

BHARTI VISHWAVIDYALAYA
DURG (C.G)

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SCHEME OF EXAMINATION
&
SYLLABUS
OF
Bachelor of Science (Honors) Physics

UNDER
FACULTY OF SCIENCE

Session: 2021-2022

(Approved by Board of Studies)

EXAMINATION SCHEME

B. Sc. (Honors) Physics

B. Sc. (Hon's) examination will be conducted in six SEMESTERS.

SEMESTER– I

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHP-101	Mathematical Physics-I	4	70	30	100
BSHP-102	Mechanics	4	70	30	100
GE-I	A. Chemistry-I B. Mathematics-I C. Comp. Sci.-I	4	35	15	50
AECC	English Communication / MIL	2	35	15	50
ECA	Radiation Safety	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHPL-101	Mathematical Physics-I Lab	2	35	15	50
BSHPL-102	Mechanics Lab	2	35	15	50
GEL-I	GE-1 Lab	2	35	15	50

B. Sc. (Honors) Physics

SEMESTER-II

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHP-201	Electricity and Magnetism	4	70	30	100
BSHP-202	Waves and Optics	4	70	30	100
GE-II	A. Chemistry-II B. Mathematics-II C. Comp. Sci.-II	4	35	15	50
AECC	Environmental Science	2	35	15	50
ECA	ECA-Extracurricular activity/ Tour, Industrial training/ Field visit, NSS/ Swachhta/ vocational Training/ Sports/ others	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHPL-201	Electricity and Magnetism Lab	2	35	15	50
BSHPL-202	Waves and Optics Lab	2	35	15	50
GEL-II	GE-II Lab	2	35	15	50

B. Sc. (Honors) Physics

SEMESTER–III

THEORY

PAPER	COURSE	CREADITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHP-301	Mathematical Physics-II	4	70	30	100
BSHP-302	Thermal Physics	4	70	30	100
BSHP-303	Digital Systems and Applications	4	70	30	100
GE-III	A. *Chemistry-III B. Mathematics-III C. Comp. Sci.-III	4	35	15	50
SEC - 1	Select one from the pool of sec courses offered by different department	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHPL-301	Mathematical Physics-II Lab	2	35	15	50
BSHPL-302	Thermal Physics Lab	2	35	15	50
BSHPL-303	Digital Systems	2	35	15	50
GEL-III	GE-III Lab	2	35	15	50

***Students may Opt any one GE-III Chemistry as mention in syllabus**

B. Sc. (Honors) Physics

SEMESTER-IV

THEORY

PAPER	COURSE	CREADITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHP-401	Mathematical Physics- III	4	70	30	100
BSHP-402	Elements of Modern Physics	4	70	30	100
BSHP-403	Analog Systems and Applications	4	70	30	100
GE-IV	A. *Chemistry-IV B. Mathematics-IV C. Comp. Sci.-IV	4	35	15	50
SEC -2	Select one from the pool of sec courses offered by different department	2	35	15	50

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHPL-401	Mathematical Physics III Lab	2	35	15	50
BSHPL-402	Elements of Modern Physics Lab	2	35	15	50
BSHPL-403	Analog Systems and Applications Lab	2	35	15	50
GEL-IV	GE-IV Lab	2	35	15	50

*Students may Opt any one GE-IV Chemistry as mention in syllabus

B. Sc. (Honors) Physics

SEMESTER-V

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHP-501	Quantum Mechanics & Applications	4	70	30	100
BSHP-502	Solid State Physics	4	70	30	100
DSE-1	DSE-1	4	70	30	100
DSE-2	DSE-2	4	70	30	100

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHPL-501	Quantum Mechanics & Applications Lab	2	35	15	50
BSHPL-502	Solid State Physics Lab	2	35	15	50
DSEL- 1	DSE-1-Lab	2	35	15	50
DSEL- 2	DSE-2-Lab	2	35	15	50

B. Sc. (Honors) Physics

SEMESTER–VI

THEORY

PAPER	COURSE	CREDITS	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHP- 601	Electro-magnetic Theory	4	70	30	100
BSHP- 602	Statistical Mechanics	4	70	30	100
DSE-3	DSE-3	4	70	30	100
DSE-4	DSE-4	4	70	30	100

PRACTICAL

PAPER	COURSE	CREDITS	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSHPL- 601	Electro-magnetic Theory Lab	2	35	15	50
BSHPL- 602	Statistical Mechanics Lab	2	35	15	50
DSEL-3	DSE-3 Lab	2	35	15	50
DSEL-4/ Project	Dissertation/ Project work followed by seminar	2	35	15	50

*As per UGC CBCS guidelines, University / departments have liberty to offer GE and SEC courses offered by one department to students of other departments. The No. of GE course is four. One GE course is compulsory in first 4 semesters each.

Minimum One Skill Enhancement course shall be proposed by each department (4 credits) [4 L or 2 L+ 2 P or 1 L+3 P or 3L+ 1 T] 1P = 2 hours.

***Credit= L+T+P/2**

Where, L-Lecture, T-Tutorial and P- Practical

Total Credits=144

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	MARKS
Experiment	25
Viva-voce	10
Teacher Assessment	15
TOTALMARKS	50

PHYSICS -DSE 1-4 (ELECTIVES)

- DSE-1: Experimental Techniques
- DSE-2: Advanced Mathematical Physics-I
- DSE-3: Embedded systems- Introduction to Microcontroller
- DSE-4: Physics of Devices and Instrumentation

SKILL ENHANCEMENT COURSE (ANY TWO)

- SEC-I: Physics Workshop Skills
- SEC-2: Electrical circuit network Skills
- SEC-3: Basic Instrumentation Skills
- SEC-4: Radiation Safety

NAME OF THE GENERIC ELECTIVE SUBJECTS OFFERED BY YOUR DEPARTMENT

1. GE I: Mathematical Physics-I
2. GE II: Electricity and Magnetism
3. GE III: Thermal Physics
4. GE IV: Elements of Modern Physics

CORE SUBJECTS (HONOURS IN PHYSICS)

Semester I

MATHEMATICAL PHYSICS-I (BSHP-101)

CREDITS: 4

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

UNIT-I

Calculus-I

Recapitulation: Introduction to Cartesian spherical and cylindrical coordinate system, Intuitive ideas of plotting of curves with example of different curves. Elementary ideas of differentiation of function and Integration of function, multiple integrals (line, surface, volume) and its application with simple curves Approximation: Taylor theorems of single variable.

UNIT-II

Calculus-II

First order and Second Order Differential equations, First Order Differential equations and integrating factor. Homogeneous Equations with constant coefficients, Particular Integral. Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials. Integrating factor with simple illustration.

UNIT-III

Vector Calculus-I

Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields. Vector Differentiation: Directional derivatives and normal derivative. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

UNIT-IV

Vector Calculus-II

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

UNIT-V

Dirac Delta function and its properties:

Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

References:

1. Higher engineering Mathematics, B.S. Grewal (Khanna Publishers)
2. Theory and Problems of vector analysis, M.R. Spiegel (Schaum's Outline series)
3. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Ed., Elsevier.
4. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
5. Differential Equations, George F. Simmons, 2007, McGraw Hill.
6. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
7. Mathematical methods for Scientists and Engineers, D.A. Mc Quarrie, 2003, Viva Book
8. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
9. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
10. Essential Mathematical Methods, K.F. Riley & M.P. Hobson, 2011, Cambridge Univ. Press

MATHEMATICAL PHYSICS-I- LAB-I (BSHPL-101)

CREDITS: 2

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

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

Topics (Description with Applications):

Introduction and Overview Computer architecture and organization, memory and Input/output devices Basics of scientific computing Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods Errors and error Analysis Truncation and round off errors, Absolute and relative errors, Floating point computations. Review of C & C++ Programming fundamentals Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) (*If---statement. If---else Statement. Nested if Structure. Else---if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops*), Arrays (*1D & 2D*) and strings, user defined functions, Structures and Unions, Idea of classes and objects Programs: Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search Random number generation Area of circle, area of square, volume of sphere, value of π Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods Solution of linear and quadratic equation, solving $\alpha = \tan\alpha$; $I = I_0 [(\sin\alpha)/\alpha]^2$ in optics Interpolation by Newton Gregory Forward and Backward difference formula,

Error estimation of linear interpolation Evaluation of trigonometric functions e.g. $\sin \theta$, $\cos \theta$, $\tan \theta$, etc. Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method Given Position with equidistant time data to calculate velocity and acceleration and vice versa. Find the area of B-H Hysteresis loop

Also attempt some problems on differential equations like:

1. Solve the coupled first order differential equations for four initial conditions. Plot x vs y for each of the four initial conditions on the same screen for $0 \leq t \leq 15$.
2. The ordinary differential equation describing the motion of a pendulum. The pendulum is released from rest at an angular displacement α . Use the RK4 method to solve the equation for $\alpha = 0.1, 0.5$ and 1.0 and plot P as a function of time in the range $0 \leq t \leq 8\pi$. Also, plot the analytic solution valid in the small P ($\sin P \approx P$).
3. Solve differential equation with the boundary conditions and plot y and dy/dx against x in the given range. Both should appear on the same graph.

References:

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

MECHANICS (BSHP-102)

CREDITS: 4

UNIT-I

Fundamentals of Dynamics

Reference frames. Inertial frames; Galilean transformations; Galilean invariance. Momentum of variable-mass system: motion of rocket. Motion of a projectile in uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum.

UNIT-II

Work and Energy

Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames.

UNIT-III

Rotational Dynamics

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

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

UNIT-IV

Gravitation and Central Force Motion

Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere.

Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications.

UNIT-V

Oscillations

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

References:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
8. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000.
9. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
10. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
11. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

MECHANICS LAB-II (BSHPL-102)

CREDITS: 2

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To study the random error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
7. To determine the elastic Constants of a wire by Searle's method.
8. To determine the value of g using Bar Pendulum.
9. To determine the value of g using Kater's Pendulum.
10. To determine coefficient of viscosity of Glycerin by strok's method.
11. To determine the Young's modulus of material of cantilever.

References:

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal.
4. Engineering practical physics, S. Panigrihi and B. Mallick, 2015 Cengage learning India pvt ltd.
5. Practical physics G.I. Squires, 2015, 4th edition, Cambridge University press.

GE-I: CHEMISTRY

INORGANIC CHEMISTRY-I

CREDITS: 4

UNIT– I: Atomic Structure

Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2 . Quantum numbers and their significance. Normalized and orthogonal wave functions. Shapes of *s*, *p*, *d* and *f* orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.

UNIT –II: Periodicity of Elements

s, *p*, *d*, *f* block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-block'

(a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table.

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

(e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(f) Electron gain enthalpy, trends of electron gain enthalpy.

(g) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffe's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Sanderson's electron density ratio.

UNIT –III: Chemical Bonding

Ionic bond- General characteristics, types of *ions*, size effects, radius ratio rule and its limitations. Packing of ions in crystals. Born-Landé equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy.

Covalent bond- Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule,

Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2 , O_2 , C_2 , B_2 , F_2 , CO , NO , and their ions; HCl , BeF_2 , CO_2 , (idea of $s-p$ mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons.

UNIT –IV: Chemical Bonding-II

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization. Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

Metallic Bond: Qualitative idea of valence bond and band theories. Semi-conductors and insulators, defects in solids.

Weak Chemical Forces. van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetic of dissolution process.

UNIT- V: Oxidation-Reduction

Redox equations, Standard Electrode Potential and its application to inorganic reactions. Principles involved in volumetric analysis to be carried out in class.

Reference Books:

1. Lee, J.D. Concise Inorganic Chemistry, ELBS, 1991.
2. Douglas, B.E. and Mc Daniel, D.H., Concepts & Models of Inorganic Chemistry, Oxford, 1970
3. Atkins, P.W. & Paula, J. Physical Chemistry, Oxford Press, 2006.

GEL- I: INORGANIC CHEMISTRY-1 Lab

CREDITS: 2

1. Titrimetric Analysis

- (i) Calibration and use of apparatus
- (ii) Preparation of solutions of different Polarity/Normality of titrants

2. Acid-Base Titrations

- (iii) Estimation of carbonate and hydroxide present together in a mixture.
- (iv) Estimation of carbonate and bicarbonate present together in a mixture.
- (v) Estimation of free alkali present in different soaps/detergents

3. Oxidation-Reduction Titrimetry

- (vi) Estimation of Fe(II) and oxalic acid using standardized KMnO_4 solution.
- (vii) Estimation of oxalic acid and sodium oxalate in a given mixture.
- (viii) Estimation of Fe (II) with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal (diphenylamine, anthranilic acid) and external indicator.

Reference:

1. Vogegl, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS.

GE-I: MATHEMATICS- I: ALGEBRA AND TRIGONOMETRY

CREDITS: 4

UNIT-I

Elementary operations on matrices, Inverse of a matrix. Linear independence of row and column matrices, Row rank, column rank and rank of a matrix. Equivalence of column and row ranks.

UNIT-II

Application of matrices to a system of linear (both homogeneous and non homogeneous) equations. Theorems on consistency of a system of linear equations.

UNIT-III

Solutions of cubic equations (Cardons method), Biquadratic equation. Mappings, Equivalence relations and partitions.

UNIT-IV

Lagrange's theorem and its consequences. Fermat's and Euler's theorems. Normal sub groups. Quo tient group, Permutation groups. Even and odd permutations. The alternating groups A_n . Cayley's theorem.

UNIT- V

De-Moivre's theorem and its applications. Direct and inverse circular and hyperbolic functions.

Text Book :

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975
2. K.B. Datta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd. New Delhi, 2000.
3. Chandrika Prasad, Text-Book on Algebra and Theory of equations, Pothishala Private Ltd., Allahabad.
4. S. L. Loney, Plane Trigonometry Part II, Macmillan and Company, London.

References:

1. P.B. Bhattacharya, S.K. Jain and S. R. Nagpaul, First Course in linear Algebra, Wiley Eastern, New Delhi, 1983.

2. P.B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2 edition), Cambridge University Press, Indian Edition, 1997.
3. S.K. Jain, A. Gunawardena and P.B. Bhattacharya, Basic linear Algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.
4. H.S. Halland S. R. Knight, Higher Algebra, H.M.Publications, 1994.
5. R. S. Verma and K. S. Shukla, Text Book on Trigonometry, Pothishala Pvt. Ltd., Allahabad.

GEL-I: MATHEMATICS- I: ALGEBRA PART- I LAB

CREDITS: 2

1. Elementary operations on matrices
2. Inverse of a matrix.
3. Linear independence of row and column matrix
4. Rank of a matrix
5. Application of matrices to a system of linear (both homogeneous and non homogeneous) equations.
6. Theorems on consistency of a system of linear equations.
7. Lagrange's theorem and its consequences
8. Euler's theorems. Normal subgroups.
9. Quotient group, Permutation groups.
10. Even and odd permutations.

References:

1. P.B. Bhattacharya, S.K. Jain and S. R. Nagpaul, First Course in linear Algebra, Wiley Eastern, New Delhi, 1983.
2. P.B. Bhattacharya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2 edition), Cambridge University Press, Indian Edition, 1997.
3. S.K. Jain, A. Gunawardena and P.B. Bhattacharya, Basic linear Algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.

GE-I-COMPUTER SCIENCE-I:
Programming Fundamentals using C++

CREDITS: 4

UNIT-I

Introduction to C and C++: History of C and C++, Overview of Procedural Programming and Object-Oriented Programming, Using main () function, Compiling and Executing Simple Programs in C++.

Data Types, Variables, Constants, Operators and Basic I/O: Declaring, Defining and Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putchar), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.h).

Expressions, Conditional Statements and Iterative Statements: Simple Expressions in C++ (including Unary Operator Expressions, Binary Operator Expressions), Understanding Operator Precedence in Expressions, Conditional Statements (if construct, switch- case construct), Understanding syntax and utility of Iterative Statements (while, do-while, and for loops), Use of break and continue in Loops, Using Nested Statements (Conditional as well as Iterative)

UNIT-II

Functions and Arrays: Utility of functions, Call by Value, Call by Reference, Functions returning value, Void functions, Inline Functions, Return data type of functions, Functions parameters, Differentiating between Declaration and Definition of Functions, Command Line Arguments/Parameters in Functions, Functions with variable number of Arguments.

Creating and Using One Dimensional Arrays (Declaring and Defining an Array, Initializing an Array, Accessing individual elements in an Array, Manipulating array elements using loops), Use Various types of arrays (integer, float and character arrays / Strings) Two-dimensional Arrays (Declaring, Defining and Initializing Two Dimensional Array, Working with Rows and Columns), Introduction to Multi-dimensional arrays

Derived Data Types (Structures and Unions): Understanding utility of structures and unions, Declaring, initializing and using simple structures and unions, Manipulating individual members of structures and unions, Array of Structures, Individual data members as structures, Passing and returning structures from functions, Structure with union as members, Union with structures as members.

UNIT-III

Pointers and References in C++: Understanding a Pointer Variable, Simple use of Pointers (Declaring and Dereferencing Pointers to simple variables), Pointers to Pointers, Pointers to structures, Problems with Pointers, Passing pointers as function arguments, Returning a pointer from a function, using arrays as pointers, Passing arrays to functions. Pointers vs. References, Declaring and initializing references, Using references as function arguments and function return values

UNIT-IV

Memory Allocation in C++: Differentiating between static and dynamic memory allocation, use of malloc, calloc and free functions, use of new and delete operators, storage of variables in static and dynamic memory allocation

File I/O, Preprocessor Directives: Opening and closing a file (use of fstream header file, ifstream, ofstream and fstream classes), Reading and writing Text Files, Using put(), get(), read() and write() functions, Random access in files, Understanding the Preprocessor Directives (#include, #define, #error, #if, #else, #elif, #endif, #ifdef, #ifndef and #undef), Macros

Using Classes in C++: Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables & Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of Template classes and their use.

UNIT-V

Overview of Function Overloading and Operator Overloading: Need of Overloading functions and operators, Overloading functions by number and type of arguments, Looking at an operator as a function call, Overloading Operators (including assignment operators, unary operators)

Inheritance, Polymorphism and Exception Handling: Introduction to Inheritance (Multi-Level Inheritance, Multiple Inheritance), Polymorphism (Virtual Functions, Pure Virtual Functions), Basics Exceptional Handling (using catch and throw, multiple catch statements), Catching all exceptions, Restricting exceptions, Rethrowing exceptions.

Reference Books

2. Herbtz Schildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.
3. Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.
4. Bjarne Stroustrup, "Programming -- Principles and Practice using C++", 2nd Edition, Addison-Wesley 2014.
5. E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.
6. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall, 2011.
7. John R. Hubbard, "Programming with C++", Schaum's Series, 2nd Edition, 2000.
8. Andrew Koenig, Barbara E. Moo, "Accelerated C++", Published by Addison-Wesley, 2000.
9. Scott Meyers, "Effective C++", 3rd Edition, Published by Addison-Wesley, 2005.
10. Harry, H. Chaudhary, "Head First C++ Programming: The Definitive Beginner's Guide", FirstCreate space Inc, O-D Publishing, LLC USA.
11. Walter Savitch, "Problem Solving with C++", Pearson Education, 2007.
12. Stanley B. Lippman, JoseeLajoie, Barbara E. Moo, "C++ Primer", Published by Addison-Wesley, 5th Edition, 2012

GEL-I: PROGRAMMING FUNDAMENTALS USING C++

LAB

CREDITS: 2

1. WAP to print the sum and product of digits of an integer.
2. WAP to reverse a number.
3. WAP to compute the sum of the first n terms of the following series $S = 1 + 1/2 + 1/3 + 1/4 + \dots$
4. WAP to compute the sum of the first n terms of the following series $S = 1 - 2 + 3 - 4 + 5 - \dots$
5. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
6. Write a function to find whether a given no. is prime or not. Use the same to generate the prime numbers less than 100.
7. WAP to compute the factors of a given number.
8. Write a macro that swaps two numbers. WAP to use it.
9. WAP to print a triangle of stars as follows (take number of lines from user):

```
      *
     ***
    *****
   *********
  ***********
```

10. WAP to perform following actions on an array entered by the user:
 - i) Print the even-valued elements
 - ii) Print the odd-valued elements
 - iii) Calculate and print the sum and average of the elements of array
 - iv) Print the maximum and minimum element of array
 - v) Remove the duplicates from the array
 - vi) Print the array in reverse order

The program should present a menu to the user and ask for one of the options. The menu should also include options to re-enter array and to quit the program.

11. WAP that prints a table indicating the number of occurrences of each alphabet in the

text entered as command line arguments.

12. Write a program that swaps two numbers using pointers.
13. Write a program in which a function is passed address of two variables and then alter its contents.
14. Write a program which takes the radius of a circle as input from the user, passes it to another function that computes the area and the circumference of the circle and displays the value of area and circumference from the main() function.
15. Write a program to find sum of n elements entered by the user. To write this program, allocate memory dynamically using malloc()/calloc() functions or new operator.
16. Write a menu driven program to perform following operations on strings:
 - a) Show address of each character in string
 - b) Concatenate two strings without using strcat function.
 - c) Concatenate two strings using strcat function.
 - d) Compare two strings
 - e) Calculate length of the string (use pointers)
 - f) Convert all lowercase characters to uppercase
 - g) Convert all uppercase characters to lowercase
 - h) Calculate number of vowels
 - i) Reverse the string
17. Given two ordered arrays of integers, write a program to merge the two-arrays to get an ordered array.
18. WAP to display Fibonacci series (i) using recursion, (ii) using iteration
19. WAP to calculate Factorial of a number (i) using recursion, (ii) using iteration
20. WAP to calculate GCD of two numbers (i) with recursion (ii) without recursion.
21. Create Matrix class using templates. Write a menu-driven program to perform following Matrix operations (2-D array implementation):
 - a) Sum
 - b) Difference
 - c) Product
 - d) Transpose
22. Create the Person class. Create some objects of this class (by taking information from the user). Inherit the class Person to create two classes Teacher and Student class. Maintain the respective information in the classes and create, display and delete objects of these two classes (Use Runtime Polymorphism).

23. Create a class Triangle. Include overloaded functions for calculating area. Overload assignment operator and equality operator.
24. Create a class Box containing length, breath and height. Include following methods in it:
- Calculate surface Area
 - Calculate Volume
 - Increment, Overload ++ operator (both prefix & postfix)
 - Decrement, Overload -- operator (both prefix & postfix)
 - Overload operator == (to check equality of two boxes), as a friend function
 - Overload Assignment operator
 - Check if it is a Cube or cuboid

Write a program which takes input from the user for length, breath and height to test the above class.

25. Create a structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 students and store them in a file.
26. Write a program to retrieve the student information from file created in previous question and print it in following format:
- | Roll No. | Name | Marks |
|----------|------|-------|
|----------|------|-------|
27. Copy the contents of one text file to another file, after removing all whitespaces.
28. Write a function that reverses the elements of an array in place. The function must accept only one pointer value and return void.
29. Write a program that will read 10 integers from user and store them in an array. Implement array using pointers. The program will print the array elements in ascending and descending order.

Reference Books

- Herbtz Schildt, "C++: The Complete Reference", Fourth Edition, McGraw Hill.
- Bjarne Stroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.
- Bjarne Stroustrup, "Programming -- Principles and Practice using C++", 2nd Edition, Addison-Wesley 2014.
- E Balaguruswamy, "Object Oriented Programming with C++", Tata McGraw-Hill Education, 2008.

AECC- ENGLISH LANGUAGE

CREDITS: 2

UNIT I

COMMUNICATION THEORY AND TYPES

Theory of Communication, Types and modes of Communication Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication

UNIT II

SPEAKING SKILLS

Monologue Dialogue Group Discussion Effective Communication/ Mis- Communication, Interview Public Speech.

UNIT III

READING AND UNDERSTANDING

Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts.

UNIT IV

WRITING SKILLS

Documenting Report Writing Making notes Letter writing .

UNIT-V

FUNCTIONAL GRAMMAR

Parts of Speech, Word order / Types of Sentences, Questions (Affirmative and Negative), Present Perfect – Simple & Continuous, Present Perfect and Past Simple, Future Tense, Articles, Prepositions, Modals, Conjunctions, Quantifiers and Voice.

Reference Books:

English Language and Indian Culture - Published by M.P. Hindi Grant Academy Bhopal.

ECA- RADIATION SAFETY

CREDITS: 2

UNIT-I

Basics of Atomic and Nuclear Physics

Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.

UNIT-II

Interaction of Radiation with matter: Types of Radiation

Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources,

Interaction of Photons: Photoelectric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients,

Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Stragling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung),

Interaction of Neutrons: Collision, slowing down and Moderation.

UNIT-III

Radiation detection and monitoring devices

Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC).

UNIT-IV

Radiation detection

Basic concept and working principle of *gas detectors* (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), *Scintillation Detectors* (Inorganic and Organic Scintillators), *Solid States Detectors* and *Neutron Detectors*, *Thermo luminescent Dosimetry*.

UNIT-V

Radiation safety management: *Biological effects of ionizing radiation*, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management.

Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. *Industrial Uses:* Tracing, Gauging, Material Modification, Sterization, Food preservation.

EXPERIMENTS:-

1. Study the background radiation levels using Radiation meter
2. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
3. Study of counting statistics using background radiation using GM counter.
4. Study of radiation in various materials (e.g. K₂SO₄ etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage.
5. Study of absorption of beta particles in Aluminum using GM counter.
6. Detection of α particles using reference source & determining its half life using spark counter
7. Gamma spectrum of Gas Light mantle (Source of Thorium)

References:

1. W.E. Burcham and M. Jobses – Nuclear and Particle Physics – Longman (1995)
2. G.F.Knoll, Radiation detection and measurements.

3. Thermoluminescence Dosimetry, Mcknlly, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
1. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.
2. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981.
3. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowental and P.L. Airey, Cambridge University Press, U.K., 2001
4. A. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981.
5. NCRP, ICRP, ICRU, IAEA, AERB Publications.
6. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical Publishers Inc. London, 1981

Semester II

ELECTRICITY AND MAGNETISM (BSHP-201)

CREDITS: 4

UNIT-I

Electric Field and Electric Potential

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

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

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

UNIT-II

Dielectric Properties of Matter

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

UNIT-III

Magnetic Field

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

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

UNIT-IV

Electromagnetic Induction

Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

UNIT-V

Electrical Circuits

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

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

References:

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

ELECTRICITY AND MAGNETISMLAB-I (BSHPL-201)

CREDITS: 2

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
4. To verify the Thevenin Theorem.
5. To verify the Norton theorem.
6. To verify the Superposition, and Maximum power transfer theorems.
7. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
8. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
9. To determine self-inductance of a coil by Rayleigh's method.
10. To determine the mutual inductance of two coils by Absolute method.
11. To determine the frequency of AC Mains using Sonometer.

References:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. Engineering Practical physics S.Panigrihi and B.Mallick, 2015, Cengage Learning.

WAVES AND OPTICS (BSHP-202)

CREDITS: 4

UNIT-I

Superposition of Collinear Harmonic oscillations

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

UNIT-II

Superposition of two perpendicular Harmonic Oscillations

Graphical and Analytical Methods. Lissajous Figures with equal and unequal frequency and their uses.

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

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

UNIT-III

Superposition of Two Harmonic Waves

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

Wave Optics: Electromagnetic nature of light. Definition and properties of wave front. Huygens Principle. Temporal and Spatial Coherence.

UNIT-IV

Interference

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

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

UNIT-V

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

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

References:

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

WAVES AND OPTICS LAB-II (BSHPL-202)

CREDITS: 2

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify $\lambda^2 - T$ law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster's focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.
6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
10. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
11. To determine dispersive power and resolving power of a plane diffraction grating.

References:

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

GE-II: ORGANIC CHEMISTRY-I

CREDITS: 4

UNIT- I

Structure and Bonding

Classification, *nomenclature* and general structure of organic compounds. Hybridization. orbital representation of methane, ethane, ethylene, acetylene and benzene. Bond energy, bond length and bond angles. Polarity of covalent bonds-Inductive, resonance, hyper-conjugation and steric inhibition in resonance and its influence on acidity and basicity of organic compounds.

UNIT- II

Mechanism of Organic reactions

Curved arrow notation, drawing electron movements with arrows, half-headed and double headed arrows. Homolysis and heterolysis of carbon-carbon bonds; Reactive species e.g. Carbocations, carbanions, free radicals and their stability. Nucleophiles and electrophiles.

UNIT- III

Alkanes and cycloalkanes

Preparation and general reactions of alkanes and cycloalkanes, Bayer Strain theory of strain less ring; Conformation of ethane, *n*-butane and cyclohexane, chlorination of methane and side chain chlorination of toluene.

UNIT-IV

Alkenes

General methods for preparation of alkenes, Reactions of alkenes: Addition reactions (Electrophilic and free radical), Halogenation, Hydrohalogenation, Hydration, Hydroxylation, Hydroboration-oxidation, Mercuration-demercuration, Epoxidation and Ozonolysis.

Dienes: Conjugated and isolated Dienes; 1,2- versus 1,4-addition. Diels-Alder reaction of dienes: Mechanism.

UNIT-V

Alkynes

Preparation of alkynes, acidity and metal acetylides, Electrophilic addition reactions viz., Halogenation, Hydrohalogenation, Hydration. Hydroboration-oxidation, Mercuration-demercuration and Ozonolysis.

Reference Books:

1. *"Organic Chemistry"*, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P)Ltd., New Delhi.
2. *"Organic Chemistry"*, S. M. Mukherjee, S. P. Singh, and R. P. Kapoor, 1st Edition (1985), New Age International (P) Ltd. Publishers, New Delhi.
3. *"Organic Chemistry"*, I. L. Finar, [Vol. 1, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in 1996], ELBS and Longman Ltd., New Delhi.
4. *'Organic Chemistry - Structure and Reactivity'*, Seyhan N' Ege, 3rd Edition (1998), AITBS Publishers and Distributors, Delhi'
5. *-Organic Chemistry"*, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
6. *"Organic Chemistry"*, G. Solomon, Wiley India, Paper Back, 9th Edition.
7. *"Modern Organic Chemistry"*, M. K. Jain and S. C. Sharma, Vishal Publishing CO. Jalandhar, India. 4th Edition (2012).

GEL-II: ORGANIC CHEMISTRY-I LAB

CREDITS: 2

1. Calibration of the thermometer
2. Purification of *organic* compounds by crystallization using the following solvents:a. Water b. Alcohol, c. Alcohol-Water
3. Determination of the melting points of unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus)
4. Effect of impurities on the melting point-mixed melting point of two unknown organic compounds.
5. Detection of special elements (N, S, Cl, Br, I).

Reference Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry*, 5th Ed., Pearson (2012)

GE-II: MATHEMATICS- II: CALCULUS-I

CREDITS: 4

DIFFERENTIAL CALCULUS

UNIT-I:

Definition of the limit of a function. Basic properties of limits. Continuous functions and classification of discontinuities.

UNIT-II:

Asymptotes. Curvature. Tests for concavity and convexity. Points of inflexion. Multiple points.

INTEGRAL CALCULUS:

UNIT-III:

Integration of transcendental functions. Reduction formulae. Definite integrals.

ORDINARY DIFFERENTIAL EQUATIONS:

UNIT-IV:

Degree and order of a differential equation. Equations reducible to the linear form. Exact differential equations. First order higher degree equations solvable for x , y , p . Clairaut's form and singular solutions.

UNIT-V:

Linear differential equations of second order. Transformation of the equation by changing the dependent variable/the independent variable.

Text Book:

1. Gorakh Prasad, Differential Calculus, Pothishala Private Ltd. Allahabad.
2. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.
3. D. A. Murray Introductory Course in Differential Equations, Orient Longman (India), 1976.

References:

1. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.
2. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow.

3. A. Codington, An Introduction to Ordinary Differential Equations, PrenticsHall of India, 1961.
4. H.T.H. Piaggio, Elementary Treatise on Differential Equations and their Applications, C.B.S. Publishe & Distributors, Dehli, 1985.
5. W.E. Boyce and P.O. Dprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 1986.

GEL-II: MATHEMATICS- II: CALCULUS- I LAB

CREDITS: 2

1. Asymptotes, Curvature.
2. Tests for concavity and convexity
3. Points of inflexion. Multiple points
4. Degree and order of a differential equation.
5. Equations reducible to the linear form. Exact differential equations.
6. First order higher degree equations
7. Clairaut's form and singular solutions
8. Linear differential equations of second order
9. Transformation of the equation by changing the dependent variable
10. Transformation of the equation by changing the independent variable

References:

1. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar, Inc. New York, 1975.
2. N. Piskunov, Differential and Integral Calculus, Peace Publishers, Moscow.
3. E. A. Codington, An Introduction to Ordinary Differential Equations, Prentics Hall of India, 1961.
4. H.T.H. Piaggio, Elementary Treatise on Differential Equations and their Applications, C.B.S. Publishe & Distributors, Dehli, 1985.
5. W.E. Boyce and P.O. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 1986.

GE-II-PROGRAMMING IN JAVA (BSHCS-201)

CREDITS: 4

UNIT I

Introduction to Java

Java Architecture and Features, Understanding the semantic and syntax differences between C++ and Java, Compiling and Executing a Java Program, Variables, Constants, Keywords Data Types, Operators (Arithmetic, Logical and Bitwise) and Expressions, Comments, Doing Basic Program Output, Decision Making Constructs (conditional statements and loops) and Nesting, Java Methods (Defining, Scope, Passing and Returning Arguments, Type Conversion and Type and Checking, Built-in Java Class Methods),

UNIT II

Arrays, Strings and I/O

Creating & Using Arrays (One Dimension and Multi-dimensional), Referencing Arrays Dynamically, Java Strings: The Java String class, Creating & Using String Objects, Manipulating Strings, String Immutability & Equality, Passing Strings To & From Methods, String Buffer Classes. Simple I/O using System.out and the Scanner class, Byte and Character streams, Reading/Writing from console and files.

UNIT III

Object-Oriented Programming Overview

Principles of Object-Oriented Programming, Defining & Using Classes, Controlling Access to Class Members, Class Constructors, Method Overloading, Class Variables & Methods, Objects as parameters, final classes, Object class, Garbage Collection.

Inheritance, Interfaces, Packages, Enumerations, Autoboxing and Metadata

Inheritance: (Single Level and Multilevel, Method Overriding, Dynamic Method Dispatch, Abstract Classes), Interfaces and Packages, Extending interfaces and packages, Package and Class Visibility, Using Standard Java Packages (util, lang, io, net), Wrapper Classes, Autoboxing/Unboxing, Enumerations and Metadata.

UNIT IV

Exception Handling, Threading, Networking and Database Connectivity

Exception types, uncaught exceptions, throw, built-in exceptions, Creating your own exceptions; Multi-threading: The Thread class and Runnable interface, creating single

and multiple threads, Thread prioritization, synchronization and communication, suspending/resuming threads. Using java.net package, Overview of TCP/IP and Datagram programming. Accessing and manipulating databases using JDBC.

UNIT V

Applets and Event Handling

Java Applets: Introduction to Applets, Writing Java Applets, Working with Graphics, Incorporating Images & Sounds. Event Handling Mechanisms, Listener Interfaces, Adapter and Inner Classes. The design and Implementation of GUIs using the AWT controls, Swing components of Java Foundation Classes such as labels, buttons, text fields, layout managers, menus, events and listeners; Graphic objects for drawing figures such as lines, rectangles, ovals, using different fonts. Overview of servlets.

Reference Books

1. Ken Arnold, James Gosling, David Homes, "The Java Programming Language", 4th Edition, 2005.
2. James Gosling, Bill Joy, Guy L Steele Jr, Gilad Bracha, Alex Buckley "The Java Language Specification, Java SE 8 Edition (Java Series)", Published by Addison Wesley, 2014.
3. Joshua Bloch, "Effective Java" 2nd Edition, Publisher: Addison-Wesley, 2008.
4. Cay S. Horstmann, Gary Corness, "Core Java 2 Volume 1 - Fundamentals)", 9th Edition, PrinticeHall.
5. Cay S. Horstmann, Gary Corness, "Core Java 2 Volume 2 - Advanced Features)", 9th Edition, Printice Hall.
6. Bruce Eckel, "Thinking in Java", 3rd Edition, PHI, 2002.
7. Balaguruswamy, "Programming with Java", 4th Edition, McGraw Hill.
8. Paul Deitel, Harvey Deitel, "Java: How to Program", 10th Edition, Prentice Hall, 2011.
9. "Head First Java", Orielly Media Inc. 2nd Edition, 2005.
10. David J. Eck, "Introduction to Programming Using Java", Published by Create Space Independent Publishing Platform, 2009.
11. John R. Hubbard, "Programming with JAVA", Schaum's Series, 2nd Edition, 2004.

GEL-II: PROGRAMMING IN JAVA LAB

CREDITS: 2

1. To find the sum of any number of integers entered as command line arguments
2. To find the factorial of a given number
3. To learn use of single dimensional array by defining the array dynamically.
4. To learn use of in case of a two dimensional array
5. To convert a decimal to binary number
6. To check if a number is prime or not, by taking the number as input from the keyboard
7. To find the sum of any number of integers interactively, i.e., entering every number from the keyboard, whereas the total number of integers is given as a command line argument
8. Write a program that show working of different functions of String and String Buffer class likeset CharAt(), setLength(), append(), insert(), concat() and equals().
9. Write a program to create a “distance” class with methods where distance is computed in terms of feet and inches, how to create objects of a class and to see the use of this pointer
10. Modify the “distance” class by creating constructor for assigning values (feet and inches) to the distance object. Create another object and assign second object as reference variable to another object reference variable. Further create a third object which is a clone of the first object.
11. Write a program to show that during function overloading, if no matching argument is found, then java will apply automatic type conversions(from lower to higher data type)
12. Write a program to show the difference between public and private access specifiers. The program should also show that primitive data types are passed by value and objects are passedby reference and to learn use of final keyword
13. Write a program to show the use of static functions and to pass variable length arguments in afunction.
14. Write a program to demonstrate the concept of boxing and unboxing.
15. Create a multi-file program where in one file a string message is taken as input from the user and the function to display the message on the screen is given in another file

- (make use of Scanner package in this program).
16. Write a program to create a multilevel package and also creates a reusable class to generate Fibonacci series, where the function to generate Fibonacci series is given in a different file belonging to the same package.
 17. Write a program that creates illustrates different levels of protection in classes/subclasses belonging to same package or different packages
 18. Write a program “DivideByZero” that takes two numbers a and b as input, computes a/b, and invokes Arithmetic Exception to generate a message when the denominator is zero.
 19. Write a program to show the use of nested try statements that emphasizes the sequence of checking for catch handler statements.
 20. Write a program to create your own exception types to handle situation specific to your application (Hint: Define a subclass of Exception which itself is a subclass of Throwable).
 21. Write a program to demonstrate priorities among multiple threads.
 22. Write a program to demonstrate multithread communication by implementing synchronization among threads (Hint: you can implement a simple producer and consumer problem).
 23. Write a program to create URL object, create a URL Connection using the openConnection() method and then use it examine the different components of the URL and content.
 24. Write a program to implement a simple datagram client and server in which a message that is typed into the server window is sent to the client side where it is displayed.
 25. Write a program that creates a Banner and then creates a thread to scrolls the message in the banner from left to right across the applet’s window.
 26. Write a program to get the URL/location of code (i.e. java code) and document (i.e. html file).
 27. Write a program to demonstrate different mouse handling events like mouse Clicked(), mouse Entered(), mouse Exited(), mouse Pressed, mouse Released() and mouse Dragged().

28. Write a program to demonstrate different keyboard handling events.
29. Write a program to generate a window without an applet window using main () function.
30. Write a program to demonstrate the use of push buttons.

Reference Books

1. Ken Arnold, James Gosling, David Homes, "The Java Programming Language", 4th Edition,2005.
2. James Gosling, Bill Joy, Guy L Steele Jr, GiladBracha, Alex Buckley"The Java Language Specification, Java SE 8 Edition (Java Series)", Published by Addison Wesley, 2014.
3. Joshua Bloch, "Effective Java" 2nd Edition,Publisher: Addison-Wesley, 2008.

AECC- ENVIRONMENTAL SCIENCE

CREDITS: 2

UNIT – I

General: Environmental segments, environmental degradation, environmental impact assessment. Concept of Ecosystem: Fundamental of Ecology and Ecosystem, components of ecosystem, food-chain, food web, trophic levels, energy flow, cycling of nutrients, major ecosystem types (forest, grass land and aquatic ecosystem).

UNIT – II

Air Pollution: Atmospheric composition, energy balance, classification of air pollutants, source and effect of pollutants – Primary (CO, SO_x, NO_x, particulates, hydrocarbons), Secondary [photochemical smog, acid rain, ozone, PAN (Peroxy Acetyl Nitrate)], green house effect, ozone depletion, atmospheric stability and temperature inversion, Techniques used to control gaseous and particulate pollution, ambient air quality standards.

UNIT – III

Water Pollution: Hydrosphere, natural water, classification of water pollutants, trace element contamination of water, sources and effect of water pollution, types of pollutants, determination and significance of D.O., B.O.D., C.O.D. in waste water, Eutrophication, methods and equipment used in waste water treatment preliminary, secondary and tertiary.

UNIT – IV

Land Pollution & Noise Pollution: Lithosphere, pollutants (agricultural, industrial, urban waste, hazardous waste), their origin and effect, collection of solid waste, solid waste management, recycling and reuse of solid waste and their disposal techniques (open dumping, sanitary land filling, thermal, composting). Noise Pollution: Sources, effect, standards and control.

UNIT – V

Environmental Biotechnology: Definition, current status of biotechnology in environmental protection, bio-fuels, bio-fertilize, bio-surfactants, bio-sensor, bio-chips,

bio-reactors. Pollution Prevention through Biotechnology: Tannery industry, paper and pulp industry, pesticide industry, food and allied industry.

Text Books:

1. Environment and Ecology by Piyush Kant Pandey and Dipti Gupta (Sum India Publication).
2. A Textbook of Environmental Chemistry and Pollution Control by S.S. Dara (S. Chand and Company).

Reference Books:

1. Masters, G.M. Introduction to Environment Engineering and Science (Prentice Hall of India).
2. Environmental Chemistry by A.K. Dey (Eastern Ltd.).
3. Environmental Chemistry by B.K. Sharma (Krishna Prakashan).
4. Nebel B.J. Environmental Science (Prentice Hall of India-1987).
5. Environmental Biotechnology by S.N. Jogdand (Himalaya Publishing House).
6. Introduction to Environmental Biotechnology by A.K. Chatterji (Prentice Hall of India).

Semester III

MATHEMATICAL PHYSICS-II (BSHP-301)

CREDITS: 4

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

UNIT-I

Fourier Series

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

UNIT-II

Frobenius Method and Special Functions

Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Bessel Functions of the First Kind: Generating Function, simple recurrence relations.

UNIT-III

Some Special Integrals

Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

UNIT-IV

Partial Differential Equations

Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry.

UNIT-V

Special Theory of Relativity

Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications.

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

References:

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

MATHEMATICAL PHYSICS-II LAB-I (BSHPL-301)

CREDITS: 2

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).

Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate springConstant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigenvectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Solution of ODE First order Differential equation Euler, modified Euler and Runge-Kutta second order methods Second order differential equation Fixed difference method	First order differential equation Radioactive decay Current in RC, LC circuits with DC source Newton's law of cooling Classical equations of motion Second order Differential Equation Harmonic oscillator (no friction) Damped Harmonic oscillator Over damped Critical damped Oscillatory Forced Harmonic oscillator
Using Scicos / xcos	Generating square wave, sine wave, saw tooth wave Solution to harmonic oscillator Study of beat phenomenon Phase space plots

References:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press

3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett
4. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
5. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
6. Scilab(A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand& Company
7. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing

THERMAL PHYSICS (BSHP-302)

CREDITS: 4

UNIT-I:

Introduction to Thermodynamics

Zeroth and First Law of Thermodynamics

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

UNIT-II:

Second Law of Thermodynamics

Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. 2nd Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics.

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

UNIT-III:

Thermodynamic Potentials

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

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

UNIT-IV:

Kinetic Theory of Gases

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

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

UNIT-V:

Real Gases: Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Van der Waal's Equation of State for Real Gases, P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.

References:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, Mc Graw-Hill.
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill

THERMAL PHYSICS LAB-II (BSHPL-302)

CREDITS: 2

1. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
2. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
4. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
5. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.
6. Coefficient of linear expansion using Gumber method.
7. Specific heat determination by calorimeter method.

References:

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

DIGITAL SYSTEMS AND APPLICATIONS (BSHP-303)

CREDITS: 4

UNIT-I

Introduction to CRO: Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

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

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

UNIT-V

Timers: IC 555: block diagram and applications: Astable multi vibrator and Monostable multi vibrator.

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

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

References:

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

DIGITAL SYSTEMS AND APPLICATIONS LAB-III (BSHPL-303)

CREDITS: 2

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To test a Diode and Transistor using a Multimeter.
3. To design a switch (NOT gate) using a transistor.
4. To verify and design AND, OR, NOT and XOR gates using NAND gates.
5. To design a combinational logic system for a specified Truth Table.
6. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
7. Half Adder, Full Adder and 4-bit binary Adder.
8. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
9. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
10. To build JK Master-slave flip-flop using Flip-Flop ICs
11. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.

References:

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

***GE-III: Choose from scheme**

CREDITS: 4

***GEL-III: Choose from scheme**

CREDITS: 2

GE-III: MATHEMATICS- III
VECTOR ANALYSIS AND GEOMETRY

CREDITS: 4

UNIT-I

Scalar and vector product of three vectors Product of four vectors.

Reciprocal Vectors.

UNIT-II

Vector Integration.

UNIT- III

General equation of second degree. Tracing of conics.

UNIT- IV

Sphere.Cone.Cylinder.

UNIT-V

Central Conicoids. Paraboloids. Plane sections of conicoids.

Genera tinglines.

Text Books :

1. N. Saran and S.N. Nigam, Introduction to vector Analysis, Pothishala Pvt. Ltd. Allahabad.
2. Gorakh Prasad and H. C. Gupta, Text Book on Coordinate Geometry, Pothishala Pvt. Ltd., Allahabad.
3. R.J.T. Bell, Elementary Treatise on Coordinate Geometry of three dimensions, Machmillan India Ltd.1994.

References:

1. Murray R. Spiegel, Theory and Problems of Advanced Calculus, SchaumPublishing Company, NewYork.
2. Murray R. Spiegel, Vector Analysis, SchaumPublishing Company, New York.
3. Shanti Narayan, AText Book of Vector Calculus, S. Chand&Co., New Delhi.
4. S. L. Loney, The Elements of Coordinate Geometry, Macmillan and Company,london.

5. P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of two Dimensions, Wiley Eastern Ltd.,1994.
6. P.K. Jain and Khalil Ahmad, A Text Book of Analytical Geometry of three Dimensions, Wiley Eastern Ltd.,1999.
7. N. Saran and R.S. Gupta, Analytical Geometry of three Dimensions, PothishalaPvt.Ltd. Allahabad.

GEL-III: MATHEMATICS- III: PRACTICAL

CREDITS: 2

**PRESENTATION-I
AND
PRESENTATION-II**

GE-III-DATA STRUCTURES

CREDITS: 4

UNIT-I

Arrays

Single and Multi-dimensional Arrays, Sparse Matrices (Array and Linked Representation)

Stacks

Implementing single / multiple stack/s in an Array; Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another; Applications of stack; Limitations of Array representation of stack

UNIT-II

Linked Lists

Singly, Doubly and Circular Lists (Array and Linked representation); Normal and Circular representation of Stack in Lists; Self Organizing Lists; Skip Lists

UNIT-III

Queues

Array and Linked representation of Queue, De-queue, Priority Queues

Recursion

Developing Recursive Definition of Simple Problems and their implementation; Advantages and Limitations of Recursion; Understanding what goes behind Recursion (Internal Stack Implementation)

UNIT-IV

Trees

Introduction to Tree as a data structure; Binary Trees (Insertion, Deletion, Recursive and Iterative Traversals on Binary Search Trees); Threaded Binary Trees (Insertion, Deletion, Traversals); Height-Balanced Trees (Various operations on AVL Trees).

Searching and Sorting

Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Insertion Sort, Insertion Sort, Shell Sort, Comparison of Sorting Techniques

UNIT-V

Hashing

Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collision by Open Addressing, Coalesced Hashing, Separate

Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function

Reference Books:

1. Adam Drozdek, "Data Structures and algorithm in C++", Third Edition, Cengage Learning, 2012.
2. Sartaj Sahni, Data Structures, "Algorithms and applications in C++", Second Edition, Universities Press, 2011.
3. Aaron M. Tenenbaum, Moshe J. Augenstein, Yedidyah Langsam, "Data Structures Using C and C++", Second edition, PHI, 2009.
4. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson.
5. D.S Malik, Data Structure using C++, Second edition, Cengage Learning, 2010.
6. Mark Allen Weiss, "Data Structures and Algorithms Analysis in Java", Pearson Education, 3rd edition, 2011
7. Aaron M. Tenenbaum, Moshe J. Augenstein, Yedidyah Langsam, "Data Structures Using Java", 2003.
8. Robert Lafore, "Data Structures and Algorithms in Java, 2/E", Pearson/ Macmillan Computer Pub, 2003
9. John Hubbard, "Data Structures with JAVA", McGraw Hill Education (India) Private Limited; 2 edition, 2009
10. Goodrich, M. and Tamassia, R. "Data Structures and Algorithms Analysis in Java", 4th Edition, Wiley
11. Herbert Schildt, "Java The Complete Reference (English) 9th Edition Paperback", Tata McGraw Hill, 2014.
12. D. S. Malik, P.S. Nair, "Data Structures Using Java", Course Technology, 2003.

GEL-III:DATA STRUCTURES LAB

CREDITS: 2

1. Write a program to search an element from a list. Give user the option to perform Linear or Binary search. Use Template functions.
2. WAP using templates to sort a list of elements. Give user the option to perform sorting using Insertion sort, Bubble sort or Selection sort.
3. Implement Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list and concatenate two linked lists (include a function and also overload operator +).
4. Implement Doubly Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
5. Implement Circular Linked List using templates. Include functions for insertion, deletion and search of a number, reverse the list.
6. Perform Stack operations using Linked List implementation.
7. Perform Stack operations using Array implementation. Use Templates.
8. Perform Queues operations using Circular Array implementation. Use Templates.
9. Create and perform different operations on Double-ended Queues using Linked List implementation.
10. WAP to scan a polynomial using linked list and add two polynomial.
11. WAP to calculate factorial and to compute the factors of a given no. (i) using recursion, (ii) using iteration
12. (ii) WAP to display fibonacci series (i) using recursion, (ii) using iteration
13. WAP to calculate GCD of 2 number (i) with recursion (ii) without recursion
14. WAP to create a Binary Search Tree and include following operations in tree:
 - (a) Insertion (Recursive and Iterative Implementation)
 - (b) Deletion by copying
 - (c) Deletion by Merging
 - (d) Search a no. in BST
 - (e) Display its preorder, postorder and inorder traversals Recursively
 - (f) Display its preorder, postorder and inorder traversals Iteratively
 - (g) Display its level-by-level traversals

- (h) Count the non-leaf nodes and leaf nodes
 - (i) Display height of tree
 - (j) Create a mirror image of tree
 - (k) Check whether two BSTs are equal or not
15. WAP to convert the Sparse Matrix into non-zero form and vice-versa.
 16. WAP to reverse the order of the elements in the stack using additional stack.
 17. WAP to reverse the order of the elements in the stack using additional Queue.
 18. WAP to implement Diagonal Matrix using one-dimensional array.
 19. WAP to implement Lower Triangular Matrix using one-dimensional array.
 20. WAP to implement Upper Triangular Matrix using one-dimensional array.
 21. WAP to implement Symmetric Matrix using one-dimensional array.
 22. WAP to create a Threaded Binary Tree as per inorder traversal, and implement operations like finding the successor / predecessor of an element, insert an element, inorder traversal.
 23. WAP to implement various operations on AVL Tree.

Reference Books:

1. Adam Drozdek, "Data Structures and algorithm in C++", Third Edition, Cengage Learning, 2012.
2. Sartaj Sahni, Data Structures, "Algorithms and applications in C++", Second Edition, Universities Press, 2011.
3. Aaron M. Tenenbaum, Moshe J. Augenstein, Yedidyah Langsam, "Data Structures Using C and C++", Second edition, PHI, 2009.
4. Robert L. Kruse, "Data Structures and Program Design in C++", Pearson.
5. D.S Malik, Data Structure using C++, Second edition, Cengage Learning, 2010.
6. Mark Allen Weiss, "Data Structures and Algorithms Analysis in Java", Pearson Education, 3rd edition, 2011
7. Aaron M. Tenenbaum, Moshe J. Augenstein, Yedidyah Langsam, "Data Structures Using Java, 2003.

Semester IV

PHYSICS: MATHEMATICAL PHYSICS-III (BSHP-401)

CREDITS: 4

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

UNIT-I

Complex Analysis

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions.

UNIT-II

Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's Integral formula. Simply and multiply connected region. Laurent and Taylor's expansion. Residues and Residue Theorem. Application in solving Definite Integrals.

UNIT-III

Integrals Transforms:

Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral.

UNIT-IV

Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

UNIT-V

Laplace Transforms: Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of Scale Theorem, Shifting Theorem. LTs of Derivatives and Integrals of Functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic Functions. Convolution Theorem. Inverse LT. Application of Laplace

Transforms to Differential Equations: Damped Harmonic Oscillator, Simple Electrical Circuits.

References:

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

MATHEMATICAL PHYSICS-III LAB-I (BSHPL-401)

CREDITS: 2

Scilab based simulations experiments based on Mathematical Physics problems like

1. Solve differential equations: $dy/dx = e^{-x}$ with $y = 0$ for $x = 0$ $dy/dx + e^{-x}y = x^2$
 $d^2y/dt^2 + 2 dy/dt = -y$ $d^2y/dt^2 + e^{-t}dy/dt = -y$
2. Dirac Delta Function: Evaluate complex integrals .
3. Fourier Series: Program to sum $(0.2)^n$

Evaluate the Fourier coefficients of a given periodic function (square wave)

4. Frobenius method and Special functions. Plot $P_n(x)$, $J_\nu(x)$ and show recursion relation
5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).
6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.
7. Evaluation of trigonometric functions e.g. $\sin \theta$, Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate $1/(x^2+2)$ numerically and check with computer integration.
8. Integral transform: FFT of e^{-x^2}

References:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. VandeWouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
5. Scilab(A free software to Matlab): H.Ramchandran, A.S.Nair. 2011 S.Chand& Company
6. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing.

ELEMENTS OF MODERN PHYSICS (BSHP-402)

CREDITS: 4

UNIT-I

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

UNIT-II

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- range of an interaction.

UNIT-III

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

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; tunneling in one dimension-across a step potential & rectangular potential barrier.

UNIT-IV

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers. Introduction to fission and fusion.

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission.

UNIT-V

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

References:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan.
6. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
7. Theory and Problems of Modern Physics, Schaum's outline, R. Gautreau and W. Savin, 2nd Ed., Tata McGraw-Hill Publishing Co. Ltd.
8. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
9. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub.
10. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill

ELEMENTS OF MODERN PHYSICS LAB-II (BSHPL-402)

CREDITS: 2

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
7. To show the tunneling effect in tunnel diode using I-V characteristics.
8. To determine the wavelength of laser source using diffraction of single slit.
9. To determine the wavelength of laser source using diffraction of double slits.
10. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

References:

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

ANALOG SYSTEMS AND APPLICATIONS (BSHP-403)

CREDITS: 4

UNIT-I

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction.

UNIT-II

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode, (3) Solar Cell.

Bipolar Junction transistors: N-P-N and P-N-P Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β . Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions.

UNIT-III

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.

Coupled Amplifier: RC-coupled amplifier and its frequency response.

Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

UNIT-IV

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

UNIT-V

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain.Frequency Response.CMRR. Slew Rate and concept of Virtual ground.

References:

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

ANALOG SYSTEMS AND APPLICATIONS LAB-III (BSHPL-403)

CREDITS: 2

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
8. To design a Wien bridge oscillator for given frequency using an op-amp.
9. To design a phase shift oscillator of given specifications using BJT.
10. To study the Colpitt's oscillator.
11. To design a digital to analog converter (DAC) of given specifications.
12. To study the analog to digital convertor (ADC) IC.
13. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
14. To design inverting amplifier using Op-amp (741,351) and study its frequency response
15. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
16. To study the zero-crossing detector and comparator
17. To add two dc voltages using Op-amp in inverting and non-inverting mode
18. To design a precision Differential amplifier of given I/O specification using Op-amp.
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.
21. To design a circuit to simulate the solution of a 1st/2nd order differential equation.

References:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4. Electronic Devices & circuit Theory, R.L. Boylestad&L.D. Nashelsky, 2009, Pearson

***GE-IV: Choose from scheme**

CREDITS: 4

***GEL-IV: Choose from scheme**

CREDITS: 2

GE-IV: MATHEMATICS- II: DIFFERENTIAL EQUATIONS

CREDITS: 4

UNIT-I

Series solutions of differential equations- Power series method, Bessel and Legendre functions and their properties-convergence, recurrence and generating relations

UNIT-II

Orthogonality of functions, Sturm-Liouville problem, Orthogonality of eigen- functions, Reality of eigen values, Orthogonality of Bessel functions and Legendre polynomials.

UNIT-III

Laplace Transformation- Linearity of the Laplace transformation, Existence theorem for Laplace transforms, Laplace transforms of derivatives and integrals, Shifting theorems. Differentiation and integration of transforms.

UNIT-IV

Convolution theorem. Solution of integral equations and systems of differential equations using the Laplace transformation.

UNIT-V

Partial differential equations of the first order. Lagrange's solution.

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., New York, 1999.
2. D.A. Murray, Introductory Course on Differential Equations, Orient Longman, (India), 1967.
3. A.R. Forsyth, A Treatise on Differential Equations, Macmillan and Co. Ltd., London.
4. Lan N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
5. Francis B. Hilderbrand, Advanced Calculus for Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1977.
6. Jane Cronin, Differential equations, Marcel Dekkar, 1994.

7. Frank Ayres, Theory and Problems of Differential Equations, McGraw-Hill Book Company, 1972.
8. Richard Bronson, Theory and Problems of Differential Equations, McGraw-Hill, Inc., 1973.
9. A.S. Gupta, Calculus of variations with-Applications, Prentice-Hall of India, 1997. R. Courant and D. Hilbert, Methods of Mathematical Physics, Vols. I & II, Wiley.

GEL-IV: MATHEMATICS- IV: LAB

CREDITS: 2

**PRESENTATION-I
AND
PRESENTATION-II**

GE-IV-DESIGN AND ANALYSIS OF ALGORITHMS

CREDITS: 4

UNIT-I:

Introduction: Basic Design and Analysis techniques of Algorithms, Correctness of Algorithm.

Algorithm Design Techniques: Iterative techniques, Divide and Conquer, Dynamic Programming, Greedy Algorithms.

UNIT-II:

Sorting and Searching Techniques

Elementary sorting techniques–Bubble Sort, InsertionSort, Merge Sort, Advanced Sorting techniques - Heap Sort, Quick Sort, Sorting in Linear Time - Bucket Sort, Radix Sort and Count Sort, Searching Techniques, Medians & Order Statistics, complexity analysis;

UNIT-III:

Lower Bounding Techniques

Decision Trees

Balanced Trees

Red-Black Trees

UNIT-IV:

Advanced Analysis Technique

Amortized analysis

UNIT-V: Graphs

Graph Algorithms–Breadth First Search, Depth First Search and its Applications,MinimumSpanning Trees.

String Processing

String Matching, KMP Technique

Recommended Books:

1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
Introduction toAlgorithms, PHI, 3rd Edition 2009
2. Sarabasse & A.V. Gelder Computer Algorithm – Introduction to Design and
Analysis,Publisher – Pearson 3rd Edition 1999

GEL-IV-DESIGN AND ANALYSIS OF ALGORITHMS LAB

CREDITS: 2

1.
 - i. Implement Insertion Sort (The program should report the number of comparisons)
 - ii. Implement Merge Sort (The program should report the number of comparisons)
2. Implement Heap Sort(The program should report the number of comparisons)
3. Implement Randomized Quick sort (The program should report the number of comparisons)
4. Implement Radix Sort
5. Create a Red-Black Tree and perform following operations on it:
 - i. Insert a node
 - ii. Delete a node
 - iii. Search for a number & also report the color of the node containing this number.
6. Write a program to determine the LCS of two given sequences
7. Implement Breadth-First Search in a graph
8. Implement Depth-First Search in a graph
9. Write a program to determine the minimum spanning tree of a graph

For the algorithms at S.No 1 to 3 test run the algorithm on 100 different inputs of sizes varying from 30 to 1000. Count the number of comparisons and draw the graph. Compare it with a graph of $n \log n$.

Recommended Books:

1. T.H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
Introduction to Algorithms, PHI, 3rd Edition 2009
2. Sarabasse& A.V. Gelder Computer Algorithm – Introduction to Design and Analysis,Publisher – Pearson 3rd Edition 1999

PHYSICS: QUANTUM MECHANICS (BSHP-501)

CREDITS: 4

UNIT-I

Limits of Classical Physics:

Black body radiation (without derivation), Photoelectric effect, Compton Effect.

UNIT-II

Wave Packets and Uncertainty Relation: de Broglie hypothesis, Wave-particle duality, Davisson-Germer experiment, Wave packets, Group velocity and phase velocity, Uncertainty principle, Complimentarity.

UNIT-III

Wave Mechanics:

Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential.

UNIT-IV

Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Stationary states, Superposition principle, Commutation relations, Commuting observables and compatibility.

UNIT-V

Application of Schrödinger Wave Equation:

Particle in one dimensional Box, Square well, Rectangular potential barrier and tunnelling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigenfunctions, Concept of spin, Hydrogen atom.

Reference Books:

1. Quantum Physics: S. Gasiorowicz.
2. Quantum Mechanics: B. H. Bransden and C. J. Joachain.
3. Quantum Physics of Atoms, Molecules, Nuclei and Solids: R. M. Eisberg and R. Resnick.
4. Quantum Mechanics: V. Devanathan.
5. Quantum Mechanics: C. S. Chaddha.

QUANTUM MECHANICS LAB-I (BSHPL-501)

CREDITS: 2

Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

$$d^2y/dr^2 = -k^2 u(r), A(r) = 2m\hbar^2 [V(r) - E] \text{ where } V(r) = -e^2/r$$

Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is -13.6 eV. Take $e = 3.795$ (eVÅ)^{1/2}, $\hbar c = 1973$ (eVÅ) and $m = 0.511 \times 10^6$ eV/c².

2. Solve the s-wave radial Schrodinger equation for an atom:

$$d^2y/dr^2 = -k^2 u(r), A(r) = 2m\hbar^2 [V(r) - E]$$

where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential $V(r) = -e^2 r e^{-r/a}$

Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take $e = 3.795$ (eVÅ)^{1/2}, $m = 0.511 \times 10^6$ eV/c², and $a = 3$ Å, 5 Å, 7 Å. In these units $\hbar c = 1973$ (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.

3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

$$d^2y/dr^2 = -k^2 u(r), A(r) = 2m\hbar^2 [V(r) - E]$$

For the anharmonic oscillator potential

$$V(r) = 1/2 k r^2 + 1/3 b r^3$$

for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose $m = 940$ MeV/c², $k = 100$ MeV fm⁻², $b = 0, 10, 30$ MeV fm⁻³. In these units, $\hbar c = 197.3$ MeV fm. The ground state energy is expected to lie between 90 and 110 MeV for all three cases.

4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

$$d^2y/dr^2 = -k^2 u(r), A(r) = 2\mu\hbar^2 [V(r) - E]$$

Where μ is the reduced mass of the two-atom system for the Morse potential $V(r) = D e^{-2\alpha(r-r_0)} - e^{-\alpha(r-r_0)}$, r_0 is the equilibrium bond length.

Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function. Take: $m = 940 \times 106 \text{ eV}/c^2$, $D = 0.755501 \text{ eV}$, $\alpha = 1.44$, $r_0 = 0.131349 \text{ \AA}$

Laboratory based experiments (Optional):

5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting
7. Quantum efficiency of CCDs

Reference Books:

1. Schaum's outline of Programming with C⁺⁺. J. Hubbard, 2000, McGraw-Hill Publication
2. An introduction to computational Physics, T. Pang, 2nd Edn., 2006, Cambridge Univ. Press
3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer.
4. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand & Co.
5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press

SOLID STATE PHYSICS (BSHP-502)

CREDITS: 4

UNIT-I

Structure and Symmetry:

Elements of external symmetry of crystals, space lattice, Bravais lattices, Miller indices for direction and planes, Common crystal structures: NaCl, CsCl, ZnS and Diamond, Close packed structures, Quasicrystals.

UNIT-II

Bonding in solids, Lennard Jones potential, concept of cohesive energy, covalent, van der Waals, ionic and metallic bonding.

Diffraction of x-rays, Laue equations and Braggs law, reciprocal lattice, Brillouin Zones and Ewald construction, atomic scattering and structure factors.

UNIT-III

Lattice Vibrations:

Vibrational modes of continuous medium, Debye's theory of specific heat, Vibrations of one dimensional monoatomic and diatomic chain, Phonons, Density of states.

UNIT-IV

Electronic Properties:

Free electron gas, Electrons in periodic potential, Kronig Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors, Motion of electron in electric and magnetic fields, Hall Effect, Fermi surface.

UNIT-V

Magnetic Properties :

Dia-, Para-and Ferromagnetism, origin of magnetism, Langevin's theory of paramagnetism, Weiss Molecular theory, Ferromagnetic ordering, spin waves, magnons, ferromagnetic domains.

Reference Books:

1. Crystallography for Solid State Physics: A. R. Verma and O.N. Srivastava.
2. Introduction to Solids: Azaroff.
3. Solids State Physics: Kittel.
4. Solids State Physics: Ashcroft and Mermin.

SOLID STATE PHYSICS LAB-II (BSHPL-502)

CREDITS: 2

At least 06 experiments from the following

1. Measurement of susceptibility of paramagnetic solution (Quinck's Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency.
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR) technique.
6. To determine the refractive index of a dielectric using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150°C) by four-probe method and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. To measure the resistivity of a semiconductor (Ge) with temperature by two-probe method and to determine its band gap.
12. Analysis of X-Ray diffraction data in terms of unit cell parameters and estimation of particle size.
13. Measurement of change in resistance of a semiconductor with magnetic field.

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

SEMESTER VI

ELECTROMAGNETIC THEORY AND BASIC ELECTRONICS (BSHP-601)

CREDITS: 4

UNIT-I

Vector Calculus:

Gradient, divergence and curl operators; Introduction to Gauss's divergence and Stoke's theorem.

UNIT-II

Electromagnetism:

Laws of Electromagnetism using vector calculus; electrostatics and magneto statics in matter, concepts of electric and magnetic polarizations, bound charges and currents; electrodynamics and displacement current, Maxwell's equations in integral and differential forms; Concepts of vector and scalar potentials, and gauge transformations, Poynting vector, energy and momentum conservation.

UNIT-III

EM wave propagation:

EM wave equations and their solutions; Polarization; Propagation of plane EM waves in free space, dielectrics (absorption coefficient) and conductors (skin depth and plasma frequency): Laws of reflection, transmission at normal and oblique incidence in linear media and conducting media (Fresnel's equations and Brewster's angle); Elementary ideas of wave guides (TE, TM modes and cut- off frequency) and coaxial transmission line.

UNIT-IV

P-N junction diode, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode.

UNIT-V

Transistor circuits, Input, Output characteristics and CB and CE modes, Early effect, α and β parameters; DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response.

Reference Books:

1. Introduction to Electrodynamics (3rd Edition): David J. Griffiths.
2. EM Waves and Fields: P. Lorrain and O. Corson. 3. Electronic Devices and Circuits: J. Millman and C. Halkias.
3. Electronics Fundamental and Application: D. Chattopadhyay and P.C. Rakshit.

ELECTROMAGNETIC THEORY AND BASIC ELECTRONICS

LAB-I (BSHPL-601)

CREDITS: 2

The laboratory content compliments the theoretical knowledge of Electromagnetic Theory and gives hands-on experience. Also, it provides the observational understanding of the subject. It enhances the qualitative and quantitative skills of the students.

At least 06 experiments from the following

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

Reference Books:

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

STATISTICAL MECHANICS (BSHP-602)

CREDITS: 4

UNIT-I

Random Walk Problem:

Probability distribution, calculation of mean and dispersion (as a measure of fluctuation), and simple numerical problems.

UNIT-II

Basics of Statistical Mechanics:

State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters.

UNIT-III

Classical Statistical Mechanics:

Ensemble theory (Micro-canonical, Canonical and Grand-canonical), applications to classical ideal gas and simple numerical problems; Gibbs paradox; Statistical equivalence of three ensembles.

UNIT-IV

Quantum Statistical Mechanics:

Introduction to Bose-Einstein and Fermi-Dirac statistics; Maxwell-Boltzmann statistics as a classical limit; Comparison of the three statistics;

UNIT-V

Qualitative features of degenerate Fermi and Bose gases.

Reference Books:

1. Fundamentals of Statistical and Thermal Physics: Frederick Reif.
2. Statistical Mechanics (2nd Edition): R.K. Pathria.
3. Equilibrium Statistical Physics: Michael Plischke and Birger Bergersen.
4. Statistical Mechanics: (Wiley): Kerson Huang.

STATISTICAL MECHANICS LAB-II (BSHPL-602)

CREDITS: 4

Use C/C++/Scilab/other numerical simulations for solving the problems based on Statistical Mechanics like

1. Computational analysis of the behavior of a collection of particles in a box that satisfy Newtonian mechanics and interact via the Lennard-Jones potential, varying the total number of particles N and the initial conditions:
 - a) Study of local number density in the equilibrium state (i) average; (ii) fluctuations
 - b) Study of transient behavior of the system (approach to equilibrium)
 - c) Relationship of large N and the arrow of time
 - d) Computation of the velocity distribution of particles for the system and comparison with the Maxwell velocity distribution
 - e) Computation and study of mean molecular speed and its dependence on particle mass
 - f) Computation of fraction of molecules in an ideal gas having speed near the most probable speed
2. Computation of the partition function $Z(b)$ for examples of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics:
 - a) Study of how $Z(b)$, average energy $\langle E \rangle$, energy fluctuation ΔE , C_v , depend upon the temperature, total number of particles N and the spectrum of single particle states.
 - b) Ratios of occupation numbers of various states for the systems considered above
 - c) Computation of physical quantities at large and small temperature T and comparison of various statistics at large and small temperature T .
3. Plot Planck's law for Black Body radiation and compare it with Rayleigh-Jeans Law at large and small wavelength for a given temperature.

4. Plot Specific Heat of Solids (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature and low temperature and compare them for these two cases.
5. Plot the following functions with energy at different temperatures
 - a) Maxwell-Boltzmann distribution
 - b) Fermi-Dirac distribution
 - c) Bose-Einstein distribution
6. Plot the distribution of particles w.r.t. energy (dN/de versus e) for
 - a) Relativistic and non-relativistic bosons both at high and low temperature.
 - b) Relativistic and non-relativistic fermions both at high and low temperature.

Reference Books:

1. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edition. 2007, Wiley India Edition.
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.
3. Introduction to Modern Statistical Mechanics, D. Chandler, Oxford University Press, 1987
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6. Statistical and Thermal Physics with computer applications, Harvey Gould and Jan Tobochnik, Princeton University Press, 2010.

PHYSICS-DSE I-IV ELECTIVES

DSE-I: EXPERIMENTAL TECHNIQUES

CREDITS: 4

This paper aims to describe the errors in measurement and statistical analysis of data required while performing an experiment. Also, students will learn the working principle, efficiency and applications of transducers & industrial instruments like digital multimeter, RTD, Thermistor, Thermocouples and Semiconductor type temperature sensors.

UNIT-I

Measurements: Accuracy and precision. Significant figures. Error and uncertainty analysis. Types of errors: Gross error, systematic error, random error. Statistical analysis of data (Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square) and curve fitting. Gaussian distribution.

Signals and Systems: Fluctuations and Noise in measurement system. S/N ratio and Noise figure. Noise in frequency domain. Sources of Noise: Inherent fluctuations, Thermal noise, Shot noise, 1/f noise.

UNIT-II

Shielding and Grounding: Methods of safety grounding. Energy coupling. Grounding. Shielding: Electrostatic shielding. Electromagnetic Interference.

UNIT-III

Transducers & industrial instrumentation (working principle, efficiency, applications): Static and dynamic characteristics of measurement Systems. Generalized performance of systems, Zero order first order, second order and higher order systems. Electrical, Thermal and Mechanical systems. Calibration. Qualitative difference between Transducers and sensors. Types of sensors (Physical, Chemical and Biological), Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Temperature transducers: RTD, Thermistor, Thermocouples, Semiconductor type temperature sensors (AD590, LM35, LM75) and signal conditioning. Linear Position transducer: Strain gauge, Piezoelectric. Inductance change transducer: Linear variable differential transformer (LVDT), Capacitance change transducers.

Radiation Sensors: Principle of Gas filled detector, ionization chamber, scintillation detector.

UNIT-IV

Digital Multimeter: Comparison of analog and digital instruments. Block diagram of digital multimeter, principle of measurement of I, V, C. Accuracy and resolution of measurement.

Impedance Bridges and Q-meter: Block diagram and working principles of RLC bridge. Q-meter and its working operation. Digital LCR bridge.

UNIT-V

Vacuum Systems: Characteristics of vacuum: Gas law, Mean free path. Application of vacuum. Vacuum system- Chamber with roughing and backing, Mechanical pumps (Rotary and root pumps), Diffusion pump & Turbo Molecular pump, Ion pumps, Pumping speed, throughput, Pressure gauges (Pirani, Penning, ionization, cold cathode).

Reference Books:

1. Experimental Methods for Engineers, J P. Holman, McGraw Hill
2. Introduction to Measurements and Instrumentation, A.K. Ghosh, 3rd Edition, PHI Learning Pvt. Ltd.
3. Transducers and Instrumentation, D.V.S. Murty, 2nd Edition, PHI Learning Pvt. Ltd.
4. Instrumentation Devices and Systems, C.S.Rangan, G.R. Sarma, V.S.V. Mani, Tata McGraw Hill
5. Electronic circuits: Handbook of design & applications, U.Tietze, Ch.Schenk, Springer

PRACTICAL- DSE-I LAB: EXPERIMENTAL TECHNIQUES

CREDITS: 2

At least 06 experiments each from the following.

1. Determine output characteristics of a LVDT & measure displacement using LVDT
2. Measurement of
 - (a) Strain using Strain Gauge,
 - (b) level using capacitive transducer.
 - (c) distance using ultrasonic transducer
3. To study the characteristics of a Thermostat and determine its parameters.
4. Calibrate Semiconductor type temperature sensor (AD590, LM35, LM75) and Resistance Temperature Device (RTD).
5. Create vacuum in a small chamber using a mechanical (rotary) pump and measure the chamber pressure using a pressure gauge.
6. Comparison of pickup of noise in cables of different types (co-axial, single shielded, double shielded, without shielding) of 2m length, understanding of importance of grounding using function generator of mV level & an oscilloscope.
7. To design and study the Sample and Hold Circuit.
8. Design and analyze the Clippers and Clampers circuits using junction diode
9. To plot the frequency response of a microphone.
10. To measure Q of a coil and influence of frequency, using a Q-meter.

Reference Books:

1. Electronic circuits: Handbook of design and applications, U.Tietze and C.Schenk, 2008, Springer
2. Basic Electronics:A text lab manual, P.B.Zbar, A.P.Malvino, M.A.Miller, 1990, Mc- Graw Hill
3. Measurement, Instrumentation and Experiment Design in Physics & Engineering, M.Sayer and A. Mansingh, 2005, PHI Learning.

Note. Students opting for Advanced mathematical physics-I course as one option in DSE cannot opt for Linear algebra and Tensor analysis as second option.

DSE-II: ADVANCED MATHEMATICAL PHYSICS-I

CREDITS: 4

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

UNIT-I

Linear Vector Spaces Abstract Systems: Binary Operations and Relations. Introduction to Groups and Fields. Vector Spaces and Subspaces. Linear Independence and Dependence of Vectors. Basis and Dimensions of a Vector Space. Change of basis. Homomorphism and Isomorphism of Vector Spaces. Linear Transformations. Algebra of Linear Transformations. Non-singular Transformations. Representation of Linear Transformations by Matrices.

UNIT-II

Matrices, Addition and Multiplication of Matrices: Null Matrices. Diagonal, Scalar and Unit Matrices. Upper-Triangular and Lower-Triangular Matrices. Transpose of a Matrix. Symmetric and Skew-Symmetric Matrices. Conjugate of a Matrix. Hermitian and Skew-Hermitian Matrices. Singular and Non-Singular matrices. Orthogonal and Unitary Matrices. Trace of a Matrix. Inner product of vectors.

UNIT-III

Eigen-values and Eigenvectors: Finding Eigen — values and Eigen vectors of a Matrix. Diagonalization of Matrices. Properties of Eigen-values and Eigen Vectors of Orthogonal, Hermitian and Unitary Matrices. Cayley-Hamilton Theorem (Statement only). Finding inverse of a matrix using Cayley-Hamilton Theorem. Solutions of ordinary second order differential equations and Coupled Linear Ordinary Differential Equations of first order. Functions of a Matrix.

UNIT-IV

Transformation of Co-ordinates and fundamentals of Tensors. Einstein's Summation Convention. Relation between Direction Cosines. Tensors. Algebra of Tensors. Sum, Difference and Product of Two Tensors. Contraction. Quotient Law of Tensors. Symmetric and Anti-symmetric Tensors. Invariant Tensors Kronecker and Alternating Tensors. Association of Antisymmetric Tensor of Order Two and Vectors.

UNIT-V

Cartesian Tensors: Vector Algebra and Calculus using Cartesian Tensors : Scalar and Vector Products, Scalar and Vector Triple Products. Differentiation.Gradient, Divergence and Curl of Tensor Fields.Tensor notation of Laplacian operator.Proof of Vector Identities involving scalar and vector products and vector identities involving Del operator under Tensor notation.Isotropic Tensors (Definition only).Tensorial Character of Physical Quantities.Moment of Inertia Tensor. Stress and Strain Tensors : Symmetric Nature. Elasticity Tensor.Generalized Hooke's Law.

Reference Books:

1. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber and F.E.Harris,1970, Elsevier.
3. Modern Mathematical Methods for Physicists and Engineers, C.D. Cantrell, 2011, Cambridge University Press
4. Introduction to Matrices & Linear Transformations, D.T.Finkbeiner,1978, Dover Pub.
5. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole

DSE-II LAB: ADVANCED MATHEMATICAL PHYSICS-I LAB

CREDITS: 2

Scilab/C++ based simulations experiments based on Mathematical Physics problems like (at least 06 experiments)

1. Linear algebra:

- Multiplication of two 3 x 3 matrices.
- Eigenvalue and eigenvectors of

$$\begin{matrix} 2 & 1 & 1 \\ 1 & 3 & 2 \\ 3 & 1 & 4 \end{matrix} \begin{pmatrix} 1 \\ +i \\ 4 \end{pmatrix} \begin{matrix} -i & 3+4i & 2 \\ 4 & ; & -i \\ 3 & -2i & 3 \end{matrix} \begin{pmatrix} 2i \\ 4 & 3 \\ 5 \end{pmatrix}$$

2. Orthogonal polynomials as eigenfunctions of Hermitian differential operators.
3. Determination of the principal axes of moment of inertia through diagonalization (Matrix can be generated for a given distribution of discrete masses).
4. Study of geodesics in Euclidean and other spaces (surface of a sphere, etc): Using variational principle find the shortest curve between two points. Suggested Physics problem: problem of refraction.
5. Application to solve differential equations for a bound system — Eigen value problem.
6. Application to computer graphics:

Write operators for shear, strain, two dimensional rotational problems, Reflection, Translation etc. Plot old and new coordinates.

Reference Books:

1. Simulation of ODE/PDE Models with MATLAB RD, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V. Fernández. 2014 Springer ISBN: 978-3319067896
2. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444
3. Scilab Image Processing: L. M. Surhone. 2010, Betascript Pub., ISBN: 978-6133459274

DSE-III: EMBEDDED SYSTEM: INTRODUCTION TO MICRSOCONTROLLERS

CREDITS: 4

This paper gives a review of microprocessor and introduces microcontroller 8051. Here, students will learn about the 8051 I/O port programming, various addressing modes, Timer and counter programming, Serial port programming with and without interrupt and interfacing 8051 microcontroller to peripherals.

UNIT-I

Embedded system in troduction: Introduction to embedded systems and general purpose computer systems, architecture of embedded system, classifications, applications and purpose of embedded systems.

8051 microcontroller: Introduction and block diagram of 8051 microcontroller, architecture of 8051, 8051 assembly language programming, Program Counter and ROM memory map, Data types and directives, Flag bits and Program Status Word (PSW) register, Jump, loop and call instructions.

8051 I/O port programming: Introduction of I/O port programming, pin out diagram of 8051 microcontroller, I/O port pins description & their functions, I/O port programming in 8051 (using assembly language), I/O programming: Bit manipulation.

UNIT-II

Programming: 8051 addressing modes and accessing memory using various addressing modes, assembly language instructions using each addressing mode, arithmetic and logic instructions, 8051 programming in C: for time delay & I/O operations and manipulation, for arithmetic and logic operations, for ASCII and BCD conversions.

UNIT-III

Timer and counter programming: Programming 8051 timers, counter programming.

Serial port programming with and without interrupt: Introduction to 8051 intemipts, programming timer interrupts, programming external hardware interrupts and serial communication intemipt, intemipt priority in the 8051.

Interfacing 8051 microcontroller to peripherals: Parallel and serial ADC, DAC interfacing, LCD interfacing.

UNIT-IV

Programming Embedded Systems: Structure of embedded program, infinite loop, compiling, linking and locating, downloading and debugging.

Embedded system design and development: Embedded system development environment, file types generated after cross compilation, disassembler/ decompiler, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.

UNIT-V

Introduction to Arduino: Pin diagram and description of Arduino UNO. Basic programming and applications.

Reference Books:

1. Embedded Systems:Architecture, Programming & Design, Raj Kamal, 2008,Tata McGraw Hill
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A. Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Microcontrollers in practice, I.Susnea and M.Mitescu, 2005, Springer.
4. Embedded Systems & Robots, Subrata Ghoshal, 2009, Cengage Learning
5. Introduction to embedded system, K.V. Shibu, 1st edition, 2009, McGraw Hill
6. Embedded Microcomputer systems: Real time interfacing, J.W.Valvano 2011, Cengage Learning.

DSE-III: LAB: EMBEDDED SYSTEM: INTRODUCTION TO MICROCONTROLLERS

CREDITS: 2

8051 microcontroller based Programs and experiments (at least 06 experiments):

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED's. Simulate binary counter (8 bit) on LED's
5. Program to glow the first four LEDs then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display 'HELP' in the seven segment LED display.
9. To toggle 1234 as 1324' in the seven segment LED display.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

Arduino based programs and experiments:

12. Make a LED flash at different time intervals.
13. To vary the intensity of LED connected to Arduino
14. To control speed of a stepper motor using a potential meter connected to Arduino
15. To display "PHYSICS" on LCD/CRO.

Reference Books:

1. Embedded Systems:Architecture, Programming and Design, Raj Kamal, 2008,Tata McGraw Hill

2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, M.A.Mazidi, J.G. Mazidi, and R.D. McKinlay, 2nd Ed., 2007, Pearson Education India.
3. Embedded System, B.K. Rao, 2011, PHI Learning Pvt. Ltd.
4. Embedded Microcomputer systems: Real time interfacing, J.W. Valvano 2011, Cengage Learning

DSE-IV: PHYSICS OF DEVICES AND INSTRUMENTATION

CREDITS: 4

This paper is based on advanced electronics which covers the devices such as UJT, JFET, MOSFET, CMOS etc. Process of IC fabrication is discussed in detail. Digital Data serial and parallel Communication Standards are described along with the understanding of communication systems.

UNIT-I

Devices: Characteristic and small signal equivalent circuits of UJT and JFET. Metal-semiconductor Junction. Metal oxide semiconductor (MOS) device. Ideal MOS and Flat Band voltage. SiO₂-Si based MOS, C-V characteristics of MOS, MOSFET— their frequency limits. Enhancement and Depletion Mode MOSFETS, CMOS. Charge coupled devices.

UNIT-II

Processing of Devices: Basic process flow for IC fabrication. Crystal plane and orientation. Diffusion and implantation of dopants. Passivation. Oxidation Technique for Si. Contacts and metallization technique. Wet etching. Dry etching (RIE). Positive and Negative Masks. Photolithography. Electron-lithography, Basic idea of SSI, MSI, LSI, VLSI and USI.

UNIT-III

RC Filters: Passive-Low pass and High pass filters, Active (1st order butterworth) -Low Pass, High Pass, Band Pass and band Reject Filters.

Phase Locked Loop (PLL): Basic Principles, Phase detector (XOR and edge triggered), Voltage Controlled Oscillator (Basics, varactor). Lock and capture. Basic idea of PLL IC (565 or 4046).

UNIT-IV

Digital Data Communication Standards:

Serial Communications: RS232, Handshaking, Implementation of RS232 on PC, Universal Serial Bus (USB), USB standards, Types and elements of USB transfers.

Parallel communications: General Purpose Interface Bus (GPIB), GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through a COM port.

UNIT-V

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

Reference Books:

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

DSE-IV-LAB: PHYSICS OF DEVICES AND INSTRUMENTATION

CREDITS: 2

At least 06 experiments each from section-A and section-B. ' Section-A.

1. To design a power supply using bridge rectifier and study effect of C-filter.
2. To design the active Low pass and High pass filters of given specification.
3. To design the active filter (wide band pass and band reject) of given specification.
4. To study the output and transfer characteristics of a JFET.
5. To design a common source JFET Amplifier and study its frequency response.
6. To study the output characteristics of a MOSFET.
7. To study the characteristics of a UJT and design a simple Relaxation Oscillator.
8. To design an Amplitude Modulator using Transistor.
9. To design PWM, PPM, PAM and Pulse code modulation using ICs.
10. To design an Astable multi vibrator of given specifications using transistor.
11. To study a PLL IC (Lock and capture range).
12. To study envelope detector for demodulation of AM signal.
13. Study of ASK and FSK modulator.
14. Glow an LED via USB port of PC.
15. Sense the input voltage at a pin of USB port and subsequently glow the LED connected with another pin of USB port.

Section-B:*SPICE/MULTISIM simulations for electronic circuits and devices*

1. To verify the Thevenin and Norton Theorems.
2. Design and analyze the series and parallel LCR circuits
3. Design the inverting and non-inverting amplifier using an Op-Amp of given gain
4. Design and Verification of op-amp as integrator and differentiator
5. Design the n^{th} order active low pass and high pass filters of given cutoff frequency
6. Design a Wein's Bridge oscillator of given frequency.
7. Design clocked SR and JK Flip-Flop's using NAND Gates
8. Design 4-bit asynchronous counter using Flip-Flop ICs
9. Design the CE amplifier of a given gain and its frequency response.

10. Design an Astable multi vibrator using IC555 of given duty cycle.

Reference Books:

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

SKILL ENHANCEMENT COURSE

SEC-I-Physics Workshop Skill

(With Mechanical Workshop)

CREDITS: 4

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT-V

Introduction to prime movers: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. Braking systems,

pulleys, working principle of power generation systems. Demonstration of pulley experiment.

References:

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

SEC-II-ELECTRICAL CIRCUITS AND NETWORK SKILLS

(With Electrical Engineering)

CREDITS: 4

The aim of this course is to enable the students to design and trouble shoots the electrical circuits, networks and appliances through hands-on mode

UNIT-I

Basic Electricity Principles: Voltage, Current, Resistance, and Power. Ohm's law, Series, parallel and series-parallel combinations.AC and DC Electricity. Familiarization with multimeter, voltmeter and ammeter.

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

UNIT-II

Electrical Drawing and Symbols: Drawing symbols. Blueprints, Reading Schematics. Ladder diagrams. Electrical Schematics, Power circuits. Control circuits. Reading of circuit schematics. Tracking the connections of elements and identify current flow and voltage drop.

UNIT-III

Generators and Transformers: DC Power sources. AC/DC generators.Inductance, capacitance and impedance. Operation of transformers.

ElectricMotors:Single-phase,three-phase&DCmotors.Basicdesign.InterfacingDC or AC sources to control heaters & motors. Speed & power of ac motor.

UNIT-IV

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

Electrical Protection: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Relay protection device.

UNIT-V

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

References:

1. Electrical Circuits, K.A. Smith and R.E. Alley, 2014, Cambridge University Press
2. A text book in Electrical Technology - B L Theraja - S Chand & Co.
3. A text book of Electrical Technology - A K Theraja
4. Performance and design of AC machines - M G Say ELBSEdn.

SEC-III-BASIC INSTRUMENTATION SKILLS

CREDITS: 2

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

UNIT-I

Basic of Measurement: Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.**Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

UNIT-II

Electronic Voltmeter: Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance.**AC millivoltmeter:** Type of AC millivoltmeters: Amplifier-rectifier, and rectifier- amplifier. Block diagram ac millivoltmeter, specifications and their significance.

UNIT-III

Cathode Ray Oscilloscope: Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period). Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

UNIT-IV

Signal Generators and Analysis Instruments: Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator. Brief idea for testing, specifications. Distortion factor meter, wave analysis.

Impedance Bridges & Q-Meters: Block diagram of bridge. Working principles of basic (balancing type) RLC bridge. Specifications of RLC bridge. Block diagram & working principles of a Q- Meter. Digital LCR bridges.

UNIT-V

Digital Instruments: Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter.

Digital Multimeter: Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time- base stability, accuracy and resolution.

The test of lab skills will be of the following test items:

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

LABORATORY EXERCISES:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
3. To measure Q of a coil and its dependence on frequency, using a Q- meter.
4. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of time period, frequency, average period using universal counter/ frequency counter.
6. Measurement of rise, fall and delay times using a CRO.

7. Measurement of distortion of a RF signal generator using distortion factor meter.
8. Measurement of R, L and C using a LCR bridge/ universal bridge.

OPEN ENDED EXPERIMENTS:

1. Using a Dual Trace Oscilloscope
2. Converting the range of a given measuring instrument (voltmeter, ammeter)

References:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBSEdn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, SubrataGhoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan& N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
7. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
8. 2008, Springer
9. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

SEC-IV-RADIATION SAFETY

CREDITS: 2

The aim of this course is for awareness and understanding regarding radiation hazards and safety. The list of laboratory skills and experiments listed below the course are to be done in continuation of the topics

UNIT-I

Basics of Atomic and Nuclear Physics: Basic concept of atomic structure; X rays characteristic and production; concept of bremsstrahlung and auger electron, The composition of nucleus and its properties, mass number, isotopes of element, spin, binding energy, stable and unstable isotopes, law of radioactive decay, Mean life and half life, basic concept of alpha, beta and gamma decay, concept of cross section and kinematics of nuclear reactions, types of nuclear reaction, Fusion, fission.

UNIT-II

Interaction of Radiation with matter: Types of Radiation: Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, **Interaction of Photons** – Photoelectric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients,

Interaction of Charged Particles: Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung),

Interaction of Neutrons- Collision, slowing down and Moderation.

UNIT-III

Radiation detection and monitoring devices: Radiation Quantities and Units: Basic idea of different units of activity, KERMA, exposure, absorbed dose, equivalent dose, effective dose, collective equivalent dose, Annual Limit of Intake (ALI) and derived Air Concentration (DAC).

UNIT-IV

Radiation detection: Basic concept and working principle of *gas detectors* (Ionization Chambers, Proportional Counter, Multi-Wire Proportional Counters (MWPC) and Gieger Muller Counter), *Scintillation Detectors* (Inorganic and Organic Scintillators), *Solid States Detectors* and *Neutron Detectors*, *Thermo luminescent Dosimetry*.

UNIT-V

Radiation safety management: *Biological effects of ionizing radiation*, Operational limits and basics of radiation hazards evaluation and control: radiation protection standards, International Commission on Radiological Protection (ICRP) principles, justification, optimization, limitation, introduction of safety and risk management of radiation. Nuclear waste and disposal management. Brief idea about Accelerator driven Sub-critical system (ADS) for waste management.

Application of nuclear techniques: Application in medical science (e.g., MRI, PET, Projection Imaging Gamma Camera, radiation therapy), Archaeology, Art, Crime detection, Mining and oil. *Industrial Uses:* Tracing, Gauging, Material Modification, Sterilization, Food preservation.

EXPERIMENTS:

1. Study the background radiation levels using Radiation meter

Characteristics of Geiger Muller (GM) Counter:

2. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
3. Study of counting statistics using background radiation using GM counter.
4. Study of radiation in various materials (e.g. K₂SO₄ etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage.
5. Study of absorption of beta particles in Aluminum using GM counter.
6. Detection of α particles using reference source & determining its half life using spark counter
7. Gamma spectrum of Gas Light mantle (Source of Thorium)

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