Sido-Kanhu Murmu University, Dumka

B. Sc. HONOURS IN PHYSICS (under CBCS) w.e.f. 2015-2018

Course Structure

Course Name		Full Marks
SEM I		
PHY-CC-1.T	MATHEMATICAL PHYSICS-I (04 Credits, 60 Lectures)	75
PHY-CC-2.T	MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-1&2.P	(PRACTICAL) (04 Credits)	50
GE -1.T/(1.T+1.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-AECC1	LANGUAGE (ENGLISH/HINDI)	50
SEM II		
PHY-CC-3.T	ELECTRICITY AND MAGNETISM (04 Credits, 60 Lectures)	75
PHY-CC-4.T	OPTICS (04 Credits, 60 Lectures)	75
PHY-CC-3&4.P	(PRACTICAL) (04 Credits)	50
GE -2.T/(2.T+2.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-AECC2	ENVIRONMENTAL STUDIES	50
SEM III		
PHY-CC-5.T	MATHEMATICAL PHYSICS -II AND THERMAL PHYSICS (04Credits, 60 Lectures)	75
PHY-CC-6.T	PHYSICS OF THERMODYNAMICS (04 Credits, 60 Lectures)	75
PHY-CC-7.T	ANALOG SYSTEMS AND APPLICATIONS (04 Credits, 60 Lectures)	75
PHY-CC-5,6&7P	(PRACTICAL) (06 Credits)	50
GE -3.T/(3.T+3.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-SEC-1	ELECTRICAL CIRCUIT & NETWORK SKILLS (Credits: 02; Theory: 30 Lectures)	50
SEM IV		
PHY-CC-8.T	MATHEMATICAL PHYSICS-III (04 Credits, 60 Lectures)	75
PHY-CC-9.T	QUANTUM MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-10.T	DIGITAL SYSTEMS AND APPLICATIONS (04 Credits, 60 Lectures)	75
PHY-CC-8,9&10P	(PRACTICAL) (06 Credits)	50
GE -4.T/(4.T+4.P)	from other disciplines (06 Credits/(04 + 02 Credits))	100/(75+25)
PHY-SEC-2	APPLIED OPTICS (Credits: 02) THEORY: 30 Lectures	50

SEM V		
PHY-CC-11.T	ATOMIC, MOLECULAR, LASER AND NUCLEAR PHYSICS (04 Credits, 60 Lectures)	75
PHY-CC-12.T	SOLID STATE PHYSICS (04 Credits, 60 Lectures)	75
PHY-CC-11&12P	(PRACTICAL) (04 Credits)	50
PHY-DSE-1.T	PHYSICS OF DEVICE & INSTRUMENT (04 Credits, 60 Lectures)	75
PHY-DSE-2.T	ADVANCE MATHEMATICAL PHYSICS (04 Credits, 60 Lectures)	75
PHY-DSE-1&2P	(PRACTICAL) (04 Credits)	50
SEM VI		
PHY-CC-13.T	ELECTROMAGNETIC THEORY (04 Credits, 60 Lectures)	75
PHY-CC-14.T	STATISTICAL MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-13&14P	(PRACTICAL) (04 Credits)	50
PHY-DSE-3.T	CLASSICAL DYNAMICS **(**Credits: Theory-04, Tutorial-02) Theory: 75 Lectures	75+25
PHY-DSE-4.T	NUCLEAR & PARTICLE PHYICS **(**Credits: Theory-04, Tutorial-02) Theory: 75 Lectures	75+25
Extra-Curricular Based Activities *(list-under UG regulation: page 17)*		50
	OR	
PHY-CC-13.T	ELECTROMAGNETIC THEORY (04 Credits, 60 Lectures)	75
PHY-CC-14.T	STATISTICAL MECHANICS (04 Credits, 60 Lectures)	75
PHY-CC-13&14P	(PRACTICAL) (04 Credits)	50
PHY-DSE-3.T	CLASSICAL DYNAMICS **(**Credits: Theory-04, Tutorial-02) Theory: 75 Lectures	75+25
PHY-DSE-4	DISSERTATION	100
Extra-Curricular Based Activities *(list-under UG regulation: page 17)*		50

GENERIC ELECTIVES FOR PHYSICS HONOURS STUDENTS

Any one discipline out of the following (annexure-2 of UG regulation)

1. MATHEMATICS
2. CHEMISTRY
3. GEOLOGY
4. STATISTICS

Important Instructions for faculty members and question setters
(see Table-09 of UG regulation).

Para I:
A paper having 06 credits carry 100 marks; 80 marks for end semester exam and 20 marks for internal exam (mid term), which further divided as 15 (internal exam-theory/practical) + 05 (attendance and other activities).

A candidate has to answer Five Questions out of Nine Questions of which Question no. 1 is compulsory and will be of short answer type to be answered in about 100 words (4 Questions to be answered out of 8). Out of the remaining 08 (eight) Questions, 04 (four) are to be answered. Each question carries 16 marks.

Para II:
A paper having 04 credits carry 75 marks; 60 marks for end semester exam and 15 marks for internal exam (mid term), which further divided as 10 (internal exam-theory/practical) + 05 (attendance and other activities).

A candidate has to answer Five Questions out of Nine Questions of which Question no. 1 is compulsory and will be of short answer type to be answered in about 100 words (3 Questions to be answered out of 6). Out of the remaining 08 (eight) Questions, 04 (four) are to be answered. Each question carries 12 marks.

Para III:
A paper having 02 credits carry 50 marks; 40 marks for end semester exam and 10 marks for internal exam (mid term), which further divided as 05 (internal exam-theory/practical) + 05 (attendance and other activities).

A candidate has to answer Three Questions out of Five Questions of which Question no. 1 is compulsory and will be of short answer type to be answered in about 100 words (2 Questions to be answered out of 4) and carry 05 marks each. Out of the remaining 04 (four) Questions, 02 (two) are to be answered and carries 15 marks.

SYLLABUS

CORE COURSES (HONOURS IN PHYSICS)

SEMESTER-I

PHY-CC-1.T: MATHEMATICAL PHYSICS-I
(04 Credits, 60 Lectures)

Calculus: Binomial series (statements only). First Order Differential Equations and Integrating Factor. Second Order Differential equations: Homogeneous Equations with constant coefficients. **(14 Lectures)**

Vector Calculus: Scalar and Vector fields, Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field and their physical interpretation. **(14 Lectures)**

Line, surface and volume integrals. Gauss' divergence theorem, Green's and Stoke's Theorems and their applications. **(18 Lectures)**

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. **(14 Lectures)**

Reference Books:

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

PHY-CC-2.T: MECHANICS (04 Credits, 60 Lectures)

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire, Bending moment, Cantiliver, beam supported at the end and loaded at middle and its application to determine Young's modulus, Searle's experiments, Flat spiral spring. Effect of temperature and pressure on elasticity. **(10 Lectures)**

Fluid Motion: Kinematics of Moving Fluids: Viscous fluid, Poiseuille's Equation for Flow of a Liquid through a Capillary Tube with correction, Flow of compressible fluid through a capillary tube, Rankine's methods for measurement of viscosity of gas. Effect of temperature and pressure on viscosity. **(5 Lectures)**

Surface Tension: Surface tension and surface energy, angle of contact, expression for excess pressure, principal of virtual work, Ripples and Gravity waves. Effect of temperature and pressure

on surface tension. **(4 Lectures)**

Central Force Motion:

Two bodies problem, Motion under central force field. Conservation of angular momentum, Kepler's Laws. **(6 Lectures)**

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.**(13 Lectures)**

Frame of references: Inertial and Non-inertial frames. Centrifugal force and Coriolis force and their simple applications, east ward deflection.**(6 Lectures)**

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Lorentz contraction. Time dilation. Relativistic addition of velocities.Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. **(16 Lectures)**

Reference Books:

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

Additional Books for Reference

1. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
2. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
3. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
4. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

PHY-CC-**1&2P (PRACTICAL)**

(04 Credits)

1. Determination of Y by bending of beam method.
2. To determine **g** and velocity for a freely falling body using Digital Timing Technique
3. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle/static method.
6. To determine the elastic Constants of a wire by Searle's method.
7. To determine the value of g using Bar Pendulum.
8. To determine the value of g using Kater's Pendulum.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal

SEMESTER-II

PHY-CC-3.T: ELECTRICITY AND MAGNETISM

(04 Credits, 60 Lectures)

Electric Field and Electric Potential

Conservative nature of Electrostatic Field. Electric field and Potential due to electric dipole and quadrupole. Boundary conditions and refraction of lines of force. Laplace's and Poisson equations. The Uniqueness Theorem. Gauss' law in integral and differential form and its applications.

(10 Lectures)

Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarizability and susceptibility of dielectrics, Displacement vector **D**. Relations between **E**, **P** and **D**. Clausius-Mossotti equation, Gauss' Law in dielectrics. **(15 Lectures)**

Magnetic Properties of Matter: Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. B-H curve and hysteresis. Properties of magnetic materials- Dia, Para and Ferromagnetism, Langevin's theory, Measurement of susceptibility by Quincke's Method. **(15 Lectures)**

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. Anderson's bridge, De-Sauty bridge and Cary Foster bridge. Equivalent circuit and vector diagram. Transformer, Lossess in transformer. **(12 Lectures)**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. **(8 Lectures)**

Reference Books:

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

PHY-CC-4.T: OPTICS

(04 Credits, 60 Lectures)

Geometrical Optics: Fermat's Principle**;** Lens and Mirror formula, Laws of reflection and refraction, Cardinal points, thick lens formula. **(7 Lectures)**

Interference: Division of amplitude and wavefront. Interference in Thin Films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index. **(15 Lectures)**

Interferometer: Michelson Interferometer , Michelson-Morley experiment and its falure-(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. **(10 Lectures)**
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. **(10 Lectures)**

Fraunhofer diffraction: Single slit. Double slit , Circular aperture and disc, Resolving Power of a telescope and Rayleigh criterian, Plane transmission grating. Concave grating, Resolving power of grating. **(10 Lectures)**

Polarization: Polarization by reflection, Brewster's law, Duble refraction, Nicol prism, retardation plate: $\lambda/2$ and $\lambda/4$ plates. Babinet compensator, Production and detection of plane, circular and elliptically polarized light. Optical activity. **(08 Lectures)**

Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Optics by B. K. Mathur.

PHY-CC-**3&4P (PRACTICAL) (04 Credits)**

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Foster's Bridge.
4. To compare capacitances using De'Sauty's bridge.
5. To verify the Thevenin and Norton theorems.
6. To verify the Superposition, and Maximum power transfer theorems.
7. To determine self inductance of a coil by Anderson'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 study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
10. To determine refractive index of the Material of a prism using sodium source.
11. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
12. To determine the wavelength of sodium source using Michelson's interferometer.
13. To determine wavelength of sodium light using Fresnel Biprism.
14. To determine wavelength of sodium light using Newton's Rings.
15. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
16. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

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

SEMESTER-III

PHY-CC-5.T: MATHEMATICAL PHYSICS-II AND THERMAL PHYSICS (04 Credits, 60 Lectures)

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. Analysis of saw tooth, triangular and square wave form. **(20 Lectures)**

Kinetic Theory of Gases Distribution of Velocities: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy, Specific heats of Gases.
(10 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. **(8 Lectures)**
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. Boyle Temperature. Vander-Waal's Equation of State for Real Gases by virial method. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule- Thomson Effect for Real and Vander-Waal Gases. Temperature of Inversion. Joule- Thomson Cooling. **(15 Lectures)**

Thermal conductivity: Rectilinear flow of heat in metal rod, Conductivity by periodic flow method, Weidemann and Frantz law. **(07 Lectures)**

Reference Books:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

---

PHY-CC-6.T: PHYSICS OF THERMODYNAMICS

(04 Credits, 60 Lectures)

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. **(12 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, 2ndLaw 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. **(14 Lectures)**

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. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics.Unattainability of Absolute Zero. **(11 Lectures)**

Thermodynamic Potentials: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Magnetic Work, Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation and Ehrenfest equations.

(11 Lectures)

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) ClausiusClapeyron equation, (2) Values of C_p-C_v, (3) T-ds Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. **(12 Lectures)**

Reference Books:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press

---

PHY-CC-7.T: ANALOG SYSTEMS AND APPLICATIONS
(04 Credits, 60 Lectures)

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. Static and Dynamic Resistance. Current equation Mechanism in Forward and Reverse Biased Diode. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. **(08 Lectures)**

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation. **(8 Lectures)**

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β and Relations between these. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow.Active, Cutoff and Saturation Regions. **(10 Lectures)**

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network, h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. **(12 Lectures)**

Coupled Amplifier: RC-coupled amplifier and its frequency response.**(5 Lectures)**

Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **(5 Lectures)**

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators. **(07 Lectures)**

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Maximum Power Transfer theorem. **(05 Lectures)**

Modulations: Amplitude modulation, solid state amplitude modulator.

Reference Books:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India
9. Hand book of electronics by Gupta and Kumar.

PHY-CC-5,6 & 7P (PRACTICAL)(06 Credits)

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
6. To test a Diode and Transistor using a Multimeter.
7. To design a switch (NOT gate) using a transistor.
8. To verify and design AND, OR, NOT and XOR gates using NAND gates.
9. To design a combinational logic system for a specified Truth Table.
10. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
11. To minimize a given logic circuit.
12. Half Adder, Full Adder and 4-bit binary Adder.
13. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
14. To design an astablemultivibrator of given specifications using 555 Timer.
15. To design a monostablemultivibrator of given specifications using 555 Timer.
16. Write the following programs using 8085 Microprocessor
    i. Addition and subtraction of numbers using direct addressing mode
    ii. Addition and subtraction of numbers using indirect addressing mode
    iii. Multiplication by repeated addition.
    iv. Division by repeated subtraction.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes,D.P.Khandelwal,1985, Vani Pub.
5. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
6. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
7. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.
8. Microprocessor 8085:Architecture, Programming and interfacing, A. Wadhwa,2010, PHI Learning.

PHY-**SEC-1 ELECTRICAL CIRCUIT & NETWORK SKILLS**
(02 Credits, 30 Lectures)

Understanding Electrical Circuits: Main electric circuit elements and their combination. Active and passive components, Kirchoff's laws, Rules to analyze DC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single-phase and three-phase alternating current sources. Rules to analyze AC sourced electrical circuits. Real, imaginary and complex power components of AC source. Power factor. Saving energy and money.**(6 Lectures)**

Generators and Transformers: DC Power sources. AC/DC generators. Inductance, capacitance, and impedance.Operation of transformers. **(3 Lectures)**

Solid-State Devices: Resistors, inductors and capacitors. Diode and rectifiers.Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources **(3 Lectures)**

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device) **(6 Lectures)**

Electrical Wiring: Different types of conductors and cables. Basics of wiring-Star and delta connection.Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Conduit. Cable trays. Splices: wirenuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board.
(7 Lectures)

Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand & Co.
2. A text book of Electrical Technology - A K Theraja
3. Performance and design of AC machines - M G Say ELBS Edn.

SEMESTER-IV

PHY-CC-8.T: MATHEMATICAL PHYSICS-III
(04 Credits, 60 Lectures)

Complex Analysis: Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers.Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Taylor's theorem (statement only). **(40 Lectures)**

Integrals Transforms: Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. **(10 Lectures)**

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. Dirac Delta function, Periodic Functions. Convolution Theorem. **(10 Lectures)**

Reference Books:

1. Mathematical Methods for Physicists and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A.Krzywicki, 1967, Dover Publications
3. Complex Variables, A.S.Fokas & M.J.Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
4. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7th Ed. 2003, Tata McGraw-Hill
5. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett

---

PHY-CC-9.T: QUANTUM MECHANICS (04 Credits, 60 Lectures)

Inadequecy of classical mechanics, Planck's theory of blackbody radiation, Photo-electric effect and Compton scattering. De- Broglie wavelength and matter waves, Davisson-Germer experiment.Wave description of particles by wave packets. Group and Phase velocities and relation between them. **(10 Lectures)**

Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Energy-time uncertainty principle. Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles.Eigenvalues and Eigenfunctions. **(15 Lectures)**

Schrodinger wave equation and its physical meaning. Its applications to one dimensional problems: Free particle in a box with rigid wall, finite potential step, one dimensional sqare well, Linear Harmonic oscillator, Rigid rotator and Hydrogen atom (s-state). **(15 Lectures)**

Operator formulation: operators eigenvalues and eigenfunctions, linear operator, commuting and non-commuting operator, hermitian operator, Position, momentum and Energy operators; commutator of position and momentum operators, Expectation values of position and momentum.

Angular momentum and spin: Commutation relation, Pauli's spin matrices, symmetric and anti-symmetric wavefunction and Pauli's exclusion principle. **(20 Lectures)**

Reference Books:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan
6. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
7. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
8. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
9. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.

Additional Books for Reference

6. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
7. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
8. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.

PHY-CC-10.T: DIGITAL SYSTEMS AND APPLICATIONS

(04 Credits, 60 Lectures)

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. **(10 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. **(14 Lectures)**

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. **(16 Lectures)**

Arithmetic Circuits: Binary Addition. Binary Subtraction using 2's Complement.Half and Full Adders.Half & Full Subtractors, 4-bit binary Adder/Subtractor.**(10 Lectures)**

Timers: IC 555: block diagram and applications: Astablemultivibrator and Monostablemultivibrator. **(10 Lectures)**

Reference Books:

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

PHY-CC-**8, 9 &10P (PRACTICAL)**

(06 Credits)

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of laser source using diffraction of single slit.
6. To determine the wavelength of laser source using diffraction of double slits.
7. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
8. To study V-I characteristics of PN junction diode, and Light emitting diode.
9. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
10. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
11. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
12. To study the various biasing configurations of BJT for normal class A operation.
13. To design a CE transistor amplifier of a given gain (mid-gain) using voltagedivider bias.
14. To study the frequency response of voltage gain of a RC-coupled transistoramplifier.
15. To design a digital to analog converter (DAC) of given specifications.
16. To study the analog to digital convertor (ADC) IC.
17. To design inverting amplifier using Op-amp (741,351) and study its frequency response
18. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011,Kitab Mahal
4. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994,

Mc-Graw Hill.
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
6. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
7. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson

---

PHY-**SEC-2 APPLIED OPTICS (Credits: 02) THEORY: 30 Lectures**

Theory includes only qualitative explanation. ***Minimum five experiments*** *should be performed covering minimum three sections.*

(i) Sources and Detectors (9 Periods) Lasers, Spontaneous and stimulated emissions, Temporal coherence and spatial coherence, Theory of laser action, Einstein's coefficients, Light amplification, Characterization of laser beam, He-Ne laser, Semiconductor lasers.
Experiments on Lasers: a. Determination of the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or solid state laser. b. To find the width of the wire or width of the slit using diffraction pattern obtained by a He-Ne or solid state laser. c. To find the polarization angle of laser light using polarizer and analyzer d. Thermal expansion of quartz using laser **Experiments on Semiconductor Sources and Detectors:** a. V-I characteristics of LED b. Study the characteristics of solid state laser c. Study the characteristics of LDR d. Photovoltaic Cell e. Characteristics of IR sensor
(ii) Fourier Optics (6 Periods) Concept of Spatial frequency filtering, Fourier transforming property of a thin lens
Experiments on Fourier Optics: a. Fourier optic and image processing 1. Optical image addition/subtraction 2. Optical image differentiation 3. Fourier optical filtering 4. Construction of an optical 4f system **b. Fourier Transform Spectroscopy** Fourier Transform Spectroscopy (FTS) is a powerful method for measuring emission and absorption spectra, with wide application in atmospheric remote sensing, NMR spectrometry and forensic science. **Experiment:** To study the interference pattern from a Michelson interferometer as a function of mirror separation in the interferometer. The resulting interferogram is the Fourier transform of the power spectrum of the source. Analysis of experimental interferograms allows one to determine the transmission characteristics of several interference filters. Computer simulation can also be done.
(iii) Holography (6 Periods) Basic principle and theory: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition
Experiments on Holography and interferometry:

1. Recording and reconstructing holograms 2. Constructing a Michelson interferometer or a Fabry Perot interferometer 3. Measuring the refractive index of air 4. Constructing a Sagnac interferometer 5. Constructing a Mach-Zehnder interferometer 6. White light Hologram
(iv) Photonics: Fibre Optics (9 Periods) Optical fibres and their properties, Principal of light propagation through a fibre, The numerical aperture, Attenuation in optical fibre and attenuation limit, Single mode and multimode fibres, Fibre optic sensors: Fibre Bragg Grating
Experiments on Photonics: Fibre Optics a. To measure the numerical aperture of an optical fibre b. To study the variation of the bending loss in a multimode fibre c. To determine the mode field diameter (MFD) of fundamental mode in a single-mode fibre by measurements of its far field Gaussian pattern d. To measure the near field intensity profile of a fibre and study its refractive index profile e. To determine the power loss at a splice between two multimode fibre

Reference Books:

1. Fundamental of optics, F. A. Jenkins & H. E. White, 1981, Tata McGraw hill.
2. LASERS: Fundamentals & applications, K.Thyagrajan & A.K.Ghatak, 2010, Tata McGraw Hill
3. Fibre optics through experiments, M.R.Shenoy, S.K.Khijwania, et.al. 2009, Viva Books
4. Nonlinear Optics, Robert W. Boyd, (Chapter-I), 2008, Elsevier.
5. Optics, Karl Dieter Moller, Learning by computing with model examples, 2007, Springer.
6. Optical Systems and Processes, Joseph Shamir, 2009, PHI Learning Pvt. Ltd.
7. Optoelectronic Devices and Systems, S.C. Gupta, 2005, PHI Learning Pvt. Ltd.
8. Optical Physics, A.Lipson, S.G.Lipson, H.Lipson, 4th Edn., 1996, Cambridge Univ. Press

SEMESTER-V

PHY-CC-11.T: ATOMIC, MOLECULAR, LASER AND NUCLEAR PHYSICS (04 Credits, 60 Lectures)

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.**(10 Lectures)**

Many electron atoms: Pauli's Exclusion Principle. Symmetric&Antisymmetric Wave Functions. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms- L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.). **(15 Lectures)**

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.
(10 Lectures)

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Nuclear shell model, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. **(10 Lectures)**

Radioactivity: Stability of the nucleus; Law of radioactive decay; Mean life and half-life, successive disintegration; Elementary idea of Alpha decay; Beta decay. Fission and fusion- mass defect, relativity and generation of energy; Fission - nature of fragments and emission of neutrons.
(7 Lectures)

Lasers: Einstein's A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser.**(8 Lectures)**

Reference Books:

Additional Books for Reference

1. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
2. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
3. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer

---

PHY-CC-12.T: SOLID STATE PHYSICS

(04 Credits, 60 Lectures)

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors.Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices.Brillouin Zones. Diffraction of X-rays by Crystals.Bragg's Law.**(14 Lectures)**

Elementary Lattice Dynamics: Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons.Qualitative Description of the Phonon Spectrum in Solids.Dulong and Petit's Law, Einstein and Debye theories of specific heat of solids. T^3 law. **(16 Lectures)**

Magnetic Properties of Matter: Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism.Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains.Discussion of B-H Curve. Hysteresis and Energy Loss.**(12 Lectures)**

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. ClausiusMosotti Equation.Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations.Langevin-Debye equation. **(8 Lectures)**

Elementary band theory: Bloch's theorem**,** Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (04 probe method) & Hall coefficient. **(10 Lectures)**

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
6. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
8. Solid State Physics, M.K. Mahan and P. Mahto, 2008, Bharti Bhawan

---

PHY-CC-11, &12 P (PRACTICAL)(04 Credits)

1. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
2. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
3. To show the tunneling effect in tunnel diode using I-V characteristics.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR)

6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150^{o}C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

PHY-**DSE-1.T. PHYSICS OF DEVICES & INSTRUMENT**

(04 Credits, 60 Lectures)

Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metal- semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO_2-Si based MOS. MOSFET– their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices. Tunnel diode. **(18 Lectures)**

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection **(6 Lectures)**

Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters.**(6 Lectures)**

Multivibrators: Astable and MonostableMultivibrators using transistors. **(5 Lectures)**

Digital Data Communication Standards:

Introduction to communication systems: Block diagram of electronic communication system, Need for modulation. Amplitude modulation. Modulation Index. Analysis of Amplitude Modulated wave.Sideband frequencies in AM wave.CE Amplitude Modulator. Demodulation of AM wave using Diode Detector. basic idea of Frequency, Phase, Pulse and Digital Modulation including ASK, PSK, FSK.**(25 lectures)**

Reference Books:

1. Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, John Wiley & Sons
2. Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt. Ltd.
3. Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Learning Pvt. Ltd
4. Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd.
5. Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
6. Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI Learning Pvt. Ltd.
7. PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India

---

PHY-**DSE-2.T. ADVANCE MATHEMATICAL PHYSICS (04 Credits, 60 Lectures)**

Linear Algebra: Vector Spaces: Vector Spaces over Fields of Real and Complex numbers. Examples. Vector space of functions.Linear independence of vectors.Basis and dimension of a vector space. Change of basis. Subspace. Isomorphisms. Inner product and Norm. Inner product of functions: the weight function. Triangle and Cauchy Schwartz Inequalities. **(14 Lectures)**

Linear Transformations: Introduction. Identity and inverse.Singular and non-singular transformations.Representation of linear transformations by matrices. Similarity transformation. Linear operators. Adjoint of a linear operator.Hermitian operators and their matrix representation. Examples. Eigenvalues and eigenvectors of linear operators.Properties of eigenvalues and eigenvectors of Hermitian and unitary operators.Functions of Hermitian operators/ matrices **(22 Lectures)**

Tensors: Symmetric and antisymmetric tensors. Change of basis: relation between coordinate basis vectors. Change of tensor components under change of coordinate system. Example: Inertial coordinates & bases in Minkowski space, Lorentz transformations as coordinate transformations, Elelctromagnetic tensor and change in its components under Lorentz transformations. **(12 Lectures)**

Calculus of Variations

Variational Principle: Euler's Equation. Hamilton's Principle and the Euler-Lagrange equations of motion. Applications: motion of a simple pendulum, particle constrained to move on a hoop. **(12 Lectures)**

Reference Books:

1. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, and F.E. Harris, 1970, Elsevier.
3. Introduction to Matrices and Linear Transformations, D.T. Finkbeiner, 1978, Dover Pub.
4. Linear Algebra, W. Cheney, E.W.Cheney & D.R.Kincaid, 2012, Jones & Bartlett Learning
5. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole
6. Mathematical Methods for Physicis & Engineers, K.F.Riley, M.P.Hobson, S.J.Bence, 3rd Ed., 2006, Cambridge University Press

---

PHY-**DSE-1&2P (PRACTICAL)(04 Credits)**

1. To design a power supply using bridge rectifier and study effect of C-filter.
2. To design the active Low pass and High pass filters of given specification.
3. To design the active filter (wide band pass and band reject) of given specification.
4. To study the output and transfer characteristics of a JFET.
5. To design a common source JFET Amplifier and study its frequency response.
6. To study the output characteristics of a MOSFET.
7. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
8. To design an Amplitude Modulator using Transistor.
9. To design PWM, PPM, PAM and Pulse code modulation using ICs.
10. To design an Astablemultivibrator of given specifications using transistor.
11. To study envelope detector for demodulation of AM signal.
12. Study of ASK and FSK modulator.

Reference Books:

1. Basic Electronics:A text lab manual, P.B. Zbar, A.P. Malvino, M.A.Miller,1994, Mc-Graw Hill
2. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
3. Electronics : Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn., 2000, Prentice Hall.
5. Introduction to PSPICE using ORCAD for circuits & Electronics, M.H. Rashid, 2003, PHI Learning.
6. PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India

---

SEMESTER-VI

PHY-CC-13.T: ELECTROMAGNETIC THEORY

(04 Credits, 60 Lectures)

Maxwell Equations: Derivation of Maxwell's equations. Displacement Current. Boundary Conditions at Interface between Different Media. Wave Equations. Plane Waves in Dielectric Media.Poynting Theorem and Poynting Vector. **(12 Lectures)**

EM Wave Propagation in Unbounded Media: Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth.

(12 Lectures)

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. **(12 Lectures)**

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Uniaxial and Biaxial Crystals. Double Refraction. Polarization by Double Refraction.Nicol Prism. Ordinary & extraordinary refractive indices.Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light. **(16 Lectures)**

Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization.Fresnel's Theory of optical rotation.Calculation of angle of rotation.Experimental verification of Fresnel's theory. Specific rotation. **(8 Lectures)**

Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Additional Books for Reference

7. Electromagnetic Fields & Waves, P.Lorrain & D.Corson, 1970, W.H.Freeman & Co.
8. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
9. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press

---

PHY-CC-14.T: STATISTICAL MECHANICS

(04 Credits, 60 Lectures)

Classical Statistics: Macrostate& Microstate, Elementary Concept of Ensemble, Phase Space, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, SackurTetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations. **(20 Lectures)**

Quantum Theory of Radiation: Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.**(8 Lectures)**

Bose-Einstein Statistics: B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description), Bose derivation of Planck's law. **(15 Lectures)**

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals. **(17 Lectures)**

Reference Books:

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

PHY-CC-**13&14 P (PRACTICAL)(04 Credits)**

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan`s law of radiation and to determine Stefan's constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

---

PHY-**DSE-3.T CLASSICAL DYNAMICS**

(Credits: Theory-04, Tutorial-02) Theory: 75 Lectures

Classical Mechanics of Point Particles: Generalised coordinates and velocities. Hamilton's Principle, Lagrangian and Euler-Lagrange equations. Applications to simple systems such as coupled oscillators. Canonical momenta& Hamiltonian.Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator, particle in a central force field. Poisson brackets. Canonical transformations. **(25 Lectures)**

Special Theory of Relativity: Postulates of Special Theory of Relativity. Lorentz Transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time-dilation, length contraction & twin paradox. Four-vectors: space-like, time-like & light-like. Four-velocity and acceleration.Four-momentum and energy-momentum relation. The Electromagnetic field tensor and its transformation under Lorentz transformations: relation to known transformation properties of **E** and **B**. Electric and magnetic fields due to a uniformly moving charge. Equation of motion of charged particle & Maxwell's equations in tensor form.Motion of charged particles in external electric and magnetic fields.**(35 Lectures)**

Electromagnetic radiation: Review of retarded potentials. Potentials due to a moving charge: LienardWiechert potentials. Electric & Magnetic fields due to a moving charge: Power radiated, Larmor's formula and its relativistic generalisation. **(15 Lectures)**

Reference Books:

1. Classical Mechanics, H.Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002,Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
3. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 1998, Wiley.
4. The Classical Theory of Fields, L.D Landau, E.M Lifshitz, 4th Edn., 2003, Elsevier.
5. Introduction to Electrodynamics, D.J. Griffiths, 2012, Pearson Education.
6. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
7. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press

---

PHY-**DSE-4.T NUCLEAR & PARTICLE PHYICS**

(Credits: Theory-04, Tutorial-02) Theory: 75 Lectures

General Properties of Nuclei: Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.
(12 Lectures)

Nuclear Models: Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force. **(14 Lectures)**

Radioactivity decay:(a) Alpha decay: basics of α-decay processes, theory of α- emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission & kinematics, internal conversion. (**14 Lectures)**

Nuclear Reactions: Types of Reactions, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct Reaction, resonance reaction, Coulomb scattering (Rutherford scattering). **(10 Lectures)**

Detector for Nuclear Radiations: Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter **(5 Lectures)**

Particle Accelerators: Accelerator facility available in India: Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.**(5 Lectures)**

Particle physics: Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model, color quantum number and gluons. **(15 Lectures)**

Reference Books:

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to the physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004).
4. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
5. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
6. Quarks and Leptons, F. Halzen and A.D. Martin, Wiley India, New Delhi
7. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP- Institute of Physics Publishing, 2004).
8. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
9. Physics and Engineering of Radiation Detection, Syed Naeem Ahmed (Academic Press, Elsevier, 2007).
10. Theoretical Nuclear Physics, J.M. Blatt & V.F.Weisskopf (Dover Pub.Inc., 1991)
