SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS

FOR

T. Y. B. Sc.

PHYSICS

(With effect from June, 2009)

SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON

Class: T. Y. B. Sc.

Subject: Physics

With effect from June, 2009

The Board of Studies in physics has decided the revision of syllabus in physics at T. Y. B. Sc. according to the U.G.C. model curriculum and Semester pattern, in it's meeting held on 29th April 2009. The nomenclature accepted is as follows,

PHY YSC [Y for year, S for semester and C for course number].

The titles of the papers for T. Y. B. Sc. (Physics) are as given below;

Course Title	Semester	Periods	Marks	
			Ext	Int
PHY 311: Mathematical Physics	1	52	40	10
PHY 321: Classical Electrodynamics	2	52	40	10
PHY 312: Classical Mechanics	1	52	40	10
PHY 322: Quantum Mechanics	2	52	40	10
PHY 313: Atomic and Molecular Physics	1	52	40	10
PHY 323: Nuclear Physics	2	52	40	10
PHY: 314(A): Electronics II	1	52	40	10
PHY314 (B): Instrumentation II	1	52	40	10
PHY 324: Statistical Mechanics & Thermodynamics	2	52	40	10
PHY 315: Solid State Physics	1	52	40	10
PHY 325: Element of Material Science	2	52	40	10
PHY 316 (A): Technical Electronics- I	1	52	40	10
PHY 326 (A): Technical Electronics- II	2	52	40	10
PHY 316(B): Refrigeration and air conditioning-I	1	52	40	10
PHY 326(B): Refrigeration and air conditioning-II	2	52	40	10
PHY 316(C): Vacuum Technology-I	1	52	40	10
PHY 326(C): Vacuum Technology-II	2	52	40	10
PHY 316(D): Microprocessor-I	1	52	40	10
PHY 326(D): Microprocessor-II	2	52	40	10

PHY 316(E): Programming in C+ + -I	1	52	40	10
PHY 326(E): Programming in C+ + -II	2	52	40	10
PHY 316(F): Solar Energy-I	1	52	40	10
PHY 326(F): Solar Energy-II	2	52	40	10
PHY 307: Practical Course-I	1 and 2	104	80	20
PHY 308: Practical Course-II	1 and 2	104	80	20
PHY 309: Project	1 and 2	104	80	20

Important Instructions:

1) The students offered Electronics Science at F. Y. B. Sc. and/or at S. Y. B. Sc. as one of the subjects will have to offer **PHY314 (B): Instrumentation II** instead of **PHY: 314(A): Electronics II** at T. Y. B. Sc. (Physics).
2) The students offered Computer Science at F. Y. B. Sc. and/or at S. Y. B. Sc. as one of the subjects will have to offer other than **PHY 316(E): Programming in C+ + -I** and **PHY 316(E): Programming in C+ + -II** as an optional subject at T. Y. B. Sc. (Physics).
3) The industrial/study tour is compulsory for students of T. Y. B. Sc. (Physics). The tour report should be submitted at the time of practical examination.

PHY 311: Mathematical Physics

Unit I: Vector Analysis.

Gauss divergence theorem, Stoke's theorem, Green's 1st and 2nd theorem, Green's theorem in the plane.(their statements, proofs and problems)

(06P, 04M)

Unit II: Curvilinear Co-ordinates.

Introduction to Cartesian (X, Y, Z), Spherical polar(r,θ,ϕ), Cylindrical(ρ,ϕ,z), co-ordination system and their transformation equations.

General Curvilinear Co-ordinates system, co-ordination surfaces, co-ordination lines, length elements and volume elements, scale factors, orthogonal Curvilinear Co-ordinates system, Proof of orthogonality of spherical polar and cylindrical co-ordinate systems.

Expression for gradient, divergence curl and Laplacian in Curvilinear Co-ordinates system and in spherical polar and cylindrical co-ordinate systems.

(13P, 10M)

Unit III: Differential Equation.

Degree, order, linearity and homogeneity of partial differential equation, Method of separation of variables in Cartesian, spherical polar and cylindrical co-ordinates system. (Wave equation and Laplace's equation).

Singular points, Singular points of Legendra and Hermite differential equation, Statement of Funche's theorem, Frobenius method of series solution, series solution of linear simple harmonic oscillator.

(15P, 12M)

Unit IV: Special Functions.

Generating functions for Legendre Polynomial Pn *(x)*, Hermite polynomial Hn*(x)*, and Bessel functions of first kind Jn *(x)*.

Proof of following properties

$i)\ (n+1)P_{n+1}(x) = (2n+1)xP_n(x) - nP_{n-1}(x).$

$ii)P_n(x) = P'_{n+1}(x) - 2xP'_n(x) + P_{n-1}(x).$

$iii)H_{n+1}(x) = 2xH_n(x) - 2nH_{n-1}(x).$

$iv)2nH_{n-1}(x) = H'_n(x).$

$v)J_{n+1}(x) + J_{n-1}(x) = \frac{2n}{x} J_n(x).$

$vi)J_{n-1}(x) - J_{n+1}(x) = 2J'_n(x)$

(08P, 06M)

Unit V: Special Theory of Relativity.

Newtonian relativity, absolute space, Gallilean transformations, Michelson-Morley experiment, postulates of special theory of relativity, Lorent'z transformation equations, Length contraction, time dilation, relativity of simultaneity, variation of mass with velocity, addition of velocities, mass-energy relation, energy momentum relation.

$E^2=P^2C^2+m_o^2C^4$

(10P, 8M)

(Total: 52 Periods, 40 Marks)

References:

1) Mathematical Physics: B.S. Rajput, Pragati Prakashan (19th Edition, 2007).
2) Mathematical Physics: B.D.Gupta.
3) Mathematical Methods for Physics: G. Arfken, Hens Weber (4th Edition, 1995).
4) Mathematical Methods in the Physical Science: Mary L. Boos.
5) Vector Analysis: Murray R. Spiegal, Schaum's series.
6) Modern Physics: J.B. Rajam.

PHY 321: Classical Electrodynamics

Unit I: Electrostatics.

Electrostatics field in vacuum, Electrostatics field and potential, potential produced by continuous charge distribution, Electrostatic field and potential due to electric dipole, Gauss's law and its application to the field produced by some charge distribution such as i) charged sphere ii) charged infinite sheet iii) infinite long uniformly charged wire.

(10P, 08M)

Unit II: Boundary Value Problems in Electrostatics.

Boundary conditions for E and D, Dielectric sphere in uniform electric field, method of electric images for a grounded conducting sphere.

(08P, 08M)

Unit III: Magnetostatics.

Lorentz force, Biot-Savart law, magnetic induction due to a wire carrying uniform current, Axial magnetic field of solenoid, Ampere circuital law and its applications for straight wire carrying current, current loop, magnetic induction, Magnetization, Intensity of magnetic field, magnetic vector potential, Relation between B,H and M, Magnetic susceptibility, Relative permeability, magnetic circuit winding with and without air gap.

(17P, 12M)

Unit IV: Electrodynamics.

Faraday's law of induction in differential and integral form, Modified Ampere's circuital law, Maxwell's equation in differential and integral form, Wave equation in free space, solution of wave equation for plane wave in free space, Poynting vector and electromagnetic energy, reflection and refraction of plane wave from non conducting boundaries (normal incidence only).

(17P, 12M)

(Total: 52 Periods, 40 Marks)

References:

1) Electrodynamics: Dr. S. L. Gupta, Dr. V. Kumar, Dr. S.P. Singh, Pragati Prakashan (19^{th} Edition, 2007).
2) Electromagnetic: B.B.Laud, Wiley aster Ltd., New Delhi (2^{nd} Edition).
3) Foundation of Electromagnetic field: John R. Reitz and Fredrick J., Narossa Publishing House, New Delhi (3^{rd} Edition).
4) Fundamental Electricity and magnetism: F.Kip, Mc Graw hill Kogakusha Ltd. (2^{nd} Edition).
5) A text book of classical Electrodynamics: Prof. M. K. Yeole, Dr. R.T. Chaudhari.

PHY 312: Classical Mechanics

Unit I: Review of classical Mechanics.

Introduction to Classical Mechanics, Newton's laws of motion, (4-1.2,1.5) Types of forces: Forces of Gravitation, Lorentz force, Hooks Force, Frictional Force, Fundamental Forces of Nature,(3-1.4) Limitations of Newton's Laws, (4-1.6)

(09P, 06M)

Unit II: Motion in central force field.

Central force, Properties of central force, Reduction of two body problem into equivalent one body problem, Motion in central force field, Motion in inverse square law force field, General features of motion, Equation of Orbits (Nature of Orbit), Kepler's laws (statement and proof) (2-5.1 to 5.6)

(12P,10M)

Unit III: Lagrangian Formulations of Mechanics.

Constraints, Holonomic and Non-holonomic Constraints, degree of freedom with examples, Concept of virtual displacement and virtual work, D'Alemberts principle (3-4.1 to 4.8)

Lagrange's equation, Properties of Lagranges equation (3-5.1 to 5.3), simple application of Lagrange's equation (simple pendulum, harmonic oscillator, compound pendulum, atwoods machine), (1-2.9.1,2.9.2,2.9.9,2.9.10) Lagrangian for a charged in an electromagnetic field (1-2.6.2)

(12P, 10M)

Unit IV: Hamiltonian Formulations of Mechanics.

Generalized coordinates, Cyclic or ignorable coordinates, Conservations Theorems (1-2.11), Idea of phase space, Hamiltonian, Hamilton's canonical equation of motion Advantages of Hamiltonian approach (1-3.2 to 3.6), Applications of Hamiltons equations of motion (simple pendulum, harmonic oscillator, compound pendulum,)(1-3.9.1, 3.9.2, 3.9.4)

(10P, 08M)

Unit V: Moving coordinate system.

Rotating coordinates system, Effects of Corioli's force (Flow of river, Formation of cyclone, Trade winds and Tropical winds)(1- 5.3 pages-233 to 236, 239,240)

(09P, 06M)

(Total: 52 Periods, 40 Marks)

References: -

1. Classical Mechanics: Gupta, Kumar and Sharma, Pragati Publication
2. Introduction to Classical Mechanics: R. G. Takwale and P. S. Puranic.
3. Classical Mechanics: Panat P. V., Narosa Publication
4. Classical Mechanics: N. C. Rana and P. S. Joag.
5. Classical Mechanics: J. C. Uappadhyaya
6. Classical Mechanics: Herbrt Goldstein

PHY 322: Quantum Mechanics

Unit I: Preliminary Concepts.
(Revision of Schrödinger's Time dependent and time independent equations)
Normalized & Orthogonal wave functions (1.1.10), Solution of Schrödinger equation (1.1.11), Stationary state solutions (1.1.12), Expectation values of dynamical quantities (1.1.13), Probability current density (1.1.14), Ehrenfest's theorem (1.1.15).

(12P, 08 M)

Unit II: Applications of Schrödinger's equation to 1-D physical problems.
Potential step (1.2.3), Rectangular potential barrier (1.2.4), Application of barrier penetration (α –decay) (1.2.5), Deep potential well (1.2.6), Square well potential (1.2.8), Linear harmonic oscillator (1.2.10), Concept of parity.

(14 P, 10 M)

Unit III: Spherically Symmetric Systems.
Eigen function & eigen values of rigid rotator with free axis (2.5.3), Schrödinger equation for spherically symmetric potentials (1.3.1), Hydrogen atom: Solution of R, θ, and φ; total wave function; energy levels and degeneracy (2.5.6), Normal state of hydrogen atom (2.5.7), Quantum numbers (2.5.5) .

(14P, 10 M)

Unit IV: The operator formalism in Quantum mechanics.
Postulates of quantum mechanics (1.4.11), Position operator, Momentum operator (1.4.12), Hamiltonian operator (1.4.13), Orbital angular momentum operator, Commutativity and commutative algebra of operators: Properties, Commutation relations between position and momentum operators; Commutation relation between momentum and Hamiltonian operator; Commutation rules for components of orbital angular momentum; Commutation relations of L^2 with components of orbital angular momentum; Commutation relations of components of orbital angular momentum with position operators(1.4.24).

(14P, 12 M)

(Total: 52 Periods, 40 Marks)

References:

1. Advanced Quantum Mechanics: Satya Prakash . Kedarnath Ram Nath, Meerut.
2. Quantum Mechanics: Gupta, Kumar, Sharma.. Sultan Chand & Sons
3. Quantum Mechanics: Chatwal and Anand.. Himalaya Publishing Co.
4. Quantum Mechanics: L. I. Schiff

PHY 313: Atomic and Molecular Physics.

Unit I: Vector Atom Model.
Quantum numbers, physical interpretation of quantum numbers, electron spin, spin orbit interaction, spectral terms, spectra of single valence electron system (sodium), selection rule, Pauli's exclusion principle.(Double spitting)

(08P, 06M)

Unit II: Two Valence Electron System.
Spin-spin and orbit- orbit interaction, LS & JJ coupling schemes, singlet triplet separations, p-d & s-p configuration in L-S coupling, Lande interval rule.

(10P, 08M)

Unit III: Zeeman & Paschen Back effect.
Magnetic dipole moment, larmor precession, Zeeman Effect, Normal Zeeman Effect, Anomalous Zeeman effect, Paschen Back effect for single valence electron system.

(08P.08M)

Unit IV: X-ray spectra.
Origin and nature of x-ray, Characteristic x-ray spectra, energy level of cadmium, regular and irregular doublets and their laws, Moseley's law and its applications.

(10P, 06M)

Unit V: Molecular spectra.
Regions of electromagnetic spectrum, classification of molecular spectra, rotation spectra of diatomic molecules, rotation energy levels of rigid diatomic molecules, vibrational spectra of diatomic molecules, vibrational energy levels of harmonic oscillations.
Raman spectra- Raman effect, experimental setup and explanation of Raman Effect.

(16 P, 12M)

(Total: 52 Periods, 40 Marks)

References:

1) Introduction to Atomic Spectra: H E White, McGraw Book Company, Inc.
2) Fundamental of molecular spectroscopy: C N Banwell, Tata McGraw hill, 3rd edition.
3) Spectra of Diatomic Molecules: G Hertzberg, D Van Nastrand compony, Inc., New York.
4) Perspectives of Modern Physics: Arthur Beiser, McGraw Hill Kogakusha Ltd, Tokyo.
5) Atomic spectra and molecular spectra: Raj kumar, Kedarnath Ramnath Prakashan.

PHY 323: Nuclear Physics.

Unit I: Nucleus and Nuclear Force

Constituents, charge, mass, shape and size of nucleus, Binding energy, packing fraction, nuclear magnetic moment, saturation and short range nuclear force, charge symmetry and charge independence, spin dependence of nuclear force.

(10P, 07M)

Unit II: Radioactivity

Revision of law of radioactive decay, half life, mean life, specific activity, partial radioactive decay, successive disintegration, Agricultural, Biological and medical application.

(07P, 05M)

Unit III: Nuclear Models

Single particle shell model: Introduction, Evidence for shell model, Theory of nuclear shell potential, nuclear spin and parities, limitations of shell model. Liquid drop model: Introduction, assumptions, semi-empirical mass formula.

(07P, 06M)

Unit IV: Nuclear Reactions

Theories of nuclear reactions, Conservation laws, Q-value equation, Energetic of exorgic reactions, Energetic of endorgic reactions, Threshold energy.

(07 P, 06M)

Unit V: Nuclear Energy.

Nuclear fission, Explanation on the basis of liquid drop model, energy available from fission, Estimation of energy from masses of fission fragments and binding energy, Nuclear chain reaction, Nuclear Fusion.

Nuclear Reactor: Basic principle, classification, constituents parts, Heterogeneous reactor, Swimming pool reactor, Breeder reactor.

(12P, 10M)

Unit VI: Nuclear Detectors and Accelerators.

Types of detectors, Geiger-Mueller counter, Scintillation counter, classification of accelerators, Cyclotron, Betatron.

(09P, 06M)

(Total: 52 Periods, 40 Marks)

References:

1) The atomic Nucleus: R D Evans, McGraw Hill Book Company.
2) Nuclear Physics: D C Tayal, Himalaya Publishing House, Bombay.
3) Nuclear Physics: Irving Kaplan, Narosa Publishing House, New Delhi.
4) Basic Nuclear Physics and Cosmic Rays: B N Srivastava, Pragati Prakashan, Meerut.

PHY: 314(A): Electronics II

Unit I: Semiconductor Devices.

Constructional details, symbols, working principle, V-I Characteristics of devices: - FET, UJT, SCR, DIAC, TRIAC. Introduction to MOSFET. Applications: - FET as VVR, FET as an amplifier, UJT as a switch, UJT as a relaxation oscillator, SCR as a switch, controlled rectification using SCR, lamp dimmer using DIAC.

(12 P, 08 M)

Unit II: DC Power Supplies.

Block diagram of unregulated and regulated power Supply, their merits and demerits, Series regulated power supply, Voltage regulation (Load and Line), Study of Monolithic voltage regulators: IC 723, Three-terminal ICs-78xx & 79xx (block diagram).

(10 P, 08 M)

Unit III: Differential Amplifier.

Introduction, black box concept, basic circuit of differential amplifier, different configurations of differential amplifier, CMRR, Need of constant current source.

(04 P, 04 M)

Unit IV:

a) Operational Amplifier: -

Block diagram, Schematic symbol, Pin diagram of IC 741, Parameters (definitions only): - Input impedance, output impedance, input offset voltage, open loop voltage gain, input bias current, slew rate. Ideal and practical characteristics of an Op-Amp, Concept of virtual ground, inverting and non-inverting amplifier with gain expression, off-set null.

b) Applications of Op-Amp.: - Adder, Substractor, Integrator, Differentiator, Comparator, Wien Bridge oscillator, Schmitt trigger, Astable multivibrator.

(14 P, 10 M)

Unit V: Digital Electronics.

a) Counters: -.

Asynchronous counter (4-bit), decade counter, Synchronous counter (4-bit), modulus of counter, mod-3 counter, mod-5 counter, up-down counter (3-BIT).

(08 P, 06 M)

b) Data Processing circuits: -Encoder, Decoder, Multiplexer (4 to 1 line), De-multiplexer (1 to 4 line), Shift Registers, Serial-in serial-out shift register, Serial-in parallel-out shift register.

(04 P, 04 M)

(Total: 52 Periods, 40 Marks)

References: -

1. Digital Principles and Applications - Leach, Malvino
2. Modern Digital Electronics - R. P. Jain
3. Operational Amplifier - G. B. Clayton
4. Operational Amplifier & Linear Integrated Circuits - R. A. Gaikwad
5. Integrated Circuits - K. R. Botkar
6. Principles of Electronics - V. K. Mehta
7. Electronic Principles - A. P. Malvino
8. Electronic Devices & Circuits - Allen Mottershead
9. Basic Electronics: B. L. Thereja

PHY314 (B): Instrumentation II

Unit I: Introduction to Instrumentation.

Functional elements of measurement system, classification of instrument, Analog and Digital type, Self-generating and power-operated type, Contacting and Non-contacting type. Define: Resolution, Threshold, Hysteresis, Dead band, Backlash, Drift.

Dynamic Characteristics of Instruments: - Introduction, Formation of system equations, Dynamic response (Periodic input-Harmonic Signal).

(12 P, 10 M)

Unit II:Transducer Elements.

Introduction, Classification of transducers. Study of Analog transducers: - Strain gages, LVDT, Potentiometric, Peizo-electrical. Study of Digital transducers:- Optical encoder, resistive digital encoder, Shaft encoder.

(10 P, 8 M)

Unit III:AC Bridges.

Introduction, General equation for bridge balance, General for of AC bridge, Maxwell's Inductance bridge, Anderson's Bridge, Carry foster Bridge, Campbell's Bridge.

(10 P, 8 M)

Unit IV:Data Acquisition system.

Introduction, Single channel Data Acquisition system. Digital to Analog converters (Binary weighted & R-2R ladder). Analog to Digital Converters: Successive approximation method, Single and dual slope integration

(10 P, 8 M)

Unit V:Input – Output Devices.

Strip chart recorder, Null type recorder, X-Y recorder, Magnetic tape recorder, LED, LCD.

(10 P, 6 M)

(Total: 52 Periods, 40 Marks)

References: -

1. Instrumentation: Measurement and analysis - Nakra and Chaudhary
2. Instrumentation: Device and system - Rangan, Mani, Sharm
3. Electronic Instrumentation and Measurement Techniques - Herrick Cooper
4. Electronic Instrumentation - H S Kalsi
5. Electrical and Electronic Measurement & Instrumentation - A. K. Sawhney
6. Electronic Measurement- U. A. Bakshi

PHY 324: Statistical Mechanics & Thermodynamics

UNIT: I - Probability Distribution:

Introduction to Statistical Mechanics, Basic concepts of probability, Probability distribution, Binomial distribution, Random walk problem in one dimension, General discussion of mean values, Calculation of mean values for random walk problem, Gaussian probability distribution (Ref 3: Article 2.18), Statistical independence.

(Ref. 1: Chapter - 1 and Ref. 2: Chapter -9) (11P, 08M)

UNIT II: Statistical Formulation.

Macroscopic & Microscopic states, phase space (Classical & Quantum), Statistical ensembles, Postulate of equal a priori probability, Accessible states, Behavior of density of state, Calculation of microstates of an ideal monatomic gas.

(Ref. 1: Chapter - 2, Ref. 2: Chapter -9 and ref. 3: Chapter – 4)) (10 P, 08M)

UNIT III: Statistical Thermodynamics.

Equilibrium conditions and constraints, Distribution of energy between systems in equilibrium, Boltzman relation for entropy, Approach to thermal equilibrium, Statistical calculations of thermodynamic quantities.

(Ref. 1: Chapter - 3) (08P, 06P)

UNIT IV: Ensembles.

Micro-canonical and canonical ensembles, their distribution functions, System with specified mean energy, Applications of canonical distribution such as Para magnetism & molecule in an ideal gas,

Calculation of mean values in canonical ensemble, connection with thermodynamic quantities, Partition functions and their properties, Equipartition theorem and its application to mean K.E.of a molecule in a gas and to Harmonic oscillator, Maxwell velocity distribution.

(Ref. 1: Chapter -6 and 7) (15P, 10M)

UNIT V: Thermodynamics.

Revision of thermodynamic potentials. Maxwell's equations from thermodynamic potentials, Two TdS equations, Energy equation, Ratio and difference of two specific heats.

(Ref. 4: Chapter -13 and Ref. 2: Chapter - 6) (08P, 08M)

(Total: 52 Periods, 40 Marks)

References:

1. Fundamental of Statistical & Thermal Physics: F. Reif (McGraw Hill)
2. Thermodynamics & Statistical Physics : Sharma & Sarkar (Himalaya Publishing House)
3. Fundamentals of Statistical Mechanics :B.B. Laud & nb p; (New Age International Publishers)
4. Heat & Thermodynamics : M.W. Zemansky

PHY 315: Solid State Physics

Unit I: The Crystal Structure.

Classification of solids (crystalline, amorphous & polycrystalline), Space lattice, Basis & crystal structure, symmetry operations, Types of lattices (2D & 3D), Miller indices, interplaner spacing. Some simple crystal structures (SC, BCC, FCC, CsCl, NaCl), Coordination number, Packing fractions for SC, BCC and FCC, Structures of diamond and Zinc blende (ZnS).

(12P, 10M)

Unit II: X-Ray Diffraction and Reciprocal lattice.

Crystal as a grating for X-rays, Bragg's diffraction condition, Bragg's law in reciprocal lattice, Ewald's construction, X-ray diffraction methods (Laue, Rotating crystal and Powder), Analysis of cubic crystal by powder method, The reciprocal lattice and its properties, Brillouin zones (1D & 2D).

(10P, 08M)

Unit III: Cohesive energy and Bonding in solids.

Cohesive energy and formation of molecules, Ionic bond and Madelung energy, Madelung constant for NaCl (1-D and 3-D), Covalent bond, Molecular bond, Metallic bond, Hydrogen bond

(10P, 06M)

Unit IV: Lattice Vibrations and Thermal Properties.

Lattice heat capacity, Classical theory of specific heat, Einstein's theory of specific heat, Vibrational modes of a 1-D monoatomic lattice, Debye's theory of specific heat of solids, Limitations of Debye model.

(10P, 08M)

Unit V: The free electron theory of metals and Band theory of solids.

Drude-Lorentz theory, Sommerfield's model, Free electron gas 1-D and 3-D, Density of states, Fermi energy. Energy band formation, Distinction between metals, semiconductors and insulators, Concept of hole and Hall effect.

(10P, 08M)

(Total: 52 Periods, 40 Marks)

References:

1. Introduction to Solid State Physics: C.Kittle.
2. Solid State Physics : A.J.Dekkar
3. Introduction to Solids : L.V.Azaroff
4. Solid State Physics : S.L. Gupta, V.Kumar.
5. Solid State Physics : S.L. Kakani, C. Hemrajan
6. Solid State Physics : C.M. Kachhava
7. Solid State Physics : R.L.Singhal, Kedar Nath, Ram Nath & Co.
8. Fundamentals of Solid State Physics: B.S. Saxena, R.C. Gupta, P.N. Saxena, Pragati Prakashan, Meerut
9. Concepts of Solid State Physics : J.N. Mandal, Pragati Prakashan, Meerut.
10. Solid State Physics : R. K. Puri and V. K. Babbar

PHY 325: Element of Material Science

UNIT I: INTRODUCTION.

Historical perspectives of materials science (1.1), Why study materials science? (1.3), Classification of materials (1.4), Advanced materials (1.5), Materials of future (1.6), Modern materials need (1.7).

(04 P, 03 M)

UNIT II: PROPERTIES OF MATERIALS.

Mechanical Properties: Introduction (1.6.1) Concept of stress and strain (1.6.2)

Elastic deformation: Stress-strain behavior (1.6.3), Elasticity (1.6.4), Elastic properties of materials (1.6.5)

Plastic deformation: Tensile properties (1.6.6), Free stress and strain (1.6.7), Hardness (1.6.10)

Electrical Properties: Introduction (1.18.1) Electrical conduction: Ohm's law (1.18.2), Electrical conductivity (1.18.3), Electronic and ionic conduction (1.18.4), Ferro electricity (1.18.24), Piezoelectricity (1.18.25).

*Thermal Properties:*Introduction (1.19.1) Heat capacity (1.19.2), Thermal expansion (1.19.3), Thermal conductivity (1.19.4), Thermal stresses (1.19.5).

*Magnetic Properties:*Introduction (1.20.1), Antoferromagnetism and Ferrimagnetisms (1.20.5), Influence of temperature on magnetic behavior (20.6), Superconductivity (1.20.11).

(18 P, 15 M)

UNIT III: IMPERFECTIONS IN SOLIDS.

Introduction (1.4.1). *Point Defects:* Vacancies and self interstitials (1.4.2), Impurities in solids (1.4.3) Specification of composition (1.4.4).

Miscellaneous Imperfections: Dislocations – Linear defects (1.4.5), Interfacial defects (1.4.6), Atomic vibrations (1.4.8)**.**

(08 P, 06M)

UNIT IV: DISLOCATIONS AND STRENGTHENING MECHANISMS.

Introduction (1.7.1) *Dislocations and Plastic Deformation*: Basic concepts (1.7.2), Characteristics of dislocations (1.7.3), Slip system (1.7.4), Slip in single crystals (1.7.5), Plastic deformation of polycrystalline materials (1.7.6).

Mechanisms of strengthening in metals: Strengthening by grain size reduction (1.7.8), Solid solution strengthening (1.7.9), Strain hardening (1.7.10).

Recovery, Recrystalization & grain growth: Recovery (1.7.11), Recrystallization (1.7.12), Grain growth (1.7.13).

(08 P, 06 M)

UNIT V: DIFFUSION.

Introduction (1.5.1), Diffusion mechanism (1.5.2), Steady sate diffusion (1.5.3), Non- steady sate diffusion (1.5.4), Factors that influence diffusion (1.5.5).

(06P, 04M)

UNIT VI: PHASE DIAGRAM.

Introduction (1.9.1), *Definitions and Basic concepts:* Solubility limit (1.9.2), Phases (1.9.3), Phase Equilibria (1.9.5)

Equilibrium Phase Diagrams: Binary Isomorphous system (1.9.6), Interpretation of phase diagrams (1.9.7), Binary eutectic system (1.9.10), Equilibrium diagrams having intermediate phases or compounds (1.9.12), Eutectoid and peritectic reactions (1.9.13)

(08 P, 06 M)

(Total: 52 Periods, 40 Marks)

References:

1. Materials Science & Engineering An Introduction (6th Edition); By William D. Callister Wiley Student Edition, India.
2. Elements of Materials Science & Engineering: Van Vlack
3. First Course in Materials Science & Engineering: Raghavan.

PHY 316 (A): Technical Electronics- I.

Unit I: Components and devices.

Resistors, Capacitors, Inductors (Types, construction and specification), Identification of resistor and capacitor values, Transformers: Types, (Single phase power transformer, auto transformer, isolation, AF, RF, IF), Relay: Types (list only), Electromagnetic relay: Principle, Construction and Working, Display devices: Seven segment display, Liquid Crystal Display (LCD).

[R1 to R5] (12P, 10M)

Unit II: Printed Circuit Board.

Idea of PCB, advantages, copper clad, Etching processes, Different steps for making PCB, Precautions while making PCB, Principle of Photolithography.

[R4 and R5] (08P, 06M)

Unit III: Transducers I.

Definition, Classification, Electrical transducer: Thermister, Thermocouple, Pressure Transducer: Strain gauges, Displacement transducer: LVDT.

[R3 and R6] (10P, 08M)

Unit IV: Data Converters.

D to A Converters: Resistive divider network, Binary ladder network.

A to D Converters: Voltage to Frequency, Voltage to Time (Single slope, Dual slope)

[R7 and R8] (10P, 06M)

Unit V: Measuring instruments.

Analog Multimeter (Simpson 260): Volt- Amp-Ohm meter

Cathode Ray Oscilloscope: Block Diagram , Front Panel Control.

Function Generator :Block Diagram and feature.

Digital Frequency meter (Frequency mode only):Block diagram & features,

Digital Voltmeter (Ramp type only): Block diagram & features.

[R9 to R13] (12P, 10M)

(Total: 52 Periods, 40 Marks)

References:

1. Basic Electronics: B. Grob McGraw Hill Book Co. New York, (8^{th} edition).
2. Understanding electronic components: F. J. Water, D.B. Taraporavala and Sons & Co. Pvt. Ltd. New Delhi.
3. Basic Electronics Solid state - B. L. Thereja
4. Electronic components and materials: Principles, Manufacture and Maintenance S.M. Dhir, Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Electronic components and materials – Madhuri Joshi, Wheeler Publication, Delhi (2^{nd} edition).
6. Transducers and display systems: B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Digital principles and applications: A.P. Malvino and D. P. Leach. Tata McGraw-Hill.
8. Data Conveters– B. S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
9. Electronic Measurements: U.A. Bakshi, V.V. Bakshi, Technical Publication, Pune
10. Modern Electronic Instruments and Measurement techniques- Albert D. Helfrick, Willam D. Cooper, Prentice Hall India Pvt. Ltd, New Delhi.
11. A course in electrical and electronic Measurements and Instruments: A. K. Sawhney, Dhanpat Rai and Sons.
12. Instrumentation Devices and system (2^{nd} edition) – C. S. Rangan, G. R. Sharma, V. S. V. Maini, Tata McGraw Hill Pvt.Ltd, New Delhi.
13. Components and Devices technology- A. B. Gogate, P. C. Rao, D.V. Sutrave, Nirali Prakashan.

PHY 326 (A): Technical Electronics- II.

Unit I: Sound System.

Microphones, loud speakers, Public address system: Need for public address system, block diagram of public address system and it's explanation, Installation planning, Sound pressure level (SPL) measurement

Ref. 1, Ref 2, Ref 3. (12P,10 M)

Unit II: Audio amplifiers and their subsystems.

Introduction, Concept of Hi –Fi sound, Mono phony, Stereophony and Quadraphony, Dolby A and Dolby B system, Graphic Equalizer (circuit expected)

Ref. 1, Ref 2, Ref 3.

(08P,06M)

Unit III: Medical instruments.

Biopotential, Types of electrodes, cardiovascular system, ECG (principle, block diagram, features)

Ref. 1, Ref 2, Ref 3.

(10P, 06M)

Unit IV: Transducer II.

Peizo-electric Transducer, Optoelectronic transducers: LDR, Chemical sensors: PH sensor, Gas sensor (Fundamental aspects), Humidity sensor.

Ref. 1, Ref 2, Ref 3. (10P, 08 M)

Unit V: Modern appliances.

Remote control : Operating principle, block diagram, features
Microwave Oven: Operating principle, block diagram, features
Fax machine: Operating principle, block diagram, features
CD player: Block Diagram, Optical assembly for reading C.D.
Washing machine: Operating principle, block diagram, features, Fuzzy Logic (Idea only),
Electronic weighing machine: Principle, Block diagram, features.

Ref. 1, Ref 2,Ref 3. (12 P,10 M)

(Total: 52 Periods, 40 Marks)

References:

1. Audio and Video Engineering System: R.G. Gupta, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Basic Electronics --B. L. Thereja
3. Introduction to Bio-medical Electronics: Joseph-Du-bary ,McGraw Hill Co.Ltd.
4. Medical instrumentation Application and design- J.C.Wobster
5. Biomedical instruments and measurements – Lesline.Cromwell, Fred J Weibell, Pretice hall of India of India Pvt. Ltd, New Delhi.
6. Transducers and display systems: B.S. Sonde, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Ceramic Sensors Technology and Application- T.G.Nenov and S.P.Yordanov, Technomic Publishing Co. U.S.A.
8. Solid state Gas sensors- edited by P. T. Moseley and B.C. Tofeld, Harwell, Adam Hilger and philadelphia
9. Consumer Electronics: J.S. Chintode, Technical Publication, Pune.

PHY 316(B): Refrigeration and air conditioning-I

Unit I: Introduction to Heat Transfer:

Introduction, Conduction through slab, pipe, hollow sphere, Convection, Heat transfer by convection, combined conduction and convection heat transfer, Fins and their applications.

(Ref. 1: Chapter -15) (6P, 4M)

Unit II: Methods of Refrigeration:

Introduction, Ice refrigeration, Evaporative refrigeration, Refrigeration by expansion of air, Refrigeration by throttling of a gas, Vapour refrigeration, Units of refrigeration, Concept of C.O.P. and E.P.R.

(Ref. 1: Chapter - 2) (6P, 4M)

Unit III: Air Refrigeration system:

Introduction, Reversed Carnot cycle and as most efficient refrigerator, C.O.P. and its dependence on source and sink temperature, Bell-Coleman air refrigeration system, Advantages and disadvantages of air refrigeration system.

(Ref. 1: Chapter - 3) (6P, 6M)

Unit IV: Vapour Refrigeration system:

i) Simple Vapour Compression Refrigeration system:

Vapour compression refrigerator, Construction of various lines on T – S chart, P- H diagram for vapour compression refrigeration, Analysis of vapour compression system Advantages and disadvantages of vapour compression refrigeration over air refrigeration system.

(Ref. 1: Chapter -4)

ii) Absorption Refrigeration system:

Introduction, Simple absorption system, Practical ammonia absorption system, C.O.P. of the absorption refrigeration system, Domestic Electrolux refrigerator, Advantages and disadvantages of absorption refrigeration over compression refrigeration system.

(Ref. 1: Chapter -6) (14P, 12M)

Unit V: Refrigerants: ***p6, M 4***

Classification of refrigerants: primary and secondary refrigerants, Desirable thermodynamic, safe working and physical properties of refrigerants, important refrigerants, refrigerant nomenclature, selection of refrigerant.

(Ref.1: Chapter -11) (6P, 4M)

Unit VI: Refrigeration equipments. ***p14, M 10***

Compressors: Functions, Reciprocating compressor, Hermetically sealed compressor, Rotary compressor with sealing blade and eccentric motor.

Condensers: Functions, Air cooled and water cooled condensers, Evaporative condensers, cooling towers.

Evaporators: Functions, Primary and Secondary evaporators, flooded evaporators, Dry expansion systems, Shell & coil evaporators.

Expansion Devices: Functions, Automatic expansion valve, Thermostatic expansion valve, Solenoid control valve, Low side and high side float valves.

(Ref.1: Chapter -13) (14P, 10M)

(Total: 52 Periods, 40 Marks)

Reference Books:

1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar. Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd Edition
3. Principles of Refrigeration : Roy J Dossat , Pearson Education (Singapur) Ltd. 4th Edition.

PHY 326(B): Refrigeration and air conditioning-II

Unit I: Psychrometry :

Introduction, Meaning of air conditioning, Five main factors of comfort air conditioning, Psychrometry and psychrometic properties, psychrometic relations : Dalton's law of partial pressure; relation between partial pressure & specific humidity; relation between degree of saturation & relative humidity, Types of psychrometers, Psychrometic processes, Bypass factor and its relation, Summer air conditioning systems for Hot & Dry; Hot & Humid out door conditions, Summer air conditioning with evaporative cooling, Winter air conditioning system for mild cold weather.

(Ref. 1: Chapter -16) (10P, 8M)

Unit II: Cooling load calculations & design of air conditioning systems:

Different heat sources, Heat flow due to conduction, Sun load, Occupants load, Equipment load, Infiltration load, Miscellaneous heat sources, Design aspects of air conditioning system, Cooling load and air quantities.

(Ref. 1: Chapter -19) (8P, 6M)

Unit III: Air Conditioning equipments:

Air Filters: Functions, Types, Wet filters, Electronic filters, Centrifugal dust collector.
Cooling Coils: Bypass factor of multidepth coils.
Humidifiers: Functions,Atomization type humidifiers, Impact type humidifiers, Pan & coil type humidifiers.
Dehumidifiers: Functions, Refrigeration humidifiers, Spray type humidifiers, Dehumidifying air washers.
Fans & Blowers: Functions, Axial flow fans, Centrifugal fans.
Grills and Registers.

(Ref. 1: Chapter -25) (10P, 8M)

Unit IV: Air Conditioning Control systems:

Basic elements of control systems, Temperature control elements: Bimetal type thermostat, Sealed bellow type thermostat, Electrical resistance and thermocouple type thermostat.
Humidity Control Elements: Hair type humidostat, Absorption type thermostat, Water vapour recorder.
Actuators: Relays
Introduction to Transmission systems.
Pre heat and humidification control systems, Cooling dehumidification and reheat control, Face and bypass control system.

(Ref. 1: Chapter -26) (12P, 10M)

Unit V: Solar Air Conditioning : ***Heating & Cooling: p12, M 8***

Vapour Compression Refrigeration system using solar energy, Vapour absorption refrigeration system using solar energy,Solar refrigeration using a solid absorption cycle,Solar refrigerators sing Photovoltaic panels, Year round solar air conditioning system, Solar air conditioning system developed at I. I. T. Chennai.

(Ref.1: Chapter -28) (12P, 8M)

(Total: 52 Periods, 40 Marks)

Reference Books:

1. A course in Refrigeration and Air –Conditioning: S.C. Arora & S. Domkundwar. Dhanpat Rai & Co. 7th Edition
2. Basic Refrigeration and Air –Conditioning: P.N. Ananthanarayanan , Tata Mcgraw Hill, New Delhi 3rd Edition

PHY 316(C) : Vacuum Technology-I

Unit I: Basics for Vacuum:

Atmosphere and Vacuum, Gas pressure, Equations of ideal gas, Fundamental assumption of kinetic theory of gas, Mean free path, Gas diffusion, Viscosity of gas, Thermal conductivity, Adsorption, Absorption, Desorption.

[Period 8, Marks 6]

Throughput and Speed, Different units of measurement of vacuum, Ranges of vacuum, Vacuum circuits: Impedance and Conductance, Mechanism of gas flow, pumping speed of vacuum pump.

[Period 10, Marks 8]

Unit II: High vacuum pumps:

Rotating vane type rotary pump: principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics.

Oil diffusion vapour pump(single stage, multistage): principle, construction, working, ultimate pressure attainable, factors on which the optimum performance of the pump depends, pump characteristics.

[Period 10, Marks 8]

Unit III: Ultrahigh vacuum pumps:

Turbomolecular pump, sorption pump, Ion pump, Getter pump, Cryogenic pump: principle, construction, working, ultimate pressure attainable.

[Period 12, Marks 10]

Unit IV: Vacuum gauges:

U-tube manometer, Mc-Leod gauge, Thermal conductivity gauges- Thermocouple gauge, Pirani gauge, Semiconductor gauge. Ionization gauges- Hot cathode and Cold cathode gauge and Bayard-Alpert gauge.

[Period 12, Marks 8]

TOTAL [Period 52, Marks 40]

References:

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington.

PHY 326(C) : Vacuum Technology-II

Unit I: Vacuum materials and components:

Diffusion and penetration of gases through solid surfaces, Vapour pressure of different materials, Outgassing of materials, Desired properties of materials used for fabrication of vacuum system.

[Period 8, Marks 6]

(i) **Vaccum Seals** : (a) Permanent seals- Welding, Brazing, Soldering (b) Demountable seals- Waxes, Resins and Adhesives, Gaskets seal: Elastomer, metal, Feedthroughs : Electrical Feedthroughs, Motion Feedthroughs: Wilson seal, Bellows seal.

(ii) **Valves** : (a) Roughing and For-line valves: Disk valve, Ball valve. (b) High vacuum valves: Gate valve, disk valve, flap valve, Butter-fly valve. (c) Gas admittance valves: disk valve, Needle valve.

[Period 16, Marks 10]

Unit II: Leak detection:

Real and Virtual leaks, Leak detection method: (a) Over pressure method- Bubble method, Halide torch, Sniffer technique. (b) Low pressure method- Blocking (sealing) method, Tesla coil, Halogen leak detector, Organic vapour and gas probe with suitable pressure gauge as detector.

[Period 12, Marks 10]

Unit III: Vacuum system fabrication:

- General consideration of designing.
- Construction of High vacuum system (Combination of Rotary and Oil diffusion pump). Its operational procedure.
- Construction of Ultrahigh vacuum system and its operational procedure.

[Period 10, Marks 8]

Unit IV: Application of Vacuum Technology:

Application of Vacuum technology in Research and Industry. (State applications only)

[Period 6, Marks 6]

TOTAL [Period 52, Marks 40]

References*:*

1. Introduction to Theory and Practical of High Vacuum Technology : L.Ward & J.P. Bunn, Butterworths.
2. High Vacuum Techniques : J. Yarwood.
3. Design and Construction of Vacuum systems : G.W. Green.
4. Vacuum Sealing Techniques : A. Roth
5. High Vacuum Engineering : A.E. Barrington.

PHY: 316(D): Microprocessor-I

Unit-I: MEMORY.

Semiconductor memory, magnetic memory, optical disc, C CD memory, Cache memory, Memory Hierachy, program and data memory, Destractive and Non destractive Read Out ,Direct Access Storage Device, Serial Access Storage Devices, on-line and off-line Devices, RAM Disk, Real and virtual memory, Associative and Set-Associative memory, MMU (memory magnet unit), PCMCIA cards and slots .
Ref 1: page 1.12 to 1.29 (16P, 12M)

Unit-II: Microcomputer Fundamentals.

Simplified microcomputer Architecture, Microcomputer operation, Address bus, Data bus, control bus, High level and law level language, Assembler, compiler, Interpreter.
(06 P, 06 M)

Unit-III: Architecture of 8085 Microprocessor.

The 8085 pin diagram and function of each pin, Intel 8085 Microprocessor Architecture and function of each block.
(08P, 06M)

Unit-IV: Instruction set of microprocessor 8085.

Different Addressing Methods for 8085, Different groups and types of instructions of 8085microprocessor.
(22P, 16 M)
Total: (52P, 40M)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram, Dhanpat Rai & Sons, Delhi.
2. Microprocessor Fundamentals – Roger-L-To Kheim.
3. Digital Computer Electronics – Alber Paul Malvino.
4. 8085 Assembly Language Programing – L. A. Leaventhal.
5. Microprocessor Architecture programming and Applications 8080 & 8085 - Ramesh Gaonkar.
6. 8086 Microprocessor programming and Interfacing – Gibson.
7. Advance Microprocessor and peripherals (Architecture, programming and interfacing) – A. K. Ray, K. M. Bhurchandi.

PHY: 326 (D) Microprocessor-II

Unit I: Assembly Language Programming.

Arithmetic programs:- '8' bit addition, 8 bit subtraction, Decimal addition and subtraction of two '8' bit numbers, one's and two's complement of 16 bit numbers, To find largest and smallest numbers from a series of number, 8 bit multiplication, masking of 4 MSB of given number.

Code conversion, ASC II code, Hex to ASC II conversion, Decimal to seven segment conversion and BCD to binary conversion.

(22 P, 16 M)

Unit II: Interfacing Of Memory and Peripheral Devices.

Introduction, Interfacing with RAMS & ROMS, I/O interfacing basics, interfacing with practical I/O Memory mapped I/O and I/O mapped I/O schemes, Direct Memory Access (DMA) data transfer.

(10 P, 10M)

Unit III: Programming Peripheral Interface (PPI).

Architecture of Intel-8255, pin diagram, functions of each pin, control word format, mode-0, mode-1 & mode-2 operation.

(08 P, 6M)

Unit IV: Programmable counter/ Interval Timer.

Intel 8253, Reading while counting, operation, MODE 0, MODE 1, MODE 2, MODE 3, MODE 4, MODE 5.

[I: 7.32 to 7.47] (12 P, 8M)

Total: (52P, 40M)

References:

1. Fundamentals of Microprocessors and Microcomputers – Badri Ram,
2. Dhanpat Rai & sons, Delhi.
3. Microprocessor Fundamentals – Roger-L-To Kheim.
4. Digital Computer Electronics – Alber Paul Malvino.
5. 8085 Assembly Language Programing – L. A. Leaventhal.
6. Microprocessor Architecture programming and Applications 8080 & 8085 - Ramesh Gaonkar.
7. 8086 Microprocessor programming and Interfacing – Gibson.
8. Advance Microprocessor and peripherals (Architecture, programming and interfacing) – A. K. Ray, K. M. Bhurchandi.

PHY 316(E): Programming in C+ + -I

Unit I: Elements of C++:-

What is C++?, applications of C++ ,comments, I/O streams, structure of C++ program. (4M, 4P)

Unit II: Variable & Expressions:

Variables, tokens, keywords, identifiers and constants, basic data types, user defined data types & derived data types. Declaration and initialization of variables.

(8M, 10P)

Unit III: Operators in C++:

Scope resolution operators, member dereferencing operator, memory management operators, manipulators, type cast operator, expressions and their types.

(8M, 10P)

Unit IV: Control structure:-

if, if-else, else-if, switch, break, continue,

Loop structures: while, do while, for, nested for loop. (8M, 12P)

Unit V: Functions in C++:

Introduction, function prototyping, call by value & call by reference, Inline functions, reference arguments and default arguments. Math library functions.

(8M, 12P)

Unit VI: Introduction to arrays, structures & union in C++ :

Definition, declaration, examples.

(4M, 4P)

Total: (52P, 40M)

Reference Books:-

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

PHY 326(E): Programming in C+ + -II

Unit I: Objects & Classes:- Simple classes (class specification, C++ objects, accessing class members), constructors and destructors, constant member functions. (6M, 7P)

Unit II: Functions and operator overloading:- Overloading functions, introduction to operating overloading, overloading unary and binary operators, overloading arithmetic assignment operator. (8M, 12P)

Unit III: Inheritance:- Derived class and base class, derived class constructors, public and private inheritance, multiple inheritance, hierarchical inheritance, multilevel inheritance, containership (classes within classes) **(**8M, 12P)

Unit IV: Virtual functions:- Virtual functions, pure virtual functions, friend functions, Static functions, copy constructor, this pointer. (6M, 7P)

Unit V: Generic programming:- Introduction to template, function within template, introduction to exceptional handling. (5M, 6P)

Unit VI: File and streams: Input/Output streams, classes for steam operation, opening and closing files, file pointers and their manipulations, error handling during file operations. (7M, 8P)

Total: (52P, 40M)

Reference Books:-

1. Master in C++ - K.R.Venugopal
2. C++ Programming - E.Balaguruswami
3. Turbo C++ Programming - Robert Lafore
4. C++ Programming - Yashwant Kanitkar.

PHY 316 (F): SOLAR ENERGY I

Unit I: Introduction

Energy demand and energy resources, Fossiel fuels, hydroelectric energy, nuclear energy: Utilization and limitations, Indian energy scenario.

(10 P, 08 M)

Unit II:Solar Energy

Importance of solar energy, Solar radiations; Beam, diffuse and global radiation, characteristics of sun, Spectral distribution of extra-terrestrial radiation, Instruments for measuring solar radiation, Pyranometer, Pyrheliometer.

(10 P, 08M)

Unit III: Thermal Devices

Basic principle, different types of solar collectors, solar dryer, solar pond, solar distillation, solar concentrators, Applications of solar concentrating collectors.

(10P, 08M)

Unit IV: Flat Plate Collector

Construction, principle of operation, transmission of beam and diffuse radiation through the glass cover system, liquid and air flat plate collectors.

(10P, 08M)

Unit V: Selective Coating

Selective coating, Ideal characteristics of selective coatings for various applications, Types of selective coatings, materials and techniques for making selective absorbers, Effect of selective coating on the efficiency of solar collectors.

(08 P, 08M)

(Total: 52 Periods, 40 Marks)

References:

1. Solar Engineering and Thermal Processes – Duffie J. and W. Beckman (1991), John Willey and Sons Inc.
2. Solar Energy- Principles of Thermal Collection and Storage- Sukhatme S. P., Second Edition, Tata Mac Graw Hill Co. Ltd.
3. Solar Energy Fundamentals and Applications – Garg H. P. and Satyaprakash (2000), Tata Mac Graw Hill Co. Ltd.
4. Solar Power Engineering – Magal B. S. (1990), Tata Mac Graw Hill Co. Ltd.
5. Renewable Energy Sources and Conversion Technology – Bansal N. K., M. K. M. Meliss (1990), Tata Mac Graw Hill Co. Ltd.

PHY 326 (F): SOLAR ENERGY II

Unit I: Introduction.

Fundamentals of photovoltaic energy conversion, Principle, & Construction of solar cell and its working principle, Materials for solar cells, Applications of solar cell, Advantages of solar cell over dry cells.

(08P, 06M)

Unit II: Review of Semiconductor Properties.

Introduction, crystal structure and orientations, forbidden energy gaps, probability of occupation of allowed states, dynamics of electrons and holes, energy density of allowed states, Bond model of group IV semiconductor, group III and group V dopants, carrier densities, location of Fermi level in doped semiconductors.

(10 Marks, 12 Periods)

3. P N JUNCTION DIODES:

Introduction, electrostatics of p n junction, junction capacitance, carrier injection, dark characteristics, illuminated characteristics, solar cell output parameters.

(10 Marks, 11 Periods)

4. EFFICIENCY LIMITS, LOSSES AND MEASUREMENT:

Introduction, efficiency limits: general, short circuit current, open circuit voltage and efficiency, efficiency limits for black body cell, effect of temperature, efficiency losses: general, short circuit current losses, open circuit current losses, efficiency measurement.

(08 Marks, 09 Periods)

5. PHOTOVOLTAIC SYSTEMS: COMPONENTS AND APPLICATIONS:

Introduction, energy storage: electro chemical batteries, large capacity approaches, Power conditioning equipments, photovoltaic applications.

(6 Marks, 8 Periods)

(Total: 52 Periods, 40 Marks)

References:

1. Solar Cells Operating Principles, Technology and System Applications – Martin A. Green, University of New Wales, Australia.
2. Solar Energy- Principles of Thermal Collection and Storage- Sukhatme S. P., Second Edition, Tata Mac Graw Hill Co. Ltd.
3. Solar Energy Fundamentals and Applications – Garg H. P. and Satyaprakash (2000) Tata Mac Graw Hill Co. Ltd.
4. Solar Energy Utilisation – G. D. Rai, (2004), Khanna Publishers.
5. Solar Thermal Engineering – Duffie J. A.

PHY 307: Practical Course-I

Section I

Perform ANY Eight experiments

(Mechanics & Properties of Matter, Heat, Statistical Physics, Atomic, Molecular & Nuclear Physics)

1. Surface Tension by Quinkes method
2. Surface Tension by soap bubble method
3. Viscosity by Rotating cylinder method
4. Y and η by Searle's method.
5. Y by Koenig's method
6. Determination of 'g' by conical pendulum.
7. Bifilar suspension with stop watch.
8. Stefen's constant.
9. Thermal conductivity of metal by Forbe's method.
10. Thermal conductivity of rubber by rubber tubing method.
11. Jolly steam calorimeter
12. Verification of Classius- Clapeyron's Latent Heat equation.
13. Verification of certain laws of probability distribution. (Ref. B. Sc. Practical Physics – C. L. Arora, S. Chand Publication, Page 120 – 123).
14. G.M. conter

Section II

Perform ANY Eight experiments

(Optics, Laser, Electricity and Magnetism, Sound)

1. μ by total internal reflection
2. Resolving power of grating
3. Searl's Goniameter.
4. To estimate temperature of Na flame
5. Lyod's single mirror.
6. λ by Michelson Interferrometer.
7. Diffraction by straight edge/ cylindrical obstacle
8. Determination of circular aperture of laser
9. Study of oscillatory charge and discharge through an inductance and resistance
10. Frequency of A.C./ tunning fork by stroboseope
11. Electromagnetic Pendulum
12. Determination of velocity of sound using Ultrasonic Interferometer.
13. To determine the human audibility
14. Variation of Resistance of a filament of a bulb with its temperature (Ref. B. Sc. Practical Physics – C. L. Arora, S. Chand Publication, Page 252- 253).

PHY 308: Practical Course-II

Section I

Group A. Perform ANY Four experiments

(Solid State Physics, Material Science, Thermodynamics)

1. Ionic conductivity of NaCl
2. Measurement of resistivity by two probe method
3. Measurement of resistivity by four probe method
4. Determination of currie temperature of Ferrite
5. Specific heat of graphite at different temperatures
6. Hall effect
7. To study characteristics of thermisters
8. Analysis of XRD

Group B. Perform ANY Four experiments

(Electronics, Instrumentation)

1. SCR characteristics
2. Build and test ERPS using transistor
3. Study of RC/ LC filter
4. UJT characteristics/ UJT as relaxation oscillator
5. FET VVR
6. 4 to 1 line multiplexer/ demultiplexer (Using IC 7400 to 7490)
7. Wien briedge oscillator using IC- 741
8. Measurement of self inductance using Maxwells Inductance Bridge/ Anderson's Bridge
9. Measurement of displacement using LVDT
10. Instrumentation Amplifier
11. OP-AMP characteristics (Input impedance, Output impedance and CMRR)
12. Binary weighted DAC convertor/ DAC (R-2R ladder using OP AMP)

Section II

Optional Course:- Perform ANY Eight experiments

A:- Technical Electronics

1. To make two PCB's
2. i. Using discrete components ii. Using IC components
3. Thermister as a thermometer using IC 741
4. To study characteristics of LDR
5. DAC (R- 2R ladder, without OP- AMP)
6. Study of IC 7490
7. Half wave and full wave precision rectifier using OP AMP
8. Triangular, square wave generator using OP AMP
9. Study of P. A. system (series and parallel connection of two speakers)
10. Study of OP AMP as an adder and subtractor
11. Study of OP- AMP as a differentiator and integrator
12. Study of strain gauges
13. Designing and fabrication of transformer
14. Study of a function generator
15. Study of E.C.G.

Section II

Optional Course:- Perform ANY Eight experiments

B:- Refrigeration and air conditioning

1. Study of different tools used in Refrigeration & Air Conditioning.
2. To carry out the following operations on Copper tube:
   i.) Cutting ii) Bending iii) Flaring
3. To carry out Swaging and Brazing of Copper tubes.
4. Study of hermetically sealed compressor used in refrigeration systems.
5. Study of thermostatic switch, LP/HP cut out switch and filters used in Refrigeration and A.C. systems.
6. Leakage testing and charging of a refrigeration system.
7. To find the COP of a domestic refrigeration system.
8. Detection of trouble/faults in a refrigerator and window air conditioner.
9. Dismantling of Window type A.C. and testing after assembly.
10. Visit to a cold storage plant.
11. Visit to a centrally air conditioned building.
12. Visit to a Ice plant.

Section II

Optional Course:- Perform ANY Eight experiments

C:- Vacuum Technology

1. To describe function of various parts of Rotary pump (with schematic diagram)
2. To describe the constructional details & working of vapour diffusion pump.
3. Study of McLeod gauge (Vaccu-stat)
4. To measure the pumping speed of vacuum system by steady state method.
5. To calibrate & study the function of Pirani guage.
6. To measure the pumping speed of vacuum system (use of Gaedes equation)
7. To evacuate a system with a rotary pump (measurement of vacuum with & without ballest using McLeod gauge)
8. Demonstration of oil diffusion pump & to evacuate the system & to measure the ultimate vacuum.
9. To study the effects of conductance of pumping speed of oil diffusion pumping module.
10. Deposition of metallic thin film.
11. To investigate the variation of pumping speed of vapour diffusion pumping module with the pressure in vacuum system.

Section II

Optional Course:- Perform ANY Eight experiments

D:- Microprocessor

1. 8-bit decimal addition/subtraction.
2. Find largest/smallest number from series of 8-bit numbers.
3. Find square root from look up table.
4. Conversion of Hex to ASCII code.
5. 8-bit binary multiplication.
6. Up-down counter (4-bit).
7. Multiplexer/Demultiplexer using IC.
8. Hexadecimal/decimal counter.
9. LED interface (Time delay generation).
10. Application of DAC (square/triangular sweep wave)
11. Interfacing of thumbwheel switch.
12. Study of shift register (using IC)

Section II

Optional Course:- Perform ANY Eight experiments

E:- Programming in C+ +

1. Write a C++ program to display the string "T. Y. B. Sc. Physics"
2. Write a C++ program to make addition, subtraction, multiplication & division.
3. Write a C++ program to demonstrate use of scope resolution operator.
4. Write a C++ program to check whether given no. is palindrome or not.
5. Write a C++ program to demonstrate use of inline function for finding maximum of two numbers.
6. Write a C++ program to accept array elements as positive and negative nos. & only print positive nos. as output (use continue statement)
   e.g. {10, -20, 3, 5,-7}
   O/P: {10,3,5}
7. Write a C++ program to generate Fibonacci series upto 20 terms
   e.g. 1,1,2,3,5,8,…… (20 terms)
8. Write a C++ program to create following structure,
   Roll-No. Stud-Name Class
   Enter at least five records.
9. Write a C++ program to implement string operations.
   i) strlen( )
   ii) strcat( ) as class members
10. Write a C++ program to swap two integers, two floats and two character variables using function overloading.
11. Write a C++ program to demonstrate use of constructors and destructors
12. Write a C++ program to overload + operator to add two complex nos.
13. Write a C++ program to implement hierarchical inheritance
14. Write a C++ program to implement multiple inheritance
15. Write a C++ program to implement virtual functions
16. Write a C++ program to demonstrate use of function templates.

Section II

Optional Course:- Perform ANY Eight experiments

F:- Solar Energy

1. Study of Power versus load characteristics of Solar Photovoltaic panel.
2. Study of Series combination of Solar Photovoltaic panels.
3. Study of Parallel combination of Solar Photovoltaic panels.
4. Study of Solar Lantern/ Street light.
5. Determination of Calorific value of Coal/Cow dung.
6. Study of Solar Box Cooker: Evaluation of F_1 and F_2.
7. Study of Solar still for Water distillation.
8. Study of Solar Hot water system.
9. Study of Concentrating type Solar Cooker – SK 14.
10. Study of Solar Dryer: Hot air collector

PHY 309: Project

A weightage of sixteen Experiments.

Note: Start the project work at the beginning of the first term.