Syllabus
B.Sc. HONOURS IN PHYSICS
(under CBCS)
Academic Session:
w.e.f. 2018-2021

for

All Constituent/Affiliated Colleges Under

Binod Bihari Mahto Koyalanchal University, Dhanbad

COURSE STRUCTURE

COURSE CODE	COURSE NAME	FULL MARKS	END/EXT. SEM. MARKS	MID/INT. SEM. MARKS
SEMESTER -I				
PHY-CC-1.T	MATHEMATICAL PHYSICS-I (04 Credits, 60 Lectures)	75	60	15
PHY-CC-2.T	MECHANICS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-1&2.P	(PRACTICAL) (04 Credits)	50	40	10
GE -1.T/(1.T+1.P)	from other disciplines (Annexure-2) (06 Credits/(04 + 02 Credits))	100/ (75+25)	80/(60+20)	20/ (15+5)
AECC-1	LANGUAGE (ENGLISH/HINDI) (Credits: 02; Theory: 30 Lectures)	50	40	10
SEMESTER - II				
PHY-CC-3.T	ELECTRICITY AND MAGNETISM (04 Credits, 60 Lectures)	75	60	15
PHY-CC-4.T	WAVES AND OPTICS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-3&4.P	(PRACTICAL) (04 Credits)	50	40	10
GE -2.T/(2.T+2.P)	from other disciplines (Annexure-2) (06 Credits/(04 + 02 Credits))	100/ (75+25)	80/(60+20)	20/ (15+5)
AECC-2	ENVIRONMENTAL STUDIES (Credits: 02; Theory: 30 Lectures)	50	40	10
SEMESTER - III				
PHY-CC-5.T	MATHEMATICAL PHYSICS -II AND THERMAL PHYSICS (04Credits, 60 Lectures)	75	60	15
PHY-CC-6.T	PHYSICS OF THERMODYNAMICS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-7.T	ANALOG SYSTEMS AND APPLICATIONS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-5,6 & 7P	(PRACTICAL) (06 Credits)	75	60	15
GE -3.T/(3.T+3.P)	from other disciplines (Annexure-2) (06 Credits/(04 + 02 Credits))	100/ (75+25)	80/(60+20)	20/ (15+5)
SEC-1	COMPUTER APPLICATIONS &INFORMATION TECHNOLOGY (Annexure-1) (Credits: 02; Theory: 30 Lectures)	50	40	10
SEMESTER - IV				
PHY-CC-8.T	MATHEMATICAL PHYSICS-III (04 Credits, 60 Lectures)	75	60	15
PHY-CC-9.T	ELEMENTS OF MODERN PHYSICS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-10.T	DIGITAL SYSTEMS AND APPLICATIONS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-8,9&10P	(PRACTICAL) (06 Credits)	75	60	15
GE -4.T/(4.T+4.P)	from other disciplines (Annexure-2) (06 Credits/(04 + 02 Credits))	100/ (75+25)	80/(60+20)	20/ (15+5)

SEC-2	SCIENCE AND LIFE (Annexure-1) (02 Credits, 30 Lectures)	50	40	10
SEMESTER -V				
PHY-CC-11.T	QUANTUM MECHANICS & APPLICATIONS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-12.T	SOLID STATE PHYSICS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-11&12P	(PRACTICAL) (04 Credits)	50	40	10
PHY-DSE-1.T	PHYSICS OF DEVICE & INSTRUMENT (04 Credits, 60 Lectures)	75	60	15
PHY-DSE-2.T	ADVANCED MATHEMATICAL PHYSICS (04 Credits, 60 Lectures)	75	60	15
PHY-DSE-1&2P	(PRACTICAL) (04 Credits)	50	40	10
SEMESTER - VI				
PHY-CC-13.T	ELECTROMAGNETIC THEORY (04 Credits, 60 Lectures)	75	60	15
PHY-CC-14.T	STATISTICAL MECHANICS (04 Credits, 60 Lectures)	75	60	15
PHY-CC-13&14P	(PRACTICAL) (04 Credits)	50	40	10
PHY-DSE-3.T	CLASSICAL DYNAMICS (04 Credits, 60 Lectures)	75	60	15
PHY-DSE-4.T	NUCLEAR & PARTICLE PHYICS (04 Credits, 60 Lectures)	75	60	15
PHY-DSE-3&4P	(PRACTICAL) (04 Credits)	50	40	10
	Extra-Curricular Based Activities *(list-under UG regulation: page 17)*	50	40	10

Total Marks = 2450

Annexure - 1

SKILL DEVELOPMENT COURSES (Common for All Programmes)

For Honours Degree

(i) Third Semester: Compulsory for All Disciplines

Any one of the following three in a particular college depending upon the facility available:

1. Constitution of India and Human Rights
2. Environment and Public Health
3. Computer Applications and Information Technology

(II) Fourth Smester: One from the following may be chosen

The courses may include the following:

1 Entrepreneurship
2 Life Skills and Personality Development
3 Human Resource Development
4 Legal Aid and Awareness
5 Indian History, Culture and Diversity
6 Science and Life
7 Banking and Finance
8 Building Mathematical Ability
9 Capital and Stock Market

Annexure-2

GENERIC ELECTIVES FOR PHYSICS HONOURS STUDENTS

Any one discipline out of the following

1. Mathematics
2. Chemistry
3. Geology
4. Statistics

Extension and Co-curricular and Extra-curricular Based Activities

A student shall opt for one of the activities mentioned below and offered in the college, in each of the first four semesters of the undergraduate programmes. The activity carries a credit each and will be internally assessed for 50 marks.

a) N.S.S./N.C.C
b) Sports and Games
c) Physical Education or Activities related to Yoga
d) Field study/Industry Implant Training
e) Involvement in campus publication
f) Publication of articles in news papers, magazines or other publications
g) Community work such as promotion of values of National Integration, Environment, Human rights and duties, Peace, Civic sense, etc.
h) A Small project work concerning achievements of India in different fields
i) Evolution of study groups/seminar circles on Indian thoughts and ideas
j) Activity exploring different aspects of Indian civilizations
k) Involvement in popularization programmes such as scientific temper
l) Computer assisted/web-based learning and e-library skills
m) Innovative compositions and creations in music, performing and visual arts, etc.
n) Other activities such as Cultural Activities or any other activity as prescribed by the University. Evaluation of Co-and Extra Curricular Activities shall be as per the procedure evolved by the university from time to time.

Important Instructions for faculty members and questions 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.

NB: Questions may be framed as per the direction issued to the paper setter from Examination Department, Numerical problems may be included. Some of the questions may be repeated from previous year.

SYLLABUS
CORE COURSES (HONOURS IN PHYSICS)

SEMESTER-I

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

Differential Equations: First Order and Second Order Differential equations: First Order Differential Equations and Integrating Factor. Homogeneous Equations with constant coefficients. Wronskian and general solution. **(14 Lectures)**

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: **(6 Lectures)**

Vector Calculus: Vector triple product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. **(6 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. Expression for divergence and curl in cartesian coordinate. **(8 Lectures)**

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. **(18Lectures)**

Orthogonal Curvilinear Coordinates: Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems. **(8 Lectures)**

Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
3. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
4. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
5. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
6. Essential Mathematical Methods, K.F.Riley & M.P.Hobson, 2011, Cambridge Univ. Press
7. Mathematical Physics - H K Das
8. Mathematical Physics - B D Gupta
9. Mathematical Physics - B S Rajput

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'e experiments. **(10 Lectures)**

Fluid Motion: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube, Mayer's equations, Rankine methods for measurement of viscosity of gas.**(8 Lectures)**

Hydrodynamics: Equation of continuity and deduction of Euler's equation **(2 Lectures)**

Surface Tension: Surface tension and surface energy, angle of contact, principle of virtual work and its use to obtain expression for the pressure on two sides of curved liquid surface. Ripples and Gravity waves, Determination of surface tension by Ripple tank method and Quincke's method. **(10 Lectures)**

Central Force Motion: Motion of a particle under a central force field: two body problem. Kepler's

Laws and their deduction. **(8 Lectures)**

Non-Inertial Systems: Non-inertial frames and fictitious forces. Centrifugal force. Coriolis force and its applications-eastward deviation of falling bodies and flattening of earth.**(8 Lectures)**

Special Theory of Relativity: Galilean transformation, Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Length contraction. Time dilation. Relativistic addition of simultaneity, Variation of mass with velocity.Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect of light. **(14 Lectures)**

Reference Books:

1. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al. 2007, Tata McGraw-Hill.
2. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
3. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
4. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
5. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
6. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
7. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
8. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

PHY-CC-1&2P (PRACTICAL) (04 Credits)

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
4. Determination of Y by bending of beam method.
5. To determine **g** and velocity for a freely falling body using Digital Timing Technique
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of g using Bar Pendulum.
11. 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. Electrostatic Potential. Laplace's and Poisson equations & its solution in Cartesian coordinates, The Uniqueness Theorem. Gauss' law in integral and differential form. Multipole expansion (monopole, dipole & quadrupole), energy density in an electric field. **(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, Solutions of electrostatic and Magnetostatic problems including boundry value problems.**(10 Lectures)**

Transients: Growth and Decay of currents in LR, CR , LC and LCR circuits .**(10 Lectures)**

Magnetic Properties of Matter: Magnetization vector (**M).** Magnetic Intensity(**H).** Magnetic Susceptibility and permeability.Relation between **B, H, M**. **(6 Lectures)**

Electrical 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's Bridge and Owen's bridge & their vector diagram representation. Three phase electrical power supply, delta and star connections. **(10 Lectures)**

Network theorems: Ideal Constant-voltage and Constant-current Sources. Network Theorems: Thevenin theorem, Norton theorem, Maximum Power Transfer theorem and Superposition Theorem.**(8 Lectures)**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. **(6 Lectures)**

Reference Books:

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, TMH
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 K K Tewary S. Chand.

PHY-CC-4.T: WAVES AND OPTICS (04 Credits, 60 Lectures)

Wave Motion: Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave.**(6 Lectures)**

Free Vibration,Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. **(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. **(7 Lectures)**

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

Acoustics of building, reverberation of time, growth and decay of sound, Sabine's formula **(4 Lecture)**

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. **(7 Lectures)**

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.**(8 Lectures)**

Fraunhofer diffraction: Single slit. Circular aperture and airy pattern, Resolving Power of a telescope. Double slit. Plane transmission grating. Resolving power of grating. **(7 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. **(6 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. Introduction to Geometrical and Physical Optics, B. K. Mathur.
8. Geometrical and Physical Optics, P. K. Chakraborty.

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, Norton, Superposition and Maximum power transfer theorems.
6. To determine self inductance of a coil by Anderson's bridge.
7. 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.
8. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
9. To determine refractive index of the Material of a prism using sodium source.
10. To determine wavelength of sodium light using Newton's Rings.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

Reference Books

1. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. 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. Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Fourier's Theorem, Analysis of saw tooth, triangular and square wave form. **(23 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 mono-,dia- and tri-atomic Gases. **(12 Lectures)**

Molecular Collisions:Mean Free Path,Collision Probability. Clausius and Maxwell Derivations of mean free path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion-Einstein's theory and experimental determination of Avogadro's number.**(10 Lectures)**

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of State. Boyle Temperature. Van der Waal's Equation of State for Real Gases using Virial theorem. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. p-V Diagrams. Theory of Joule-Thomson effect, Porous Plug Experiment. J-T effect for perfect and Van der Waal gases, Temperature of Inversion & Critical temperature. Joule- Thomson Cooling, Relation between Boyle temperature. **(15 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)

Zeroth and First Law of Thermodynamics: Zeroth Law of Thermodynamics, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, Applications of First Law: General Relation between CP and CV, 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, 2^{nd}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. **(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.**(12 Lectures)**

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

Phase Transitions with examples, Clausius Clapeyron Equation **(12 Lectures)**

Maxwell's Thermodynamic Relations: Derivations and applications of Maxwell's Relations, Maxwell's Relations:(1) Clausius Clapeyron equation, (2) Values of Cp-Cv, (3) Tds Equations, (4) Joule-Kelvin coefficient for Ideal and Van der Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. **(10 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: Derivation of Richardson's formula, 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. **(10 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, C-filter (2) Zener Diode and Voltage Regulation. **(10 Lectures)**

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and $\beta$and Relations between α and β. 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. Classification of Class A, B & C Amplifiers. **(10 Lectures)**

Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response. **(4 Lectures)**

Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.**(6 Lectures)**

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency.Hartley & Colpitts oscillators, Wien Bridge Oscillator.**(10 Lectures)**

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, TMH
5. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
6. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
7. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

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 study V-I characteristics of PN junction diode, and Light emitting diode.
6. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
7. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
8. To study the characteristics of a Bipolar Junction Transistor in CE and CB configurations .
9. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.

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.

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: poles and branch points, order of singularity. Integration of a function of a complex variable. Cauchy's Inequality & Theorem. Cauchy's Integral formula. Laurent and Taylor's Theorem. Residues and Cauchy's Residue Theorem. **(24 Lectures)**

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. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transform with examples, Application of Fourier transforms to differential equations: one dimensional wave and diffusion/heat flow equations. **(18 Lectures)**

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of 1st and 2nd order Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function.**(18 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
6. Mathematical Physics H K Dass

PHY-CC-9.T: ELEMENTS OF MODERN PHYSICS (04 Credits, 60 Lectures)

Quantum Mechanics: Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; 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, two slit experiment with electrons, probability, wave amplitude and wave functions, Bohr Correspondence Principle **(12 Lectures)**

Position measurement-gamma ray microscope through experiment, Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; estimating minimum energy of a confined particle using uncertainty principle, Energy-time & Position-momentum uncertainty principle **(10 Lectures)**

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension. **(10 Lectures)**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron

being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, Liquid Drop model: semi-empirical mass formula and binding energy.**(8 Lectures)**

Radioactivity: Stability of the nucleus; Law of radioactive decay; Decay constant, Mean life and half-life, successive disintegration; methods of measurement of half-life, spectra of emitters, Elementary idea of Alpha decay; Beta decay.**(8 Lectures)**

Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. **(4 Lectures)**

Lasers: Spontaneous and Stimulated emissions. Einstein's A and B coefficients. Metastable states. Optical Pumping and Population Inversion. Three-Level laser system and He-Ne Laser and Ruby Laser.**(8 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. 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.
9. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.

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)**

Boolean algebra: De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Karnaugh Map -Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Product of Sum Method**(12 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 their applications.**(14 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)**

Data processing circuits: Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders, BCD to 7 segments **(4 Lectures)**

Conversion: Resistive network (weighted and R-2R ladder), accuracy and resolution, A/D conversion (successive approximation). **(4 Lectures)**

Timers: IC 555: block diagram and applications: Astable multivibrator and Monostable multivibrator. **(6 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. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. 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. To determine the Planck's constant using LEDs of at least 4 different colours.
3. To determine the wavelength of laser source using diffraction of single slit.
4. To determine the wavelength of laser source using diffraction of double slits.
5. To design a switch (NOT gate) using a transistor.
6. To verify and design AND, OR, NOT and NOR gates using NAND gates.
7. To design a combinational logic system for a specified Truth Table.
8. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
9. Half Adder, Full Adder and 4-bit binary Adder.
10. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
11. To design an astable multivibrator of given specifications using 555 Timer.
12. To design a monostable multivibrator of given specifications using 555 Timer.
13. To design a digital to analog converter (DAC).
14. To study the analog to digital convertor (ADC).

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 Edn, 2011,Kitab Mahal
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
5. Electronic Devices & circuit Theory, R.L. Boylestad & L.D. Nashelsky, 2009, Pearson
6. Modern Digital Electronics, R.P. Jain, 4th Edition, 2010, Tata McGraw Hill.
7. Microprocessor Architecture Programming and applications with 8085, R.S. Goankar, 2002, Prentice Hall.

SEMESTER-V

PHY-CC-11.T: QUANTUM MECHANICS AND APPLICATION (04 Credits, 60 Lectures)

Time dependent Schrodinger equation: Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of Wave Function.Interpretation of Wave Function Probability and probability current densities; Conditions for Physical Acceptability of Wave Functions. Normalization, Eigenvalues and Eigenfunctions. Expectation values of position and momentum.**(10 Lectures)**

Time independent Schrodinger equation- Time independent Schrodinger equation; General solution of the time independent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension.**(10 Lectures)**

Operators: Postulates of quantum mechanics, Position, momentum, Hamitonian,and Energy operators; eigenvalues and eigenfunctions, commutator of position and momentum operators **(6 Lectures)**

General discussion in an arbitrary potential- One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, one dimensional potential step, Quantum tunnelling & rectangular potential barrier, one-dimensional square well potential .**(10 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.**(12 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). **(12Lectures)**

Reference Books:

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, Leonard I. Schiff, 3rd Edn. 2010, Tata McGraw Hill.
4. Quantum Mechanics, G. Aruldhas, 2nd Edn. 2002, PHI Learning of India.
5. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
6. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
7. Quantum Mechanics, Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
8. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
9. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer
10. Advanced Quantum Mechanics ,Satya Prakash

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, Unit Cell, Bravais lattice (2D &3D), Miller Indices. Reciprocal Lattice- properties and applications. Types of Lattices. Brillouin Zones-construction & applications. Diffraction of X-rays by Crystals, Bragg's Law, Laue's equation. **(14 Lectures)**

Lattice Vibrations and Phonons: Phonons of monatomic one dimensional lattice, Linear 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-, and Ferromagnetic Materials. Classical Langevin Theory of dia– and Paramagnetic materials.Curie's law, Weiss's Theory of Ferromagnetism and Ferromagne tic Domains.Discussion of B-H Curve. Hysteresis and Energy Loss.**(12 Lectures)**

Dielectric Properties of Materials: Polarization. Local Electric Field at an Atom. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability.Langevin-Debye equation. **(8 Lectures)**

Elementary band theory: Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Conductivity of Semiconductor, mobility, Hall Effect. **(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
9. Introduction to Solid State Physics , Arun Kumar, PHI Learning.

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.
11. To study the V-I characteristics of a Zener diode
12. Use of Zener Diode as a voltage regulator.

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 & INSTRUMENTS (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. **(14 Lectures)**

Power supply and Filters: Block Diagram of a Power Supply, Qualitative idea of C and L Filters. T and Pi section filters. Regulators, Line and load regulation, Short circuit protection **(12 Lectures)**

Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters. **(10 Lectures)**

Multivibrators: Astable and Monostable Multivibrators using transistors. **(6 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. **(18 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. Basic Electronics: Arun Kumar, Bharti Bhawan 2007

PHY-DSE-2.T. ADVANCED 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 **(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 an Astable multivibrator of given specifications using transistor.
10. To study envelope detector for demodulation of AM signal.

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. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edn., 2000, Prentice Hall.
4. Introduction to PSPICE using ORCAD for circuits & Electronics, M.H. Rashid, 2003, PHI Learning.
5. 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 field equations. Displacement Current. Boundary Conditions at Interface between Different Media**.(10 Lectures)**

EM Wave Propagation in Unbounded Media: Propagation of 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. Poynting Theorem and Poynting Vector. **(15 Lectures)**

EM Wave in Bounded 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. **(10 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. **(15 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. **(10 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
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, Boltzmann entropy relation, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, SackurTetrode equation. Ideas of ensembles, micro-canonical, canonical and grand canonical ensembles. and expression for distribution function, partition function and and calculation of themodynamic quantities. **(25 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. **(10 Lectures)**

Bose-Einstein Statistics: Bose -Einstein distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose derivation of Planck's law.**(12 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. **(13 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 study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
9. To verify the Stefan`s law of radiation and to determine Stefan's constant.
10. 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

PHY-DSE-3.T CLASSICAL DYNAMICS (04 Credits, 60 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)**

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 (04 Credits, 60 Lectures)

Structure and properties of the nucleus: Structure of nucleus, Discovery of the nucleus, composition. Basic properties; charge, mass, size, spin, magnetic moment, electric quadruple moment, binding energy, binding energy per nucleon and its observed variation with mass number of the nuclei. **(8 Lectures)**

Nuclear Force: Two nucleon system, deuteron problem, binding energy. **(5 Lectures)**

Nuclear detectors: Detectors for charged particles; ion chamber, GM counter, resolving time, cloud chamber and bubble chamber. **(8 Lectures)**

Accelerator: Need for accelerators, linear accelerators, cyclotron, synchrocyclotron. **(7 Lectures)**

Radioactivity: Geiger-Nuttal Law, Gamow's theory of α decay. **(10 Lectures)**

Nuclear reactions: Rutherford's experiments of nuclear transmutation, conservation theorems, Q-value, threshold energy, cross-section of nuclear reactions. **(8 Lectures)**

Cosmic rays and elementary particles: Discovery of cosmic rays: hard and soft components, discovery of muon, pion, heavy mesons and hyperons, mass and life-time determination for muon and pion. Primary cosmic rays: Extensive air showers, solar modulation of primary cosmic rays, effect of earth's magnetic field on the cosmic ray trajectories. **(14 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)

PHY-DSE-3&4P (PRACTICAL)(04 Credits)

1. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
2. To determine the wavelength of sodium source using Michelson's interferometer.
3. To determine wavelength of sodium light using Fresnel Biprism.
4. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating
5. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO..

6. Measurement of viscosity of liquid by oscillating disc method
7. To determine value of Boltzmann constant using V-I characteristic of PN diode.
8. To determine work function of material of filament of directly heated vacuum diode.
9. To determine value of Planck's constant using LEDs of at least 4 different colours.

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