co.
- A text book of Electrical Technology - A KTheraja
- PerformanceanddesignofACmachines-MGSayELBSEdn.

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives covering whole course. Each question must carry a problem of 3 marks minimum

SEC- PHY -1: COMPUTATIONALPHYSICS

(Credits:02)

Theory: 25 Lectures

The aim of this course is not just to teach computer programming andnumericalanalysis but to emphasize its role in solving problems inPhysics.

- *Highlights the use of computational methods to solve physicalproblems*
- *Use of computer language as a tool in solving physics problems(applications)*
- *Course will consist of hands on training on the Problem solving onComputers.*

Introduction: Importance of computers in Physics, paradigm for solvingphysics problems for solution**.** Usage of linux as an Editor. **Algorithms andFlowcharts:** Algorithm:Definition,propertiesanddevelopment.Flowchart:Conceptofflowchart, symbols,guidelines,types.Examples:CartesiantoSphericalPolarCoordinates,Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finiteseries, calculationofsin(x)asaseries,algorithmforplotting(1)lissajousfiguresand(2) trajectory of a projectile thrown at an angle with thehorizontal. **(4Lectures)**

Scientific Programming: Some fundamental Linux Commands (Internal andExternalcommands). Development of FORTRAN, Basic elements of FORTRAN: CharacterSet, Constantsandtheirtypes,Variablesandtheirtypes,Keywords,VariableDeclaration and concept of instruction and program. Operators: Arithmetic, Relational, Logicaland Assignment Operators. Expressions: Arithmetic, Relational, Logical, Characterand Assignment Expressions. Fortran Statements: I/O Statements(unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Formatof writing Program and concept of coding, Initialization and Replacement Logic.Examples from physicsproblems. **(5Lectures)**

Control Statements: Types of Logic (Sequential, Selection, Repetition),Branching Statements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASEand ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO,DO-WHILE,ImpliedandNestedDOLoops),JumpingStatements(UnconditionalGOTO, ComputedGOTO,AssignedGOTO)SubscriptedVariables(Arrays:TypesofArrays, DIMENSION Statement, Reading and Writing Arrays), Functions andSubroutines (Arithmetic Statement Function, Function Subprogram and Subroutine),RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/OStatements, open a file, writing in a file, reading from a file. Examples from physicsproblems.

Programming:

1. Exercises on syntax on usage ofFORTRAN
2. Usage of GUI Windows, Linux Commands, familiarity with DOS commandsand working in an editor to write sources codes inFORTRAN.

- To print out all natural even/ odd numbers between givenlimits.
- To find maximum, minimum and range of a given set ofnumbers.
- Calculating Euler number using exp(x) series evaluated atx=1 **(6Lectures)**

Scientific word processing: Introduction to LaTeX: TeX/LaTeX wordprocessor, preparingabasicLaTeXfile,Documentclasses,PreparinganinputfileforLaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining

LaTeX commands and environments, Changing the type style, Symbols fromother languages. **Equation representation:** Formulae and equations, Figures andother floating bodies, Lining in columns- Tabbing and tabular environment, Generatingtableof contents,

bibliography and citation, Making an index and glossary, Listmaking environments, Fonts, Pictur environment and colors, errors. **(4Lectures)**

Visualization: Introduction to graphical analysis and its limitations. Introductionto Gnuplot.importanceofvisualizationofcomputationalandcomputationaldata,basicGnuplot commands: simple plots, plotting data from a file, saving andexporting, multipledatasetsperfile,physicswithGnuplot(equations,buildingfunctions,user defined variables and functions), Understanding data withGnuplot

Hands onexercises:

- To compile a frequency distribution and evaluate mean, standard deviationetc.
- To evaluate sum of finite series and the area under acurve.
- To find the product of twomatrices
- To find a set of prime numbers and Fibonacciseries.
- To write program to open a file and generate data for plotting usingGnuplot.
- Plotting trajectory of a projectile projectedhorizontally.
- Plotting trajectory of a projectile projected making an angle with thehorizontally.
- Creating an input Gnuplot file for plotting a data and saving the output forseeing on the screen. Saving it as an eps file and as a pdffile.
- To find the roots of a quadraticequation.
- Motion of a projectile using simulation and plot the output forvisualization.
- Numerical solution of equation of motion of simple harmonic oscillator andplotthe outputs for visualization.

12. Motion of particle in a central force field and plot the output forvisualization.

(6Lectures)

ReferenceBooks:

- Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Learning Pvt.Ltd.
- Computer Programming in Fortran 77". V. Rajaraman(Publisher:PHI).
- LaTeX–A Document Preparation System", Leslie Lamport (SecondEdition, Addison-Wesley, 1994).
- Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning2010)
- Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill BookCo.
- Computational Physics: An Introduction, R. C. Verma, et al. New AgeInternationalPublishers, New Delhi(1999)
- AfirstcourseinNumericalMethods,U.M.AscherandC.Greif,2012,PHILearning
- Elementary Numerical Analysis, K.E. Atkinson, 3 rdEdn., 2007, Wiley IndiaEdition.

Scheme of Examination:

Duration: 2 hours

Marks: 50

Four questions with alternatives covering whole course. Each question must carry a problem of 3 marks minimum