POST GRADUATION DEPARTMENT OF APPLIED PHYSICS AND BALLISTICS, F. M. UNIVERSITY, BALASORE

SYLLABUS FOR THE COURSE M. SC. IN APPLIED PHYSICS AND BALLISTICS

2017 onwards

P.G. Department of Applied Physics and Ballistics

Approved by BOS on Dt. 20.09.2017

(Regular Mode)

M.Sc. in Applied Physics and Ballistics		
Semester	Marks	Credit
1st semester	300	24
2nd semester	300	24
3rd semester	300*	24*
4th semester	300	24
Total	1200	96
* choice based credit paper is selected by the student of other PG Depts.		

P.G. Department of Applied Physics and Ballistics

Syllabus structure

M.Sc. in Applied Physics and Ballistics (Regular Mode)

First Semester

Code	Name	Mark	Credit
APAB-101	Classical Mechanics	50	04
APAB-102	Mathematical Methods in Physics	50	04
APAB-103	Electronics & Computer Programming	50	04
APAB-104	General Instrumentations	50	04
APAB-105	Practical: Electronics	100	08
	Total	300	24

Second Semester

Code	Name	Mark	Credit
APAB-201	Statistical Mechanics	50	04
APAB-202	Quantum Mechanics	50	04
APAB-203	Fluid Dynamics	50	04
APAB-204 (A)	Internal Ballistics	50	04
APAB-205	Practical: Computational Physics:	100	08
	Total	300	24

Third Semester

Code	Name	Mark	Credit
APAB-301	Solid State Physics	50	04
APAB-302	Electrodynamics	50	04
APAB-303	Nuclear & Particle Physics:	50	04
APAB-304	**Modern Physics and Electronics**	50	04 (Choice based Credit paper)
APAB-305	Practical: Modern Physics & Material Science	100	08
APAB-306	Fakir Mohan Studies	100(Non Credit)	00 (Non credit paper)
	Total	300	24

Fourth Semester (out of 3 special papers 1 special paper is mandatory)

Special paper-I	Ballistics
Special Paper-II	Electronics
Special Paper-III	Condensed matter physics

Special Paper-I (Ballistics)

Code	Name	Mark	Credit
APAB-401(A)	Terminal Ballistics	50	04
APAB-402(A)	Modeling, Simulation Analysis & Application to Ballistics	50	04
APAB-403(A)	Rocket Ballistics:	50	04
APAB-404 (A)	External Ballistics:	50	04
APAB-405 (A)	Project & Grand viva:	100	08
	Total	300	24

Special Paper-II (Electronics)

Code	Name	Mark	Credit
APAB-401(B)	Electrical circuit & Control:	50	04
APAB-402(B)	Optoelectronics & Optical Communication:	50	04
APAB-403(B)	Pulse & Digital circuit:	50	04
APAB-404 (B)	Advance electronics practical:	50	04
APAB-405 (B)	Project & Grand viva:	100	08
	Total	300	24

Special Paper-III (Condensed Matter Physics)

Code	Name	Mark	Credit
APAB-401(D)	Condensed Matter Physics-I	50	04
APAB-402(D)	Condensed Matter Physics-II	50	04
APAB-403(D)	Condensed Matter Physics-III	50	04
APAB-404 (D)	Seminar:	50	04
APAB-405 (D)	Project & Grand viva :	100	08
	Total	300	24

SEMESTER-I

PAPER-APAB-101 **Marks: 40**
SUB: CLASSICAL MECHANICS **Internal Marks: 10**
Total Marks: 50
Credits:04

UNIT-I

Survey of the elementary particles: Mechanics of a particle-Mechanics of a system of particles – Constraints-D'Alembert's principle and Lagrange's equations-velocity dependent potentials and the dissipation function, simple applications of the Lagrange formulation. Variational Principle and Lagrange's Equations: Some techniques of the calculus of variations-Derivations of Lagrange's equations-from Hamilton's principle-Extension of Hamilton's principle to nonholonomic systems-Advantages of variational principle formulation-conservation theorems and symmetry properties.

UNIT-II

Two body Central force Problems ; Reduction to the equivalent one-body problem-The equations of motion and first integrals-The equivalent one-dimensional problems and classification of orbits-The virial theorem-The differential equation of orbit and integrable power-law potentials-conditions for closed orbits (bertrand's theorem)-The Kepler Problem Inverse square law of force-The motion in time in the Kepler problem-The Laplace-Runge-Lenz vector-Scattering in a central force field, Transformation of the scattering problem to the laboratory co-ordinates.

UNIT-III

The Kinematics of Rigid Body Motion: The independent co-ordinates of a rigid body-Orthogonal transformation-Formal properties of the transformation matrix, The Euler Angles, Euler's theorem on the motion of a rigid body-Finite rotations-Infinitesimal rotations-Rate of change of vector-The Coriolis force.

UNIT-IV

The Rigid Body Equations of Motion: Angular momentum and kinetic energy of motion about a point-Tensor and dyadics-The inertia tensor and the momentum of inertia-The eigen values of the inertia tensor and the principal axis transformation-Methods of solving rigid body problems and the Euler equations of motion Torque-Free motion of a rigid body-The heavy symmetrical top with one point fixed-Precession of the equinoxes and of satellite orbits-Precession of system of changes in a magnetic field.

TEXT BOOKS:

1 Classical Mechanics-Herbert Goldstein, Addison-Wesley/Narosa (Indian Student Edition)
2 Classical Mechanics-Rana and Joag, Tata-McGraw-Hill

REFERENCE BOOKS:

1 Classical Mechanics of particles and Rigid body-Kiran C. Gupta, New age Publishers
2 Classical Mechanics-J.D. Uppadaya
3 Classical mechanics – S.L.Gupta, Meenakshi prakashan, 1970, New Delhi.
4 Introduction to classical mechanics – R.G.Takwall and P.S.Puranik, Tata – McGrawHill, 1980, New Delhi.
5 An Introduction to Continuum Mechanics-M. E. Gurtin, Academic Press

PAPER-APAB-102 **Marks: 40**
SUB: Mathematical Methods in Physics **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Functions of a Complex Variable: Analytic functions, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor's Theorem, Laurent's Theorem, Singularities, Residues, Residue Theorem and Evaluation of Integrals, multi-valued function-branch point and branch cut, contour integration involving branch point,

UNIT-II

Linear Vector Space: Definition, Linear independence, basis and dimension, scalar product, dual vector, Cauchy-Schwarz inequality, orthonarmal basis, Scmidt orthogonalisation process

Matrices: Inverse of a matrix, orthogonal matrix, rotation, similarity transformation, Eigen-values and eigenvectors, secular equation, Cayley-Hamilton theorem, matrix diagonalisation

UNIT-III

Tensors: Cartesian tensor, covariant tensor, contravariant and mixed tensors, tensor algebra, the Kronecker delta and Levi-Civita symbol, tensors in Minkowski space, tensor calculus, tensors in general relativity, the Reimann-Christoffel symbol, Ricci and curvature tensor

Group theory: Basic concepts of groups, group representation, relevance to quantum mechanics, Lie group and Lie algebra, SU(2) groups and their representation, SO(3) groups and their representation.

UNIT-IV

Special Functions: Series solutions: Frobenius Method, Legendre polynomials, generating function, recurrence formulae, orthogonality properties, Bessel's function, generating function, recurrence formulae, orthogonality properties, Hypergeometic functions and their properties, Laguree polynomial and their properties

Integral Transform: Fourier series, Fourier Integrals, Fourier transforms, Convolution theorem, Laplace transform- derivatives, properties and applications to solution of differential equations

TEXT BOOKS:

1 Mathematical Methods for Physicist: G. B. Arfken, Hans. J. Weber,-Academic Press
2 Mathematical Physics: H. K. Dass, Rama Verma-S. Chand and Company Ltd.

REFERENCE BOOKS:

1 Matrices and tensors: A. W. Joshi
2 Numerical Methods using FORTRAN: C. Xavier-New Age International Publishers
3 Mathematical Physics: B. S. Rajput
4 Mathematical Physics: Satya Prakash
5. Introduction Mathematical Physics: Charlie Harper

PAPER-APAB-103 **Marks: 40**
SUB: Electronics and Computer Programming **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Network Analysis: Node & mesh analysis, Superposition theorem, Thevenin's theorem, Reciprocity theorem, Norton's theorem, Maximum power transfer theorem, Network Analysis using Laplace Transformation: Step response of series RL, RC, RLC, parallel RLC, Response of series RL, RC, RLC, and parallel RLC to exponential driving voltage.

UNIT-II

Semiconductor devices : P-N Junction Diode, diodes, Applications of Diode, rectifier circuits, Zener Diode, Transistors: Connections, Transistor as an amplifier, OP-AMP Basics, Virtual Ground, The Ideal Op Amp, Inverting and Non – Inverting configurations, Equivalent Circuit model, Op-amp application in Integration, differentiation and Summing Circuits, Differential Amplifier, Voltage Buffer.

UNIT-III

Digital Electronics: Number Systems, Binary Arithmetic, Boolean Algebra, Logic Gates, Simplification using Karnaugh map, Combinational Circuits: Adder, Subtractor, Multiplexer, decoder. Sequential Circuits: Flip Flops, Shift Registers, Counters and D/A and A/D Converters.

UNIT-IV

Numerical Computing: Programming in C: Constants, variables and data types, Operators and expressions, Input and Output, Decision making and branching, Looping, Arrays Characteristics of numerical computing, Trapezoidal Integration, Simpson's rules for Integration, Runge-Kutta Method and Newton-Raphson method in C .

TEXT BOOKS:

1. Network Analysis: M.E. Van Valkenburg
2. Network Analysis: G.K. Mithal
3. Digital Electronics and Computer Design: M. M. Mano (PHI)
4. Principles of Electronics: V.K. Mehta
5. Electronic Devices and Circuit Theory: Boylestad, Nashelsky
6. Let us C:- Yashavant Kanetkar (BPB Publications)
7. C Language and Numerical Mehods – C. Xavier
8. Numerical Techniques in C – E. Balguruswamy

PAPER-APAB-104
SUB: General Instrumentations

Marks: 40
Internal Marks: 10
Total Marks: 50
Credits: 04

Unit I

Transducers (Strain Gauges, temperature, pressure/vacuum, magnetic field, vibration, optical, and particle detectors), measurement and control; Signal conditioning and recovery, impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding; lock-in detector, box-car integrator, modulation techniques.

Unit II

Ordnance : Introduction, Classification (Small Arms, Mortar as, Guns, Howitzers, Rocket Launchers, Missiles), Classification based on specific tactical roles, Basic structure, Superstructure, Saddle, Cradle, Requirements of an Ideal Field Gun, Basic components and functional requirements, Certain definitions related to a barrel, Rifling, Rifling design considerations (Forms of twist, Rifling profile), Breech mechanism (breech ring, breech block, thrust surfaces, breech screw, carrier), Extractor, Obturation, Firing mechanism, Chamber.

Unit III

Gun Barrel and Design : Desired characteristics of a barrel, Stresses on barrels (Radial stress, Circumferential stress, Longitudinal stress, Torsional stress and Girder stress), Barrel construction (Wire wound, Composite, Mono block), Use of plastic region of the material and its application to auto frettaged method of gun construction, Comparison of different methods of gun construction, Basic gun design rules, Theories of elastic failures, von Misses-Hencky theory of failure including its derivation, Barrel wear (erosion, fatigue, causes and their reduction). (Interior ballistics 3.3) (Part2-Balistics-1-14.2/3).

Recoil systems (Functions, mechanism of recoil energy absorption), Buffer types (Valve key, Shallowing groove cylinder, Tapered rod, Rotating), Liquid for buffer, Cut off gear, Recuperator, Controls to run out, Soft recoil.

Fume extractor, Muzzle brake, Advantages and disadvantages, Droop, Balancing gears, Elevating and traversing gears, Carriages and mountings, Articulation, Spades, Forces and their behavior during firings, Stability, Jump, (Part2-Balistics-1-15.2)

Unit IV

Ammunition : Cartridge and make up of cartridges (BL, QF – fixed, separate), Cartridge cases (metallic & essential qualitative requirements, semi-combustible, combustible, relative merits & demerits), Means of ignition (ignition problem, percussion, electrical), classification and characteristics of projectile (ogive, nose, shoulder, body, driving band, base, boat tailing, bands, bourrelet)

Driving band attachment to body and engraving process, Forces on the Driving band, Requirements of a projectile (ballistic efficiency, tactical efficiency, shape), crh (simple and compound), fuze, Components of fuzes, arming and safety arrangements in fuzes.

Reference Books and Materials:

1. A Course in Electrical and Electronic Measurements and Instrumentation – A.K. Sawhney, Dhanpat Rai & Co.
2. "Text Book of Ballistics and Gunnery", 1987 - War Office, UK.
3. "Element of Ordnance", 1982 – T.J Hayes, John Wiley, New York.
4. "Ballistics: Theory and Design of Guns and Ammunition", David E. Carlucci and Sidney S. Jacobson.
5. "Handbook of Artillery Weapons", 1987- Royal College of Military Science, UK
6. "e-Ballistics" by Gunther Dyckmans (Freely available in the internet).
7. Gene Slover's US Navy Pages (freely available in the internet).
8. "Engineering Design Handbook, Guns Series, Muzzle Devices", US Army Material Command, May 1968
9. "Engineering Design Handbook, Guns Series, Guns General", US Army Material Command, August 1964
10. "Engineering Design Handbook, Guns Series, Gun Tubes", US Army Material Command, February 1964
11. "Design of Towed Artillery Weapon Systems", US Army Material Command, March 1990.

PAPER-APAB-105
SUB: Electronics Practical **Total Marks: 100**
Credits: 08

List of Experiments

1. Study of Kirchhoff's Law (Loop and Node Analysis)
2. Study of Superposition Theorem
3. Study of Thevenin's, Norton's and Maximum Power transfer Theorem
4. To study working of Wheatstone bridge
5. To study the diode as a half wave rectifier with and without filter
6. To study the diode as a full wave rectifier with and without filter
7. To set up and study a Zener diode shunt regulator and to plot its line and load regulation characteristics
8. To study the DC Amplifier using Bipolar Transistor
9. Study of half adder, full adder, half subtractor and full subtractor
10. To study the behavior of S-R, J-K, MS-JK, D and T flip flop
11. To study and design of ripple counter, synchronous binary using JK flip flop
12. To study and design of Ring and Junction counter
13. To measure OPAMP Parameters
14. To study OPAMP as inverting and non-inverting amplifier
15. To design and test integrator circuit using OPAMP and to find usual frequency range for integrator.
16. To study differential amplifier using single OPAMP.

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SEMESTER-II

PAPER-APAB-201 **Marks: 40**
SUB: STATISTICL MECHANICS **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Statistical Thermodynamics: Macroscopic and microscopic states, connection between statistics and thermodynamics, classical ideal gas, entropy of mixing and Gibb's paradox. Ensemble Theory: Phase space, Liouville's theorem, microcanonical ensemble, examples, quantum states and phase space.
Canonical Ensemble: Equilibrium, partition function, energy fluctuation, equipartition and Virial theorem, harmonic oscillators, statistics of paramagnetism, Grand Canonical Ensemble: Equilibrium, partition function, density and energy fluctuation, correspondence with other ensembles, examples.

. UNIT-II

Formulation of Quantum Statistics: Quantum mechanical ensemble theory, density Matrix, statistics of various ensembles, examples. Ideal gas in different quantum mechanical ensembles. Systems of: monatomic, diatomic and polyatomic molecules.

UNIT-III

Ideal Bose gas: Photons and Planck's Law, Phonons, Bose-Einstein condensation, Thermodynamic description of phase transition, Phase transitions of second kind, Discontinuity of specific heat, Change in symmetry in a phase transition of second kind.

UNIT-IV

Ideal Fermi Gas: Thermodynamics, Pauli paramagnetism, Landau diamagnetism, DeHassVan Alphen Effect, thermionic and photoelectric emissions, white dwarfs.
Ising Model: Ising model,: definition of Ising Model, ID-Ising model.

TEXT BOOKS:

1. Statistical Mechanics-K: Huang
2. Statistical Mechanics- R. K. Patheria

REFERENCE BOOKS:

1 Elementary Statistical Physics- C Kittel
2 Statistical Mechanics-F: Mohling
3 Statistical Mechanics-Landau and Lifshitz.
4 Physics Transitions and Critical Phenomena-H.E. Stanley
5 Thermal Physics-C.Kittel
6 Fundamentals of Statistical and Thermal Physics-F.Reief

PAPER-APAB-202
SUB: QUANTUM MECHANICS

Marks: 40
Internal Marks: 10
Total Marks: 50
Credits: 04

UNIT-I

General Principles of Quantum Mechanics: Linear vector space, ket and bra vectors, scalar product of vectors and their properties, Linear operator, Adjoint Operators, Unitary Operators and transformations, Expectation values of dynamical variables and physical interpretation, Hermitian operators, Probability interpretation, degeneracy, Schimdt method of orthogonalization.

Mathematical Basics: Expansion Theorem, Completeness and Closure property of the basis set, Co-ordinate and Momentum representation, Compatible and incompatible observables, Commutator algebra, Uncertainty relation as a consequence of noncommutability, Minimum uncertainty wave packet

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UNIT-II

Quantum Dynamics: Time evolution of quantum states, time evolution operator and its properties, Schroedinger Picture, Heisenberg Picture, Interaction Picture, Equation of Motion, Operator Method of solution of Harmonic oscillator, Matrix representation and time evolution of creation and annihilation operator

UNIT-III

Rotation and Orbital Angular Momentum: Rotation Matrix, Angular momentum operators as the generators of rotation. L_x, L_y, L_z and L^2 in spherical polar co-ordinates, Eigen values and Eigen functions of L_z and L^2 (OP method), Spherical Harmonics, Matrix representation of L_+, L_- and L^2.

Spin ½ particles, Pauli spin matrices and their properties, Eigen values and Eigen functions, Spinor transformation under rotation.

Total Angular momentum J, Eigen value problem of J_z and J^2, Angular momentum matrices, Addition of angular momenta and C. G. Co-efficient, angular momentum states for composite systems in the angular momenta (1/2, ½) and (1,1/2).

UNIT-IV

Motion in Spherical Symmetric Field: Hydrogen atom, Reduction of two body problem to equivalent to one body problem, Radial equation, Energy eigenvaues and eigenfunctions, Degeneracy, radial probability distribution.

Free particle problem incoming and outgoing spherical waves, Expansion of plane waves in terms of spherical waves, bound states of a 3-D square well, particle in a sphere.

Approximation Methods: Time independent perturbation theory and application, variational method, WKB approximation, Time dependent perturbation theory, Fermi's Golden rule, selection rules.

Scatterings: Elementary theory of scattering, Phase shifts, Partial waves, Born approximations

TEXT BOOKS:

1. Quantum Mechanics-Joichan

REFERENCE BOOKS:

1 Quantum Mechanics- Gasorowicz
2 Quantum Mechanics-Ghatak and Loknathan

PAPER-APAB-203 **Marks: 40**
SUB: FLUID DYNAMICS **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Fluid Flow Concepts and Basic equations: Velocity field, acceleration of a fluid element, continuity equation, conservation of momentum , stream line functions, rotation of fluid element, Euler's equation.

Bernoulli's equation along a stream line and in rotational flow, Bernoulli's equation from thermodynamics ,static and dynamics pressure, Losses due to geometric changes:-Sudden expansion and contraction Venturimetre.

UNIT-II

Dimensional Analysis and Dynamic Similitude: Buckingham's Π Theorem, Dimensionless parameters, Euler's number, Reynold's number, Froude's number, Weber number, Model studies and wind tunnel tests.

UNIT-III

Viscous Effect: Normal stress shear stress, Navier-Stokes theorem, Flow through a parallel channel, Flow past a sphere, Terminal velocity order of magnitude analysis, Approximation of the Navier-Stokesequations.
Boundary layer concepts:-Momentum integral equation, velocity profile, Boundary layer thickness, SkinFriction effecter, Transverse component of velocity, Displacement thickness, momentum thickness.Drag:-Bluff badles, Aerofoil, Boundary layer control, entrance region.

UNIT-IV

Compressible flow: Perfection gas Relations:-Speed of propagation in gas, in isothermal and adiabatic condition, Mach number, Limits of incompressibility. Isentropic flow:-Laws of conservation, Static and stagnation values, flow through a duct of varying cross-section, mass flow rate, choking a converging passage, constant area adiabatic flow and Fanno like, constant area frictionless flow and Raleigh line.

Fluid Metrology: Pressure measurement, Velocity measurement, Turbulence measurement, Viscosity measurement,

TEXT BOOKS:

1 Fluid Mechanics, A.K. Mohanty, PHI
2 Fluid Dynamics, R.V. Mises, Springer

REFERENCE BOOKS:

1 Foundation of Fluid Mechanics , S. W .Yuan, PHI
2 Text Book of Fluid Mechanics, R. S. Khurmi, S. Chand
3 Perspective in Fluid Dynamics, Batchelor, Cambridge

PAPER-PHY-204(A)
SUB: INTERNAL BALLISTICS

Marks: 40
Internal Marks: 10
Total Marks: 50
Credits: 04

Unit-I

Explosives: Combustion, Deflagration, Explosion, Detonation, Characteristics of an explosive (Criteria for a material to be designated as an explosive), Transition from burning to detonation, Propagation of detonation shockwave, Characteristics of military explosives, Sensitivity, power and brisance, Measurement of explosive parameters, Caterigorisation of explosives (low explosives – high explosives – primary, secondary, intermediary, tertiary), Explosive train, Gun powder and Pyrotechnic compositions.

Unit II

Gun propellant: Key feature of propellant, Characteristics of an ideal propellant, explosive compounds and explosive mixtures, chemical composition of gun propellants. Single-, Double-, and Triple base propellants

Thermo physics and Thermo chemistry of propellants: Oxygen balance, Heat of formation and heat of explosion (or, combustion), Internal energy, Helmholtz free energy changes, Balancing combustion (explosion) equations, Composition of combustion products, Indicators to determine volume of combustion products, Thermal equilibrium, Equilibrium constant, Water-gas equilibrium. Determination of flame temperature.

Corrections for deviations: from Ideal gas laws, for water-gas equilibrium, for internal energy of products.

Prediction of propellant performance, Force constant, Pressure of combustion.

Efficiency of gun-ammunition system (thermodynamic and piezometric) (Interior ballistics 2-6)

Unit III

Internal Ballistics:

Propellant combustion, Laws of burning, Propellant vivacity, Form function, Ballistic size, Types of burning, Shape function and Z-f relationship, Burning characteristics of different shapes of propellants, Pressure-time, Travel-time, and Velocity-time curves, All burnt point and its importance.

The main issues of internal ballistics, Approach to solution, The basic analytical model and the simplifying assumptions underneath it, Estimation of energy losses under various heads (gas inertia, heat transfer, friction, air resistance inside bore, recoil energy, rotational energy), Improved analytical model, estimation of velocity. Pressure gradient and prediction of pressure history, Empirical methods of computing muzzle velocity. Le Duc's formula for muzzle velocity (Part2-Balistics-1-11).

Importance of pressure-space(shot travel) curve, Variations in loading conditions (propellant mass, propellant size, propellant shape, projectile mass, chamber capacity, bore area, shot-start pressure, shot travel).

Attainment of higher velocities (Interior Ballistics 2.12)

Unit IV

Intermediate Ballistics: Gas dynamics of the muzzle flow field, Flash, Blast, Flash and blast suppression, Sabot and sabot separation process.

Rigid body motion of recoiling parts. Barrel vibration, Equations of motion of barrel. Current trends and future directions in gun propulsion

Analytical & computational Ballistics: Introduction, Lagrange gradient, Lagrangian approach

Measurement of Ballistic Parameters:

Dispersion of Fire, Yaw and Jump by photogrammetry or high speed photography.

Barrel recoil and runout, Buffer pressure, Barrel vibration

Reference Books and Materials:

1. "Chemistry of Powder and Explosives", Tenney L. Davis
2. "The Chemistry of Explosives", Jacqueline Akavan
3. "Propellants and Explosives – Thermochemical Aspects of Combustion" Naminosuke Kubota, Wiley-VCH
4. "High Explosives and Propellants", S. Fordham, Pergamon Press
5. "Interior Ballistics", 1951 HMSO Publications, UK
6. "Theory of Interior Ballistics of Guns", J Corner, John Wiley and Sons Inc, USA, 1950
7. "Interior Ballistics of Guns", AMCP, US Army Materials Command, February 1965
8. "e-Ballistics" by Gunther Dyckmans (Freely available in the internet).
9. "Mathematical Treatise on Interior Ballistics of Guns", Dr. Himanshu Shekhar, Power Publishers, Kolkata
10. "Text Book of Ballistics and Gunnery", 1987 - War Office, UK.
11. "Ballistics: Theory and Design of Guns and Ammunition", David E. Carlucci and Sidney S. Jacobson.
12. "Elements of Armament Engineering Part II – Ballistics", AMCP, US Army Materials Command, September 1963
13. "Gene Slover's US Navy Pages Naval Ordnance 1937" (Freely available in the Internet)

PAPER-APAB-205
SUB:COMPUTATIONAL PHYSICS **Total Marks: 100**
Credits:08

EXPERIMENT LIST: (FORTRAN / C)

1 To find largest or smallest of a given set of numbers
2 To generate and print first hundred prime numbers
3 To find sum of AP and GP
4 To find transpose of Matrix
5 Matrix Algebra
6 Evaluation of Log and exponential
7 Solution of Quadratic Equation
8 Numerical Differentiations
9 Numerical Integration by Trapezoidal Method
10 Numerical Integration by Simpson Method
11 Evaluation of Gamma Function
12 Solution of Second order differential equation by Range-Kutta Method
13 Finding roots of an equation by Newton-Raphson Iteration method
14 Least Square fitting of linear equations
15 Solution of system of linear equation

MATLAB

MATLAB Fundamentals, MATLAB's opening window features, Getting started with MATLAB, M – file, control statements of M – file programming, Matrix manipulation, creating a function file.

SEMESTER-III

PAPER-APAB-301
SUB: SOLID STATE PHYSICS

Marks: 40
Internal Marks: 10
Total Marks: 50
Credits: 04

UNIT-I

Crystal Physics: Types of lattices, Miller indices, simple crystal structures, crystal diffraction, Bragg's law, Reciprocal lattice (sc, bcc, fcc), Laue equations, structure factor, Atomic form factor, Types of crystal binding, cohesive energy of ionic crystals, Madelung constant, Inert gas crystals, Vander Waal, London equation, Metal crystals, Hydrogen bonded crystals. Defects in crystals; Point and line defects.
Lattice vibration and thermal properties: Einstein and Debye models; continuous solid; linear lattice; acoustic and optical modes; dispersion relation; attenuation; density of states; phonons and quantization; Brillouin zones; thermal conductivity of metals and insulators.

UNIT-II

Quantized free electron theory: Fermi energy, wave vector, velocity and temperature, density of states. Electronic specific heats. Pauli spin paramagnetism. Sommerfeld's model for metallic conduction. AC conductivity and optical properties, plasma oscillations. Hall effects.
Intrinsic and extrinsic semiconductors: carrier concentration and Fermi levels of intrinsic and extrinsic semi-conductors Bandgap. Direct and indirect gap semiconductors. Hydrogenic model of impurity levels.
Energy bands in solids: The Bloch theorem. Bloch functions. Review of the Kroning-penney model. Brillouin zones. Number of states in the band. Band gap in the nearly free electron model. The tight binding model. The fermi surface. Electron dynamics in an electric field. The effective mass. Concept of hole. (elementary treatment)

UNIT-III

Dielectrics: Polarizability; Clausius-Mossotti formula; Dielectric constant; ferroelectrics.
Magnetic properties of solids: Diamagnetism, Langevin equation. Quantum theory of paramagnetism. Curie law. Hund's rules. Paramagnetism in rare earth and iron group ions. Elementary idea of crystal field effects. Ferromagnetism. Curie-Weiss law. Heisenberg exchange interaction. Mean field theory. Antiferromagnetism. Neel point. Other kinds of magnetic order. Nuclear magnetic resonance.

UNIT-IV

Superconductivity: Experimental facts, occurrence, effect of magnetic fields, Meissner effect, entropy and heat capacity, energy gap, microwave and infrared properties, type-I and type-II superconductor, theoretical explanation, thermodynamics of superconducting transition, London equation, coherence length, BCS Theory, single particle Tunneling, Josephson Tunneling, DC and AC Josephson effects, High temperature super conductors-SQUIDS.

Texts:

1. H. P. Myers, *Introduction to Solid State Physics,* Viva books (1998).
2. M.A. Omar, *Elementary Solid State Physics,* Addison-Wesley (1975).
3. C. Kittel, *Introduction to Solid State Physics,* John Wiley (1996).

References:

1. A. J. Dekker, *Solid State Physics*, Macmillan (1986).
2. N. W. Ashcroft and N. D. Mermin, *Solid State Physics*, HBC Publ., (1976).
3. F.C.Phillips: *An introduction to crystallography* (wiley)(3rd edition)
4. Charles A Wert and Robb M Thonson: *Physics of Solids*
5. J. P. Srivastava: *Elements of solid state physics* (Prentice Hall India; 2nd edition).
6. Christmaan-*solid state physics* (academic press)
7. John Singleton: *Band theory and Electronic properties of Solids* (Oxford University Press; Oxford Master Series in Condensed Matter Physics).
8. Ibach & Luth: *Solid State Physics*

PAPER-APAB-302
SUB: ELECTRODYNAMICS

Marks: 40
Internal Marks: 10
Total Marks: 50
Credits: 04

UNIT-I

Maxwell's Equations: Green function solution of Maxwell's equation, Lorentz and Coulomb Gauge, Gauge invariance, Plane waves in a non conducting medium, Linear and circular polarization, Stoke's parameters, frequency dispersion characteristics of dielectrics, conductors and plasma, waves in dispersive medium, Kramer-Kroning relations.

UNIT: II

Microwave Propagation: Cylindrical cavities and wave guides Mode in a rectangular wave guide, Resonant cavities.

UNIT: III

Radiation, Scattering and Diffraction: Fields and radiation of localized oscillating source, Electric dipole, Magnetic dipole and electric quadrupole, Field radiation, Center-fed linear antenna with sinusoidal current, scattering by small dielectric sphere in long wave length limit, Rayleigh scattering, Thompson scattering, Kirchhoff's formulation of diffraction by a circular aperture.

UNIT-IV

Covariant Formulation: Four vector notation, Relativistic particle kinematics and dynamics, covariant form of Maxwell equations, Maxwell field tensor, Transformation of electromagnetic field components, Lagrangian of a charged particle in an external EM field and EL equations.

Radiation by a moving Charge: Lienard-Weichert potential and field for a point charge, Total power radiated by an accelerated charge, Lamour's formula, angular distribution of radiation from an accelerated charge.

TEXT BOOKS:

1 Classical Electrodynamics-J.D Jackson
2 Introduction to Electrodynamics- Griffith

REFERENCE BOOKS:

1 Introduction to Electrodynamics-A.Z. Capri and P.V. Panat
2 Principles of Optics- M. Born and E. Wolf

PAPER-APAB -303 **Marks: 40**
SUB: NUCLEAR AND PARTICLE PHYSICS **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Nuclear size and shape: Nuclear radii and charge distributions, nuclear binding energy, electric and magnetic moments. **Nuclear Models:** Liquid drop model, semi-empirical mass formula, Bohr-Wheeler theory of fission, Experimental evidences for shell effects, Shell model, Spin-orbit coupling, Magic numbers, Angular momenta and parities of nuclear ground states, Qualitative discussion and estimate of transition rates, magnetic moments and Schmidt lines, Collective model of Bohr and Mottelson.

UNIT-II

The Two-Nucleon Problem: The Ground state of deuteron, excited state of deuteron, n-p scattering at low energies, tensor forces and deuteron problem, p-p scattering at low energies.

Nuclear Force: Central and non-central forces, Force dependent on Isospin, Exchange force, charge dependence and charge symmetry of Nuclear force, Mirror Nuclei.

UNIT-III

Nuclear Reaction: Energetic of Nuclear reaction, Compound nuclear theory, Resonance scattering, Brit-Wigner formula, Nuclear Fusion, Alpha decay, Fermi's theory of Beta decay, Selection Rules for allowed transition, Parity violation.

UNIT-IV

Particle Accelerators and Detectors: G-M Counter, Scintillation Detectors, Semiconductor detectors.

Radiation Hazards and Protection: Radiation Hazards, Radiation dose, Monitoring of radiations, Hazards of Laboratory contamination and precautions, Shielding Materials.

Particle Physics: Basic forces, Classification of Elementary particles, Spin and Parity, Determination of Isospin, Strangeness, Lepton and Baryon Number, Conservation Laws, Gellmann-Nishijima Scheme, Meson and Baryon Octet, Elementary Ideas of SU(3), Symmetry Quark Model.

TEXT BOOKS:

1 Nuclear Physics: R.R.Roy and B.P Nigam
2 Introductory Nuclear Theory: L. R. B. Elton
3 Elementary Particle Physics: M.J.Longo
4 Nuclear Physics Experiments: J. Verma

REFERENCE BOOKS:

1 Theoretical Nuclear Physics: Blatt and Weisskopf
2 Nuclear Physics: D. C. Tayal
3 Particle Physics: R. Omens
4 Nuclear Physics: Pandey and Yadav
5 Nuclear Physics: I. Kaplan
6 Concepts of Nuclear Physics: L. Cohen
7 Introduction to Nuclear and Particle Physics: R. C. Verma

PAPER-APAB -304 **Marks: 40**
SUB: Modern Physics & Electronics **Internal Marks: 10**
(CBCS Paper for non-Physics student) **Total Marks: 50**
Credits: 04

UNIT-I

Quantum Mechanics: Wave properties of Particles, the wave equation, Schrodinger equation, Expectation Values, Particle in a box, finite Potential well, Tunnel effect, harmonic oscillator, Quantum theory of hydrogen atom.

UNIT-II

Nuclear Structure: Nuclear Composition, some nuclear properties, stable nuclei, binding energy, liquid drop model, Shell model, Meson theory of nuclear forces
Nuclear Transformations: Radioactive Decay, half life, radioactive series, alpha decay, beta decay, gamma decay, cross section, nuclear reactions, nuclear fission, nuclear reactors, nuclear fusion in stars, fusion reactors

UNIT-III

The Solid State: Crystalline and Amorphous Solids, Ionic crystals, Covalent crystals, Van der Waals Bond, Metallic Bond, Band theory of solids, semiconductor devices, energy bands: alternative analysis, Superconductivity, Bound electron pairs

UNIT-IV

Network Analysis using KCL, KVL, Norton's Theorem, Thevenin's Theorem and Maximum power transfer theorem, Sinusoidal Alternating Currents and Voltages, Inductance and Capacitance in AC circuits, Resonance, Power factor, Detailed theory of Transformer,

TEXT BOOKS:

1. Ghoshal S.N., Atomic and nuclear physics, Vol.2., S. Chand and Company, Delhi, 1994.
2. Evans R.D., Atomic nucleus, Tata Mc Grow Hill, New Delhi, 1976.
3. Penrose R., Road to Reality, Vintage Books, 2007.
4. Ladd M.F.C. and Palmer R.A., Structure determination by X-ray crystallography, Plenum Press, USA, 2003.
5. De Gennes P.G. and Prost J., The physics of liquid crystals, 2nd Edn., Clarendon Press, Oxford, 1998.
6. Arthur Beiser, Concepts of modern physics, 5th Edn., McGraw-Hill, New York, 1997.
7. Halliday D., Resnick R. and Merryl J., Fundamentals of physics, Extended 3rd Edn., John Wiley, New York, 1988.
8. Chattopadhyay D, Rakhit P. C, Quantum Mechanics, Statistical Mechanics & Solid state Physics, S. Chand & Company Pvt. Ltd., New Delhi
9. A Text Book Of Electrical Technology by BL Theraja and AK Theraja, S. Chand, and Company, New Delhi

PAPER-APAB-305 PRACTICAL
SUB: MODERN PHYSICS AND MATERIAL SCIENCE LABORATORY

Total Marks: 100

Credits: 08

EXPERIMENT LIST:

1 Study of thermal properties of solid using HEAT CAPACITY KIT.

2 Study of B-H loop of a ferromagnetic specimen by using B-H Curve UNIT.

3 Determine the Curie temperature of a ferroelectric/ferromagnetic material by using CURIE TEMPERATURE KIT.

4 Measurement of ultrasonic velocity in solids and Young's Modulus of those solids in YOUNG'S MODULUS KIT.

5 Study of Lattice Dynamic KIT.

6 Study of particle size by using LASER Apparatus

7 Measurement of Acoustic signal using data acquisition system .

8 Forbidden gap calculation.

9 Plank's constant measurement

10 Hall effect study.

11 Study of impressibility of a fluid by using Ultrasonic interferometer.

SEMESTER-IV

PAPER-APAB-401(A)-SP: Ballistics **Marks: 40**
SUB: Terminal Ballistics **Internal Marks: 10**
Total Marks: 50
Credits:04

Unit I

Terminal Ballistics: General introduction, definition, classification of projectiles, phase diagram and ballistics limit, failure mechanism

Properties of materials: Introduction, stress in solids, anisotropy of real materials, metallic and non-metallic materials, stress-strain relationships-elastic and plastic deformation, fracture, fragmentation, fatigue, waves in rods, propagation of elastic and plastic waves in rods, shock wave, reflection of elastic waves, bending waves.

Unit II

Munitions and the defeat of armour: fragmentation warheads, introduction, natural fragmentation, theoretical estimation of maximum fragmentation size, distribution of the number of fragments and of fragmentation masses, fragmentation initial velocity in a static detonation, direction of projection of fragments, effect of air resistance on fragmentation velocity, fragmentation efficiency, controlled fragmentation.

Shape charge warheads: estimation of the radii of jet and slug, equation of jet, effect of compressibility, effect of spinning a linear during jet formation, jet breakup, jet stability, break-up time, cut-off velocity, penetration by shaped charge jets.

Kinetic energy projectiles: introduction, empirical formulae for the prediction of penetration, an application of one dimensional analysis, impact velocity regime, analytical model of failure modes, modeling of penetration/perforation process for high velocity impact of long rod, high explosive squash head, plate charge.

Unit III

Design and Defeat of Armour: Introduction, Mechanical property requirements, Armour material characteristics, Armour structure, Defeat of armour, Failure mechanism, Ballistics limit.

Penetration: Penetration Theory, penetration and perforation of metals (aluminum), penetration and perforation of composites.

Unit IV

Forensic Ballistics: Internal and External Ballistics-Introduction, direction, time and range of fire-projectile velocity, Recoil, Trajectory-effect of projectile on hitting a target, Function of bullet shape, Striking velocity and angel, Tumbling bullets-Cavitations-Ricochet.

Dispersion: Measure of dispersion, analysis of dispersion, consistency, statistical treatment of consistency, the chance of a round falling within a zone, practical determination of consistency, accuracy, precision-Probability error of delivery, circular probability areas, Ricochet, Safety Zones

Text Books:

1. Text Book of Ballistics and Gunnery, 1987, War Office, UK.
2. Ballistics: Theory and Design of Gun and Ammunition – DE Carlucci and SS Jacobson, CRC Press

Reference Books:

1. T.B.B.G. pamphlet No.9
2. Terminal Ballistics- Text Book and atlas of gunshot wounds, Malcom J Dodd, CRC Press, Taylor & Francis publications
3. Firearms in Criminal Investigation and Trials, Dr. BR Sharma, 3rd Edition, Universal Law Publishing Co. Pvt Ltd.
4. Gunshot Wounds – Practical aspects of Firearms, ballistics and Forensic Techniques, Vincent JM DiMaio, Elseviour Science Publishing Co. Inc.
5. Wound Ballistics and the Scientific Background, Karl G Sellier & Beat P Kneubuehl, Elsevior Science Publishing Co. Inc.

PAPER-APAB-402(A) – SP: Ballistics **Marks: 40**
SUB: Modeling, Simulation, Analysis and Application to Ballistics **Internal Marks: 10**
Total Marks: 50
Credits: 04

Unit I

Introduction to systems: Classification of systems, linear system, Dynamic systems, Time-varying vs. Time-invariant systems, Continuous-time vs. Discrete-time systems.
System Modeling: Needs of system modeling, Classification of models, Mathematical Modeling of Physical Systems, Modeling of Mechanical systems, Modeling of Electrical systems, Modeling of Fluid systems, modeling of thermal systems. State-space model and solution of state equations.

Unit II

Simulation: Advantage of simulation and applications. Numerical methods for simulation, Integration using rectangle rule, Trapezoidal rule and Simpson's rule, Range-Kutta methods. Characteristics of Numerical methods, Errors during simulation with Numerical Methods, Modeling and simulation of simple pendulum, Continuous system simulation (Water Reservoir system), Chemical reactor, Rocket Dynamics and water Pollution Problem, Introduction to Discrete-Event Modeling and Simulation.

Unit III

Nonlinear and Chaotic System : Linear vs. Nonlinear system, Nonlinearity in Flight control of Aircraft, Designing a PID Controller for Pitch Control in Flight, Introduction to Chaotic System.
Modeling with Artificial Neural Network: Artificial Neuron, Topology, Training, Back propagation, Application of Neural Network modeling. **Modeling with Fuzzy systems**: Fuzzy set, Operations on Fuzzy set, Applications of Fuzzy Systems to System Modeling.

Unit IV

Trajectory modeling of (a) The in-vacuo trajectory model (b) The point-mass model (c) The modified point-mass model (d) The six degree-of-freedom (e) Gun vibration Model (f) Gun Pressure and Velocity prediction Models.

Text Books:

1. Getting Started with MATLAB- Rudra Pratab, Oxford University Press
2. Modeling and Simulation of Systems using MATLAB and Simulink –DK Chaturvadi, CRC Press
3. Reliability and Maintenance and Safety engineering – AK Gupta, University Science Press
4. Military BALLISTICS: A Basic manual – GM Moss et al, Brassey Series
5. Ballistics: Theory and Design of Gun and Ammunition – DE Carlucci and SS Jacobson, CRC Press

Reference Books:

1. System Modeling and Simulation: An Introduction, FL Seveverans
2. Principles of Mathematical Modeling, Clive L. Dym and Elizabeth S. Ivy, academic Press
3. System Modeling and Simulation – VP Singh, New Age International Publishers

PAPER-APAB-403(A)-SP: Ballistics
SUB: Rocket Ballistics

Marks: 40
Internal Marks: 10
Total Marks: 50
Credits: 04

Unit I

Classifications, Definitions and Fundamentals, Nozzle Theory and Thermodynamics Relations (Chapter –1 ,2 and 3)

(TB:- Rocket Propulsion Elements - George P. Sutton and Oscar Biblarz, John Wiley & Sons, Inc.)

Rocket motors and nozzle design – The internal ballistics of rocket motors

(TB:- Text Book of Ballistics and Gunnery: Rocket Ballistics, 1987, War Office, UK.)

Unit II

Flight Performance, Chemical Rocket Propellant Performance Analysis and Liquid Propellant Rocket Engine Fundamentals (Chapter –4 ,5 and 6)

(TB:- Rocket Propulsion Elements - George P. Sutton and Oscar Biblarz, John Wiley & Sons, Inc.)

Launch Dynamics – External Ballistics of Rockets

(TB:- Text Book of Ballistics and Gunnery: Rocket Ballistics, 1987, War Office, UK.)

Unit III

Solid Propellant Rocket Fundamentals, Solid Propellants, Combustion of Solid Propellants and Solid Rocket Components and Motors Design (Chapter –11, 12, 13 and 14)

(TB:- Rocket Propulsion Elements - George P. Sutton and Oscar Biblarz, John Wiley & Sons, Inc.)

Unit IV

Introduction, The Generalized Missile Equations of Motion and Aerodynamic Forces and Coefficients (Chapter –1 ,2 and 3)

(TB:-Missile Guidance and Control Systems - George M. Siouris, Springer)

Tactical Missile Guidance Laws and Weapon Delivery Systems (Chapter – 4 and 5)

(TB:-Missile Guidance and Control Systems - George M. Siouris, Springer)

Reference Books:

1. Introduction to Rocket Science and Engineering – Tavis S Taylor, CRC, Press)
2. Mathematical Theory Of Rocket Flight - J. Barkley Rosser et al, Mcgraw-Hill Book Company, Inc.

PAPER-APAB -404(A) **Marks: 40**
SUB: External Ballistics **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Aerodynamic Forces & Moments Acting on Projectiles:

Elements of trajectory, definition of projectile coordinates, generalised yaw of a projectile, drag force, spin-damping moment, rolling moment, lift and normal force, center of gravity (CG) and center of pressure (CP), overturning moment, Magnus effect, Magnus force and moment, pitch damping force and moment.

.UNIT-II

Dynamic review: Kinematics of particle, hodograph, kinematics of rigid body, kinematics equations for plane motion of a rigid body using translating and rotating system

Trajectories: Vacuum trajectory, simple air trajectory (Flat Fire), wind effects on a simple air trajectory, generalized point mass trajectory, effect of earth's rotation on a flat fire and vacuum trajectory six degree of freedom (6-DOF) trajectory, modified point mass trajectory

UNIT-III

Mass asymmetries:

Mass asymmetries, lateral throw-off, aerodynamic jump, static imbalance and dynamic imbalance

Linearized Aeroballistics: Lineraized theory, linearized pitching and yawing motions, Gyroscopic and dynamic stability, epicyclic motion, yaw response, roll response, effect of slight mass asymmetry on the initial pitching and yawing motion of a spinning projectile, swerve motion

UNIT-IV

Aeroballistic Design: Introduction-Artillery shell-Design criteria-Low drag design for artillery shell-stability of artillery shell

Direct Fire Projectiles: Direct fire projectiles-spin-stabilized K.E. penetrators-statically stable K.E. penetrator and long rods-Aircraft fired projectiles-Bombs and sub-munitions.

Wind tunnel methods: Examples of supersonic wind tunnel measurement, advantages and disadvantages of wind tunnels for projectile aeroballistics testing.

Reference Book:

1. Text Book of Ballistics and Gunnery, 1987, War Office, UK.
2. Military Ballistics: A Basic Manual – GM Moss et al, Brassey Series-unit-1 (ch 1, ch 4), unit-4 (ch-3)
3. Introduction to air craft flight mechanics, Thomas R. Yechout. (freely available on google books)(unit-2)
4. Ballistics: Theory and Design of Gun and Ammunition – DE Carlucci and SS Jacobson, CRC Press: unit-2 (ch-6, 7), unit-3 (ch-8), unit-4 (chap-4)
5. Modern Exterior Ballistics , 1999, Robert L McCoy – Schiffer Publishing Ltd. Unit-V(ch-14)
6. Proximity Fuzes : Theory and Techniques – VK Arora, DRDO, Ministry of Defence. Unit-V(ch1, 2, 3)
7. Ammunition For The Land Battle- PR Courtney-Green, Brassey Series unit-V (ch-13)

PAPER-APAB-405(A)-SP-Ballistics

SUB: Project and Grand Viva **Total Marks: 100**
Credits: 08

SEMESTER-IV

PAPER-APAB-401(B)-SP-Electronics **Marks: 40**
SUB: Electrical Circuits and Control **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Circuit components, KCL, KVL, Circuit analysis methods: nodal analysis, mesh analysis, basic network theorems, Superposition theorem, Thevenin's Theorem, Norton's theorem, Reciprocity theorem, Milliman's theorem, Maximum Power Transfer Theorem.

UNIT-II

Laplace transforms of unit step, shifted unit step, ramp and impulse functions. Response of RL, RC, RLC series circuits, series and parallel resonance, bandwidth, Q-factor. Low pass, High pass, R –C filters.Low, high, bandpass and band elimination filters.

UNIT-III

Open loop and closed loop control systems, Mathematical modeling of physical systems, Block diagram representation of systems – Block diagram reduction methods – Closed loop transfer function, determination of signal flow graph. Mason's gain formula – Examples.

UNIT-IV

Test signals – time response of first order and second order systems – time domain specifications – types and order of systems – generalized error co-efficient – steady state errors – concepts of stability – Routh-Hurwitz stability.

Bode plot, Root locus technique, Elementary state variable formulation, state transition matrix and response for linear time invariant systems.

TEXT BOOKS:

1. A course in Electrical Circuit Analysis – Soni and Gupta, Dhanpat Rai
2. Control System Engineering, 3rd Edition, New Age International Edition, 2002- Nagrath & Gopal,
3. Network and systems – D Roy Choudhury

REFERENCE BOOKS:

1. Network analysis – M.E Van Valkenberg, PHI
2. Network analysis – G.K. Mittal
3. Automatic Control Systems, 7th Edition – Prentice Hall of India, 2002, Benjamin.C.Kuo,
4. Modern Control Engineering, Prentice Hall of India, 4th Edition, 2003, Ogata.K

PAPER-APAB-402(B)-SP-Electronics **Marks: 40**
SUB: Optoelectronics and Optical Communication **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Optical Processes in Semiconductors: Electron- hole Pair formation and recombination- band to band recombination- absorption in semiconductors- exciton absorption - donor-acceptor and impurity band absorption- absorption in quantum wells - radiation in semiconductors-Luminescence from quantum wells- time resolved photo luminescence.

UNIT-II

Semiconductor Junctions : The hetrojunction- LED structure - heterojunction LED - Edge emitting LED- I-VCharacteristics -Spectral and frequency response

Photodetectors: Junction photo diodes- PTN-APD- Photo transistor- modulated barrier photo diode – Schottky barrier - MSM photo diode- multicavity Photo diodes - Basic Principles of Solar cells.

UNIT-III

Switching Devices and Opto-electronic ICs : Electro optic modulators - Optical switching and logic devices - application of OEIC' S- materials and processing for OEIC'S - Integrated transmitters and receivers – guided wave devices

UNIT-IV

Fiber Optic Communication Optical fibre - Characteristics and fundamental parameters - Propagating modes -low loss fibres - transmission distance with optical fibres - examples of optical transmission techniques - instrumentation and control with optical fibres.

TEXT BOOKS:

1. Semiconductor opto electronic devices-Pallab Bhattacharya PHI, 1995.
2. Opto Electronics - Wilson and Hawker
3. Optical Fibre Communication - Snematsu and Toa (John Wiley and sons)

REFERENCE BOOKS:

1. Opto Electronics - Texas Instruments.
2. Opto Electronics - Jasprit Singh
3. Fibre Optic Communication - R.L.Keiser.

PAPER-APAB-403(B)-SP-Electronics **Marks: 40**
SUB: Pulse and Digital Circuits **Internal Marks: 10**
Total Marks: 50
Credits: 04

UNIT-I

Linear Wave shaping : High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator and integrator, RL and RLC circuits and their response for step input, Ringing circuit.

Non-Linear Wave shaping: Diode clippers, Transistor clippers, clipping at two independent levels, Transfer characteristics of clippers, Emitter coupled clipper, Comparators, applications of voltage comparators, clamping operation, clamping circuits using diode with different inputs,

UNIT-II

Switching Characteristics of Devices: Diode as a switch, piecewise linear diode characteristics, Transistor as a switch, Break down voltage consideration of transistor, saturation parameters of Transistor and their variation with temperature, Design of transistor switch, transistor-switching times.

UNIT-III

Multivibrators: Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using transistors

Time base Generators: General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators – basic principles, Transistor miller time base generator, Transistor Bootstrap time base generator, Current time base generators.

UNIT-IV

Combinational Digital Circuits: Number systems and codes, De-Morgan laws, Boolean Algebra, K-map and simplification of Boolean functions using K-map, Implementation of various Boolean functions. Design of Adders, Multiplexers, Decoders, BCD to 7 segment Decoder

Sequential Digital Circuits: Clocked S-R Flip-Flop, J-K Flip-Flop, Master Slave J-K Flip-Flops, T and D Flip-Flops, Shift registers, Synchronous and Asynchronous Counters, Ring and Johnson Couters.

TEXT BOOKS:

1 Pulse, Digital and Switching Circuits, J Millman and Taub, TMH, 2003.
2 Solid State Pulse Circuits,David A Bell, 4th Ed, PHI,
3 Digital Electronics and Computer Design – M.M. Mano, PHI

REFERENCE BOOKS:

1 Pulse and Digital Circuits, MS Prakash Rao,TMH, 2006.
2 Pulse & Digital Circuits, Anand Kumar, PHI
3 Pulse, Digital circuits and Computer fundamentals, R Venkataraman

PAPER-APAB-404(B)-SP-Electronics (PRACTICAL) **Total Marks: 50 (04 credits)**

SUB: Practical: Advanced Electronics Lab

PAPER-APAB-405(B)-SP-Electronics

SUB: PROJECT& Grand-Viva **Total Marks: 100**
Credits: 08