ASSAM UNIVERSITY, SILCHAR

SYLLABUS UNDER

CHOICE BASED CREDIT SYSTEM

PHYSICS

(HONOURS & GENERAL)

Semester wise list of Physics papers to be studied by a Physics (H) student

SEMESTER	COURSE OPTED	COURSE NAME	CREDITS
I	PHSHCC101T	Mathematical Physics-I	4
	PHSHCC101P	Mathematical Physics-I Lab	2
	PHSHCC102T	Mechanics	4
	PHSHCC102P	Mechanics Lab	2
II	PHSHCC201T	Electricity and Magnetism	4
	PHSHCC201P	Electricity and Magnetism Lab	2
	PHSHCC202T	Waves and Optics	4
	PHSHCC202P	Waves and Optics Lab	2
III	PHSHCC301T	Mathematical Physics-II	4
	PHSHCC301P	Mathematical Physics-II Lab	2
	PHSHCC302T	Thermal Physics	4
	PHSHCC302P	Thermal Physics Lab	2
	PHSHCC303T	Digital Systems and Applications	4
	PHSHCC303P	Digital Systems & Applications Lab	2
	PHSSEC301T	Workshop skill	4
IV	PHSHCC401T	Mathematical Physics III	4
	PHSHCC401P	Mathematical Physics-III Lab	2
	PHSHCC402T	Elements of Modern Physics	4
	PHSHCC402P	Elements of Modern Physics Lab	2
	PHSHCC403T	Analog Systems and Applications	4
	PHSHCC403P	Analog Systems & Applications Lab	2
	PHSSEC401T	Electrical Circuit and Network	4
V	PHSHCC501T	Quantum Mechanics & Applications	4
	PHSHCC501P	Quantum Mechanics Lab	2
	PHSHCC502T	Solid State Physics	4
	PHSHCC502P	Solid State Physics Lab	2
	PHSDSE501T	A. Classical Dynamics B. Biological Physics	6
	PHSDSE502	A. Nuclear and Particle Physics B. Advanced Mathematical Physics	6
VI	PHSHCC601T	Electro-magnetic Theory	4
	PHSHCC601P	Electro-magnetic Theory Lab	2
	PHSHCC602T	Statistical Mechanics	4
	PHSHCC602P	Statistical Mechanics Lab	2
	PHSDSE601T	A. Astronomy and Astrophysics B. Nano-materials and applications	6
	PHSDSE602T	A. Dissertation B. Physics of Devices and Communication	6

Semester wise list of Physics Generic Elective papers for students taking honours in other disciplines

SEMESTER	COURSE OPTED	COURSE NAME	CREDITS
I	PHSGEC101T	Mechanics	4
	PHSGEC101P	Mechanics Lab	2
II	PHSGEC201T	Electricity, Magnetism and EMT	4
	PHSGEC201P	Electricity, Magnetism and EMT Lab	2
III	PHSGEC301T	Thermal Physics and Statistical Mechanics	4
	PHSGEC301P	Thermal Physics and Statistical Mechanics Lab	2
IV	PHSGEC401T	Waves and Optics	4
	PHSGEC401P	Waves and Optics Lab	2

Semester wise list of Physics papers to be studied by a B.Sc. student with Physics.

SEMESTER	COURSE OPTED	COURSE NAME	CREDITS
I	PHSDSC101T	Mechanics	4
	PHSDSC101P	Mechanics Lab	2
II	PHSDSC201T	Electricity, Magnetism and EMT	4
	PHSDSC201P	Electricity, Magnetism and EMT Lab	2
III	PHSDSC301T	Thermal Physics and Statistical Mechanics	4
	PHSDSC301P	Thermal Physics and Statistical Mechanics Lab	2
	PHSSEC301T	Physics workshop skill	4
IV	PHSDSC401T	Waves and Optics	4
	PHSDSC401P	Waves and Optics Lab	2
	PHSSEC401T	Electrical Circuits and Network Skills	4
V	PHSSEC501T	Basic Instrumentation Skills	4
	PHSDSE501T	A. Classical Dynamics B. Biological Physics	6
VI	PHSSEC601T	Renewable Energy and Energy Harvesting	4
	PHSDSE601T	A. Astronomy and Astrophysics B. Nano-materials and Applications	6

SYLLABI FOR CORE COURSE PAPERS

PHSHCC101T: MATHEMATICAL PHYSICS-I

Contact Hours: 60
Full Marks = 70 [ESE (50) CCA(20)]
Pass Marks = 28 [ESE (20) CCA (8)]

(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

The emphasis of course is on applications in solving problems of interest to physicists. The students are to be examined entirely on the basis of problems, seen and unseen.

Unit 1: Matrices and Ordinary differential equations

Matrices : Addition law of matrices, matrix multiplication, properties of matrices, special square matrices, inverse of matrices, Elementary transformation of matrices – similarity, orthogonal and unitary transformation. Eigen value, Eigen vector. Solution of simultaneous linear equations. Diagonalisation of matrix. **(8 Lectures)**

First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. Statement of existence and Uniqueness Theorem for Initial Value Problems. Particular Integral. **(7 Lectures)**

Unit 2: Vector Calculus I:

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. **(5 Lectures)**

Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities. **(7 Lectures)**

Unit 3: Vector Calculus II:

Vector Integration: Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs). **(14 Lectures)**

Unit 4: Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

(8 Lectures)

Unit 5: Introduction to probability and Theory of errors

Independent random variables: Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance.

Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing. **(7 Lectures)**

Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Least-squares fit. Error on the slope and intercept of a fitted line.

(4 Lectures)

Reference Books:

- Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
- An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
- Differential Equations, George F. Simmons, 2007, McGraw Hill.
- Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
- Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
- Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
- Mathematical Physics, Goswami, 1st edition, Cengage Learning
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
- Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press

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PHSHCC101P

Contact Hours: 60

Full Marks = 30 Pass Mark = 20 ESE Time = 3 hours

(A minimum of 8 practical should be done taking at least one from each group of no.5)

Two experiments to be performed from two groups of no. 5 at the time of ESE.

The aim of this Lab is to emphasize its role in solving problems in Physics.

- *Highlights the use of computational methods to solve physical problems*
- *The course will consist of lectures (both theory and practical) in the Lab*
- *Evaluation done not on the programming but on the basis of formulating the problem*
- *Aim at teaching students to construct the computational problem to be solved*
- *Students can use any one operating system Linux or Microsoft Windows*

Topics	Description with Applications
1. Introduction and Overview	Computer architecture and organization, memory and Input/output devices

2. Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow &overflow-emphasize the importance of making equations in terms of dimensionless variables, Iterative methods
3. Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
4. Review of C & C++ /FORTRAN Programming	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (*If statement. If else Statement. Nested if Structure.Else-if Statement. Ternary Operator. Goto Statement. Switch Statement. Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops*), Arrays (*1D & 2D*) and strings, user defined functions, Structures and Unions, Idea of classes and objects
5. (a) Programs:	i. Sum & average of a list of numbers. ii. largest of a given list of numbers and its location in the list iii. sorting of numbers in ascending descending order iv. Maximum minimum and range of numbers, v. addition, multiplication and inverse of matrix, vi. solution of quadratic equation, vii. solution of simultaneous equation, viii. values of sine, cosine and exponential function using their series expansion
(b) Random number generation	i. Area of circle, ii. area of square, iii. volume of sphere, iv. value of pi (**π**)
(c) Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson,Simpson Rule and Secant methods	i. Solution of linear and quadratic equation, ii. solving $\alpha = \tan\alpha ; I = I_0 \left(\frac{\sin \alpha}{\alpha} \right)^2$ in optics
(d) Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. *sin θ, cos θ, tan θ, etc.*
(e) Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method	i. Given Position with equidistant time data to calculate velocity and acceleration and vice versa. ii. Find the area of B-H Hysteresis loop

(f) Solution of Ordinary Differential Equations (ODE) First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods	Attempt following problems using RK 4 order method: i. Radioactive decay ii. Current in RC, LC circuits with DC source iii. Newton's law of cooling iv. Classical equations of motion

Referred Books:

- Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
- Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Pressetal, 3rd Edn. , 2007, Cambridge University Press.
- A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
- Elementary Numerical Analysis, K.E. Atkinson, 3 r d E d n . , 2 0 0 7 , Wiley India Edition.
- Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
- An Introduction to computational Physics, T.Pang, 2nd Edn. , 2006,Cambridge Univ. Press
- Computational Physics, Darren Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.

PHSHCC102T: MECHANICS
Contact Hours: 60
Full Marks = 70 [ESE (50) CCA(20)]
Pass Marks = 28 [ESE (20) CCA (8)]

(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1:

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse.

(6 Lectures)

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. 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.

(4 Lectures)

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

Unit 2:

Rotational Dynamics: Angular momentum of a particle and system of particles Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

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

(17 Lectures)

Unit 3:

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.

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. Weightlessness. Basic idea of global positioning system (GPS). **(9 Lectures)**

Unit 4:

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. **(6 Lectures)**

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. **(5 Lectures)**

Unit 5:

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum.

(10 Lectures)

Reference Books:

- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

PHSHCC102P

Contact Hours: 60

Full Marks = 30 Pass Mark = 20 ESE Time = 3 hours

One experiment to be performed at the time of ESE.

1. To measure the diameter of a wire using vernier caliper, screw gauge and travelling microscope and hence find its cross-section.
2. To determine the Moment of Inertia of unknown body by suitable method
3. To determine Coefficient of Viscosity of water by suitable method
4. To determine the Young's Modulus of a Wire by suitable method.
5. To determine the Modulus of Rigidity of a Wire by suitable method
6. To determine the value of g using Bar Pendulum.
7. To determine the value of g using Kater's Pendulum.
8. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

Semester II

PHSHCC201T: ELECTRICITY AND MAGNETISM

Contact Hours: 60

Full Marks = 70 [ESE (50) CCA(20)]

Pass Marks = 28 [ESE (20) CCA (8)]

(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1:

Electric Field and Electric Potential

Electric field: Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry.

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. **(12 Lectures)**

Unit 2:

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere. **(10 Lectures)**

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics. **(6 Lectures)**

Unit 3:

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field**B**. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of **B**: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. **(11 Lectures)**

Unit 4:

Magnetic Properties of Matter: Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferromagnetism. B-H curve and hysteresis. **(4 Lectures)**

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. **(6 Lectures)**

Unit 5:

Electrical Circuits: AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR Circuit. **(4 Lectures)**

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits. **(4 Lectures)**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR. **(3 Lectures)**

Reference Books:

- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

PHSHCC201P

Contact Hours: 60

Full Marks = 30 Pass Mark = 20 ESE Time = 3 hours

One experiment to be performed at the time of ESE.

1. To study the characteristics of a series RC Circuit connected to an ac/dc source.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Foster's Bridge.
4. To compare two capacitances using De'Sauty's bridge.
5. To determine the strength of the magnetic field produced at the centre of the tangent galvanometer coil due to a current flowing in it and hence to determine horizontal component of earth's magnetic field.
6. To verify the Thevenin, Norton and Maximum power transfer theorems.
7. To determine self inductance of a coil by Anderson's bridge/Maxwell's bridge.
8. To study response curve of a Series LCR circuit and determine its
   (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and
   (d) Band width.
9. To determine the resistance of a given galvanometer by half deflection method.
10. To determine the mutual inductance between two coils by suitable method.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Engineering Practical Physics, S.Panigrahi and B.Mallick, 2015, Cengage Learning.
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

PHSHCC202T: WAVES AND OPTICS
Contact Hours: 60
Full Marks = 70 [ESE (50) CCA(20)]
Pass Marks = 28 [ESE (20) CCA (8)]
(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1:

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats). Superposition of N collinear Harmonic Oscillations with (1) equal phase differences and (2) equal frequency differences. **(5 Lectures)**

Superposition of two perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures with equal an unequal frequency and their uses. **(2 Lectures)**

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves. **(4 Lectures)**

Unit 2:

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction. **(6 Lectures)**

Superposition of Two Harmonic Waves: Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves. **(7 Lectures)**

Unit 3:

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence. **(3 Lectures)**

Interference: Division of amplitude and wavefront. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **(9 Lectures)**

Unit 4:

Interferometer: Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer. **(4 Lectures)**

Diffraction: Kirchhoff's Integral Theorem, Fresnel-Kirchhoff's Integral formula. (Qualitative discussion only) **(2 Lectures)**

Fraunhofer diffraction: Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating. **(8 Lectures)**

Unit 5:

Fresnel Diffraction: Fresnel's Assumptions. Fresnel's Half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

(7 Lectures)

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

(3 Lectures)

Reference Books

- Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
- Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
- Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
- Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
- The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
- The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
- Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications.

PHSHCC202P

Contact Hours: 60

Full Marks = 30 Pass Mark = 12 ESE Time = 3 hours

One experiment to be performed at the time of ESE.

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^2 –T law.
2.. To determine refractive index of the material of a prism using sodium source.
3. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
4. To determine the wavelength of sodium source using Michelson's interferometer.
5. To determine wavelength of sodium light using Fresnel Biprism.
6. To determine wavelength of sodium light using Newton's Rings.
7. To draw the D- λ calibration curve and hence find the wavelength of unknown source.
8. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
9. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

Semester III

PHSHCC301T: MATHEMATICAL PHYSICS-II
Contact Hours: 60
Full Marks = 70 [ESE (50) CCA(20)]
Pass Marks = 28 [ESE (20) CCA (8)]
(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.

Unit 1:

Fourier Series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity. **(11 Lectures)**

Unit 2:

Frobenius Method: Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to find the solution of Legendre, Bessel, Hermite and Laguerre Differential Equations.

(12 Lectures)

Unit 3:

Special Functions: Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions ($J_0(x)$ and $J_1(x)$)and Orthogonality.

(12 Lectures)

Unit 4:

Some Special Integrals: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. **(5 Lectures)**

Dirac Delta function and its properties:

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function. **(6 Lectures)**

Unit 5:

Partial Differential Equations: Solutions to partial differential equations using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes, diffusion Equation.

(14 Lectures)

Reference Books:

- Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
- Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
- Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
- Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
- Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
- Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
- Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

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PHSHCC301P

Contact Hours: 60

Full Marks = 30 Pass Mark = 12 ESE Time = 3 hours

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation will be done on the basis of formulating the problem

Two experiments to be performed at the time of ESE.

Topics	**Description with Applications**
Introduction to Numerical computation software Scilab/FORTRAN/C/C^{++}/Matlab/Mathematica.	Introduction to Scilab/FORTRAN/C/C^{++}/Matlab/Mathematica, Advantages and disadvantages.
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring Constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Generation of Special functions using	Generating and plotting Legendre Polynomials
User defined functions in Scilab	Generating and plotting Bessel function
Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed difference method	First order differential equation • Radioactive decay • Current in RC, LC circuits with DC source • Newton's law of cooling • Classical equations of motion Second order Differential Equation • Harmonic oscillator (no friction) • Damped Harmonic oscillator • Over damped • Critical damped • Oscillatory • Forced Harmonic oscillator • Transient and • Steady state solution • Apply above to LCR circuits also
Partial differential equations	Partial Differential Equation: • Wave equation • Heat equation • Poisson equation • Laplace equation

Reference Books:

- Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
- Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 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, 1st Edn., 2015, Scientific International Pvt. Ltd.
- A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
- Scilab by example: M. Affouf 2012, ISBN: 978-1479203444

- Scilab (A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand & Company
- Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing
- www.**scilab**.in/textbook_companion/generate_book/291

PHSHCC302T: THERMAL PHYSICS

Contact Hours: 60

Full Marks = 70 [ESE (50) CCA(20)]

Pass Marks = 28 [ESE (20) CCA (8)]

(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1: Introduction to Thermodynamics

Zeroth and First Law of Thermodynamics: Extensive and intensive Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Co-efficient. **(7 Lectures)**

Second Law of Thermodynamics: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. **(8 Lectures)**

Unit 2:

Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. Unattainability of

Absolute Zero. **(9 Lectures)**

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications.

(3 Lectures)

Unit 3:

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of C_p-C_V, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process.

Phase Transition: First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations. **(12 Lectures)**

Unit 4:Kinetic Theory of Gases

Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Doppler Broadening of Spectral Lines and Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases.

(7 Lectures)

Molecular Collisions: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance.

(4 Lectures)

Unit 5:

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation.

The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling. **(10 Lectures)**

Reference Books:

- Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
- Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
- Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
- Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.

- Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.

PHSHCC302P

Contact Hours: 60

Full Marks = 30 Pass Mark = 12 ESE Time = 3 hours

One experiment to be performed at the time of ESE.

1. To determine Mechanical Equivalent of Heat, J, by Joule's / Callender and Barne's constant flow method

2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus or any suitable method.

3. To determine the coefficient of linear expansion by optical lever method or any other suitable method.

4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method or any suitable method

5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT)

6. To study the variation of resistance with temperature by Carry-Foster bridge and hence determine the temperature coefficient of the material using hotplate.

7. To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions

8. To calibrate a thermocouple to measure temperature in a specified Range using

i) Null Method, ii) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

Reference Books

- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.

PHSHCC303T: DIGITAL SYSTEMS AND APPLICATIONS

Contact Hours: 60

Full Marks = 70 [ESE (50) CCA(20)]

Pass Marks = 28 [ESE (20) CCA (8)]

(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1:

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection System and

Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference. **(3 Lectures)**

Integrated Circuits (Qualitative treatment only): Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.

(3 Lectures)

Digital Circuits: Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers. **(6 Lectures)**

Unit 2:

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

(6 Lectures)

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.

(4 Lectures)

Unit 3:

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor. **(5 Lectures)**

Sequential Circuits: SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop. **(6 Lectures)**

Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. **(3 Lectures)**

Unit 4:

Shift registers: Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in-Parallel-out Shift Registers (only up to 4 bits). **(2 Lectures)**

Counters (4 bits): Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter. **(4 Lectures)**

Computer Organization: Input/Output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.

(6 Lectures)

Unit 5:

Intel 8085 Microprocessor Architecture: Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing & Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI.

(8 Lectures)

Introduction to Assembly Language: 1 byte, 2 byte & 3 byte instructions.

(4 Lectures)

Reference Books:

- Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw
- Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
- Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
- Digital Electronics G K Kharate ,2010, Oxford University Press
- Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning
- Logic circuit design, Shimon P. Vingron, 2012, Springer.
- Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
- Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill
- Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

PHSHCC303P

Contact Hours: 60

Full Marks = 30 Pass Mark = 12 ESE Time = 3 hours

One experiment to be performed at the time of ESE.

1. To verify the truth tables of AND, OR, NOT, NOR and NAND gates.

2. To design a combinational logic system for a specified Truth Table.

3. To convert a Boolean expression into logic circuit and design it using logic gate ICs

4. To design and verify the De Morgan's theorem using breadboard.

5. To design and verify Half Adder and Full Adder.

6. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.

7. To build JK Master-slave flip-flop using Flip-Flop ICs

8. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.

9. To design an astable multivibrator of given specifications using 555 Timer.

10. To design a monostable multivibrator of given specifications using 555 Timer.

11.To measure (a) Voltage, (b) rise and fall times and (c) Time period of a periodic waveform using CRO.

12. Write the following programs using 8085 Microprocessor

a) Addition and subtraction of numbers using direct addressing mode

b) Addition and subtraction of numbers using indirect addressing mode

c) Multiplication by repeated addition.

f) Use of CALL and RETURN Instruction.

Reference Books:

- Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
- Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
- Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
- Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa, 2010, PHI Learning.

SYLLABI FOR DSC/GE PAPERS

PHSDSC101: MECHANICS / PHSGEC101T: MECHANICS

Contact Hours: 60
Full Marks = 70 [ESE (50) CCA(20)]
Pass Marks = 28 [ESE (20) CCA (8)]
(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1:

Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. **(4 Lectures)**

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.
(6 Lectures)

Unit 2:

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.
(6 Lectures)

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.
(6 Lectures)

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.
(5 Lectures)

Unit 3:

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications.
Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

(10 Lectures)

Unit 4:

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder, Torsional pendulum.
(10 Lectures)

Unit 5:

Fluids: Surface Tension: Synclastic and anticlastic surface - Excess of pressure - Application to spherical and cylindrical drops and bubbles - variation of surface tension with temperature - Jaegar's method. Viscosity: Viscosity - Rate flow of liquid in a capillary tube - Poiseuille's formula and Determination of coefficient of viscosity of a liquid - Variations of viscosity of a liquid with temperature. **(8 Lectures)**

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.
(5 Lectures)

Note: All examples should involve differentiation either in one dimension or with respect to the radial coordinate.

Reference Books:

- University Physics. FW Sears, MW Zemansky and HD Young13/e, 1986. AddisonWesley
- Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
- Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
- Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

PHSDSC101P : MECHANICS / PHSGEC101P: MECHANICS

Contact Hours: 60

Full Marks = 30 Pass Mark = 12 ESE Time = 3 hours

One experiment to be performed at the time of ESE.

1. Measurements of length (or diameter) using Vernier Calliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a regular body by torsional pendulum.
3. To determine the Young's Modulus of a Wire by Searle's Method.
4. To determine the Modulus of Rigidity of a Wire by Statistical method.
5. To determine g by Bar Pendulum.
6. To determine g by Kater's Pendulum.
7. To determine **g** and velocity for a freely falling body using Digital Timing Technique
8. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g
9. To determine the Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).

Reference Books:

- Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

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Semester II

PHSDSC201T: ELECTRICITY AND MAGNETISM /
PHSGEC201T: ELECTRICITY AND MAGNETISM

Contact Hours: 60
Full Marks = 70 [ESE (50) CCA(20)]
Pass Marks = 28 [ESE (20) CCA (8)]

(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1:

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

(12 Lectures)

Unit 2:

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric. **(15 Lectures)**

Unit 3:

Magnetism: Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.
Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.
(13 Lectures)

Unit 4:

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic Field. Trasformer, Auto Trasformer, different losses of trasformer

(10 Lectures)

Unit 5:

Maxwell`s equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum. **(10 Lectures)**

Reference Books:

- Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education..
- Electricity and Magnetism, J.H. Fewkes & J. Yarwood. Vol. I, 1991, Oxford Univ. Press.
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- D.J. Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.

PHSDSC201P: ELECTRICITY AND MAGNETISM / PHSGEC201P: ELECTRICITY AND MAGNETISM

Contact Hours: 60

Full Marks = 30 Pass Mark = 12 ESE Time = 3 hours

One experiment to be performed at the time of ESE.

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. To determine the specific resistance by metre bridge.
3. To determine the strength of the magnetic field produced at the centre of the tangent galvanometer coil due to a current flowing in it and hence to determine horizontal component of earth's magnetic field.
4. To determine the self induction of a coil and its internal resistance in an L-R circuit
5. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
6. To determine the resistance of a galvanometer by half deflection method.
7. To determine a resistance per unit length of metre bridge wire by Carey Foster's method.
8. To verify the Thevenin and Norton theorem.
9. To verify series and parallel laws of resistance by Post office Box.
10. To compare the emf of two cells by potentiometer.

Reference Books

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

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Semester III

PHSDSC301T: THERMAL PHYSICS AND STATISTICAL MECHANICS / PHSGEC301T: THERMAL PHYSICS AND STATISTICAL MECHANICS

Contact Hours: 60
Full Marks = 70 [ESE (50) CCA(20)]
Pass Marks = 28 [ESE (20) CCA (8)]

(Two questions of 10 marks will be set from each unit, one needs to be answered from each unit)

Unit 1:

Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermo dynamical Processes, Applications of First Law: General Relation between C_P & C_V, Work Done during Isothermal and Adiabatic Processes, Compressibility & Expansion Coefficient, Reversible & irreversible processes, Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero. **(15 Lectures)**

Unit 2:

Thermodynamic Potentials: Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (C_P – C_V), C_P/C_V, TdS equations. **(12 Lectures)**

Unit 3:

Kinetic Theory of Gases: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

(12 Lectures)

Unit 4:

Theory of Radiation: Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. **(10 Lectures)**

Unit 5:

Statistical Mechanics: Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law, Bose-Einstein distribution law, comparison of three statistics.

(11 Lectures)

Reference Books:

- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
- Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
- Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill
- Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears &

G.L.Salinger. 1988, Narosa

- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.

PHSDSC301P: THERMAL PHYSICS AND STATISTICAL MECHANICS / PHSGEC301P: THERMAL PHYSICS AND STATISTICAL MECHANICS

Contact Hours: 60

Full Marks = 30 **Pass Mark = 12** **ESE Time = 3 hours**

One experiment to be performed at the time of ESE.

1. To determine Mechanical Equivalent of Heat, J, by Joule's method.
2. To determine the specific heat of a liquid by the method of cooling.
3. To verify Stefan's law by electrical method.
4. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
5. To determine the coefficient of linear expansion by suitable method.
6. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
7. To study the variation of thermo emf across two junctions of a thermocouple with temperature.

Reference Books:

- Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
- A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.

SYLLABI FOR SEC PAPERS

PHSSEC301T: WORKSHOP SKILL

Contact Hours: 60
Full Marks = 50 [ESE (35) CCA (15)]
Pass Marks = 20 [ESE (14) CCA (6)]

(Two questions of 7 marks will be set from each unit, one needs to be answered from each unit during end semester exam. CCA will be on the basis of Hands on skill test.)

The aim of this course is to enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode

Unit 1:
Introduction: Measuring units. conversion to SI and CGS. Familiarization with meter scale, Vernier calliper, Screw gauge and their utility. Measure the dimension of a solid block, volume of cylindrical beaker/glass, diameter of a thin wire, thickness of metal sheet, etc. Use of Sextant to measure height of buildings, mountains, etc.

(8 Lectures)

Unit 2:
Mechanical Skill: Concept of workshop practice. Overview of manufacturing methods: casting, foundry, machining, forming and welding. Types of welding joints and welding defects. Common materials used for manufacturing like steel, copper, iron, metal sheets, composites and alloy, wood.

(8 Lectures)

Unit 3:
Concept of machine processing, introduction to common machine tools like lathe, shaper, drilling, milling and surface machines. Cutting tools, lubricating oils. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet.

(8 Lectures)

Unit 4:
Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

(8 Lectures)

Unit 5:
Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

(8 Lectures)

Hands on Training: 20 hours.

Reference Books:

- A text book in Electrical Technology - B L Theraja – S. Chand and Company.
- Performance and design of AC machines – M.G. Say, ELBS Edn.
- Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
- Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]
- New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]
