SCHEME OF INSTRUCTION AND SYLLABUS

B.Sc. (Hons.) Physics

Academic Year: 2024 - 25

Faculty of Applied Sciences & Humanities

United University

Rawatpur - Jhalwa (Prayagraj)

Uttar Pradesh

University Vision

"To establish a value based Global University having dynamic learning environment encouraging creativity and innovation, research inspired experimental learning and focusing on topics that are pertinent to the development of the region, the Country and the World."

University Mission

To achieve the Vision, the Mission of the University is

- "To provide a dynamic, inspiring, and varied learning environment with global exposure.
- To position the institution as a premier hub for research and experiential learning.
- To develop into an adaptable university meeting the demands of society and business.
- To incorporate Value thinking, integrity, wisdom and passion in professional for their career and life"

Department Vision

" The Vision of the Faculty of Applied Sciences & Humanities is to foster an inclusive academic environment that promotes interdisciplinary learning, critical thinking, and innovative research. We strive to cultivate a community of scholars dedicated to addressing global challenges through science, technology and the humanities. By aligning with the University's commitment to excellence, we aim to empower students with the knowledge, skills and ethical values needed to contribute meaningfully to society and to lead in their chosen fields."

Department Mission

" To create a community of learners where we may contribute to their expertise and admire one another to create an enhanced society.

To provide learners with a solid foundation not only in the field of engineering by employing model tools and research facilities but also to teach them maths, the fundamental sciences, Environmental issues, and human values.

The Department is focused on a student-centred curriculum that emphasizes intellectual development, connecting with challenging coursework, and assignment-based learning.

The department is committed to encouraging an entrepreneurial, innovative mind-set in the students by exposing them to a plethora of events and activities on a global level too.

It promotes the overall development of a good citizen and an upright individual.

We look forward to helping them strengthen their inborn skills with the proper training in their field and offer an opportunity for expression to lead a bright career ahead."

Program Educational Objectives
(Undergraduate)

1. **PEOs-1:** Develop a strong foundation in Physics, enabling graduates to pursue higher studies, research, or professional careers.
2. **PEOs-2:** Cultivate critical thinking, problem – solving, and analytical skills necessary for addressing real-world challenges.
3. **PEOs-3:** Encourage research-oriented thinking and innovation that contribute to academic and professional advancements.
4. **PEOs-4:** Instill ethical values, social responsibility, and an understanding of the broader impact of physics on society and the global scientific community.
5. **PEOs-5:** Promote a culture of continuous learning and adaptability to keep pace with advancements in physics and related fields.

Program Outcomes

On successful completion of the B.Sc. (Honors) Physics programme the student will acquire:

PO1 – *Disciplinary Knowledge:* Demonstrate a solid understanding of fundamental principles of classical and modern physics.

PO2 – *Experimental Skills:* Develop the ability to design, conduct and analyze experiments using modern laboratory equipment.

PO3 – *Mathematical Proficiency:* Apply advanced mathematical tools to solve complex physics problems.

PO4 – *Problem – Solving Ability:* Analyze and interpret physical problems and apply appropriate principles to find solutions.

PO5 – *Research Competency:* Develop skills in conducting independent research, including literature review, data analysis, and presentation of results.

PO6 – *Computational Skills:* Use computational tools and techniques to model physical systems and solve quantitative problems.

PO7 – *Communication Skills:* Effectively communicate scientific ideas, technical reports, and research findings in both written and oral formats.

PO8 – *Ethics and Social Responsibility:* Understand and apply ethical principles in scientific practice and research, contributing responsibly to societal needs.

PO9 - *Lifelong learning:* Cultivate a commitment to lifelong learning to adapt to new scientific advancements and technologies.

PO10 - *Teamwork and Collaboration:* Work effectively in teams, demonstrating leadership and collaboration in both academic and research settings.

PO11 – *Interdisciplinary Approach:* Integrate Physics with other disciplines to solve interdisciplinary problems.

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Program Specific Outcomes

PSO1: Advanced Understanding of Physics Concepts

Develop a deep understanding of core concepts in physics, including classical mechanics, quantum mechanics, electromagnetism, solid-state physics, electronics, statistical mechanics and thermodynamics, preparing students for advanced studies and research in physics.

PSO2: Proficiency in Experimental Techniques

Develop the ability to design and conduct experiments, interpret experimental data, and effectively use modern laboratory instruments to explore and verify physical principles.

PSO3: Problem – Solving and Analytical Thinking

Apply mathematical and computational techniques to solve complex problems in physics, using tools like SCILAB, MATLAB, and Python for simulations and analysis.

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SCHEME OF INSTRUCTION

COURSE CATEGORY ABBREVIATIONS

1. Applied Sciences and Humanities-AS&H
2. Program Core-PC
3. Soft Skills-SS
4. Skill Enhancement Course-SEC
5. Compulsory Course-MC
6. Program Elective-PE
7. Open Elective-OE
8. Internship/Project

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Semester I

						Contact Hours	**30**
S. No.	**Course Code**	**Course Category**	**Course Name**	**L**	**T**	**P**	**C**
1	SCUCPH101T	PC	MATHEMATICAL PHYSICS- I	4	0	0	4
2	SCUCPH101P	PC	MATHEMATICAL PHYSICS – I LAB	0	0	4	2
3	SCUCPH102T	PC	MECHANICS AND RELATIVITY	4	0	0	4
4	SCUCPH102P	PC	MECHANICS LAB	0	0	4	2
5	CASCPSC10T	PC	FUNDAMENTALS OF COMPUTER AND C- PROGRAMMING	4	0	0	4
6	CASCPSC10P	SEC	C - PROGRAMMING LAB	0	0	4	2
7	ARSPCSC10T	SS	INTRODUCTION TO PROFESSIONAL COMMUNICATION	2	0	0	2
8	PTSPPSC10T	SEC	PROFESSIONAL PROFICIENCY	4	0	0	4
			Total	**18**	**0**	**12**	**24**

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Semester II

						Contact Hours	**30**
S. No.	**Course Code**	**Course Category**	**Course Name**	**L**	**T**	**P**	**C**
1	SCUCPH201T	PC	ELECTRICITY AND MAGNETISM	4	0	0	4
2	SCUCPH201P	PC	ELECTRICITY AND MAGNETISM LAB	0	0	4	2
3	SCUCPH202T	PC	WAVES AND OPTICS	4	0	0	4
4	SCUCPH202P	PC	WAVES AND OPTICS LAB	0	0	4	2
5	CASCPSC20T	PC	FUNDAMENTALS OF DATA SCIENCE	4	0	0	4
6	CASCPSC20P	SEC	FUNDAMENTALS OF DATA SCIENCE LAB	0	0	4	2
7	SCUCEV201T	SEC	ENVIRONMENTAL SCIENCE	2	0	0	2
8	PTSPPSC20T	SEC	PROFESSIONAL PROFICIENCY	4	0	0	4
			Total	**18**	**0**	**12**	**24**

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Semester III

						Contact Hours	**30**
S. No.	**Course Code**	**Course Category**	**Course Name**	**L**	**T**	**P**	**C**
1	SCUCPH301T	PC	MATHEMATICAL PHYSICS-II	4	0	0	4
2	SCUCPH302T	PC	THERMAL PHYSICS	4	0	0	4
3	ETSECSC31T	PC	DIGITAL SYSTEMS AND APPLICATIONS	4	0	0	4
4	ETSECSC32T	SEC	NEURAL NETWORK	4	0	0	4
5	PTSPPSC30T	SEC	PROFESSIONAL PROFICIENCY	4	0	0	4
6	SCUCPH301P	PC	MATHEMATICAL PHYSICS – II LAB	0	0	2	2
7	SCUCPH302P	PC	THERMAL PHYSICS LAB	0	0	4	2
8	ETSECSC31P	PC	DIGITAL SYSTEMS AND APPLICATIONS LAB	0	0	4	2
			Total	**20**	**0**	**10**	**26**

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Semester IV

						Contact Hours	**28**
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	SCUCPH401T	PC	MATHEMATICAL PHYSICS-III	4	0	0	4
2	SCUCPH402T	PC	ELEMENTS OF MODERN PHYSICS	4	0	0	4
3	CASPYSC40T	SEC	PYTHON PROGRAMMING	4	0	0	4
4	PTSPPSC40T	SEC	PROFESSIONAL PROFICIENCY	4	0	0	4
5	SCUCPH401P	PC	MATHEMATICAL PHYSICS-III LAB	0	0	4	2
6	SCUCPH402P	PC	ELEMENTS OF MODERN PHYSICS LAB	0	0	4	2
7	CASPYSC40P	SEC	PYTHON PROGRAMMING LAB	0	0	4	2
			Total	**16**	**0**	**12**	**22**

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Semester V

						Contact Hours	**30**
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	SCUCPH501T	PC	QUANTUM MECHANICS AND APPLICATIONS	4	0	0	4
2	SCUCPH501P	PC	QUANTUM MECHANICS LAB	0	0	4	2
3	SCUCPH502T	PC	SOLID STATE PHYSICS	4	0	0	4
4	SCUCPH502P	PC	SOLID STATE PHYSICS LAB	0	0	4	2
5	SCUCPH503T	PC	ANALOG SYSTEMS AND APPLICATIONS	4	0	0	4
6	SCUCPH503P	PC	ANALOG SYSTEMS AND APPLICATIONS LAB	0	0	4	2
7	CASCPSC50T	SEC	AI AND MACHINE LEARNING	4	0	0	4
8	CASCPSC50P	SEC	AI AND MACHINE LEARNING LAB	0	0	2	2
			Total	**16**	**0**	**14**	**24**

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Semester VI

						Contact Hours	**30**
S. No	Course Code	Course Category	Course Name	L	T	P	C
1	SCUCPH601T	PC	ELECTROMAGNETIC THEORY	4	0	0	4
2	SCUCPH601P	PC	ELECTROMAGNETIC THEORY LAB	0	0	4	2
3	SCUCPH602T	PC	STATISTICAL MECHANICS	4	0	0	4
4	SCUCPH602P	PC	STATISTICAL MECHANICS LAB	0	0	4	2
5	SCUCPH603T	PC	CLASSICAL MECHANICS	4	0	0	4
6	SCUCPH603P	PC	CLASSICAL MECHANICS LAB	0	0	4	2
7	SCUCPH604T	PE	NANO MATERIALS AND APPLICATIONS	2	0	0	2
8	SCUCPH604P	PROJECT	MAJOR PROJECT (6 Months)	0	0	4	4
			Total	**14**	**0**	**16**	**24**

[*L - Lecture, T - Tutorial, P - Practical, C - Credits*]

COURSE DETAILS FOR SEMESTER – I

COURSE CODE & NAME: SCUCPH101T / MATHEMATICAL PHYSICS- I

COURSE OBJECTIVE

To familiarize students with a range of mathematical methods that is essential for solving advanced problems in theoretical physics.

COURSE OUTCOMES

1. Understand the concept of basic calculus.
2. Understand the concept of Vector calculus.
3. Study the concept of Orthogonal Curvilinear Coordinates.
4. Study the concept of differential equation.
5. Study the concept of probability.

UNIT I:

Matrices: Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, System of linear equations, Characteristic equation, Cayley-Hamilton Theorem and its application, Eigen values and eigenvectors.

UNIT II:

Calculus: Differential Calculus: Introduction to limits, continuity and differentiability, Derivative, Derivatives of Sum, Differences, Product & Quotients, Chain Rule, Derivatives of Composite Functions.

Partial derivatives, Euler's theorem of homogeneous function, Total derivative, Jacobians, Approximation of errors.

Integral Calculus: Indefinite integrals, Basic formulae. Integration by parts, Integration by substitution, Definite integrals. Properties of definite integrals, Evaluation of double integration & triple integration, Application of definite integral to find Area and Volume.

UNIT III:

Vector Calculus:

Vector differentiation: Gradient, Divergence and Curl and their Physical interpretation, Directional derivatives.

Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem, Stoke's theorem (without proof) and their applications.

UNIT IV:

Ordinary Differential Equation of Higher Order: First Order Differential Equations, Variable separable, Homogeneous Equations, Exact Differential equation, Linear differential equation, Integrating factor, Linear differential equation of nth order with constant coefficients, Simultaneous linear differential equations.

UNIT V:

Introduction to probability: Concept of Probability, Baye's theorem, Independent random variables, Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance (without Proof).

TEXTBOOKS

1. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
2. Mathematical Physics, H K Dass & Dr Rama Verma, S Chand and Compony Limited
3. Mathematical Physics, B.S. Rajpoot, 2010, Pragati Edition.

REFERENCE BOOKS

1. **Mathematical Methods for Physicists**, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.
2. **An introduction to ordinary differential equations**, E. A. Coddington, 2009, PHI learning.
3. **Differential Equations**, George F. Simmons, 2007, McGraw-Hill.
4. **Mathematical Tools for Physics**, James Nearing, 2010, Dover Publications.
5. **Mathematical methods for Scientists and Engineers**, D.A. McQuarrie, 2003,VivaBook.
6. **Advanced Engineering Mathematics**, D. G. Zilland, W.S.Wright, 5Ed., 2012, Jones and Bartlett Learning.
7. **Mathematical Physics**, Goswami, 1st edition, Cengage Learning.

COURSE CODE & NAME: SCUCPH101P / MATHEMATICAL PHYSICS LAB - I

COURSE OBJECTIVE

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.

COURSE OUTCOMES

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

1. Topic: Basics of scientific computing

Description with Applications: Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, under flow & overflow- emphases size them port and making equations interims of dimensionless variables, Iterative methods.

2. Topic: Errors and error Analysis

Description with Applications: Truncation and round off errors, Absolute and relative errors, Floating point computations.

3. Topic: Review of C & C++ Programming fundamentals

Description with Applications: Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, cinandc out, Manipulators for data formatting, Control statements (decision making and looping statements) (If-statement. If-else Statement. Nestedif Structure. Else-if Statement. Ternary Operator. Go to Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops).

4. Topic: Programs

Description with Applications: Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of number sina spending descending order, Binary search.

5. Topic: Random number generation

Description with Applications: Area of circle, area of square, volume of sphere, value of pi (π).

6. Topic: Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation

Description with Applications: Evaluation of trigonometric functions e.g. sin θ, cos θ, tan θ, etc.

7. Topic: Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method

Description with Applications: Given Position with equidistant time data to calculate velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop.

8. Topic: Solution of Ordinary Differential Equations (ODE)First order Differential equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods:

Description with Applications:

First order differential equation

- Radioactive decay
- Current in RC, LC circuits with D C source
- Newton's law of cooling
- Classical equations of motion

TEXTBOOKS

1. Introduction to Numerical Analysis, S.S.Sastry, 5thEdn., 2012, PHI Learning Pvt. Ltd.
2. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.

REFERENCE BOOKS

1. **Schaum's Outline of Programming with C++**. J. Hubbard, 2000, McGraw-HillPub.
2. **Numerical Recipes in C: The Art of Scientific Computing**, W.H. Pressetal, 3rdEdn., 2007, Cambridge University Press.
3. **Elementary Numerical Analysis**, K.E. Atkinson, 3 rdEdn. , 2007, Wiley India Edition.
4. **Numerical Methods for Scientists & Engineers**, R.W.Hamming, 1973, Courier Dover Pub.

COURSE CODE & NAME: SCUCPH102T / MECHANICS AND RELATIVITY

COURSE OBJECTIVE

To develop a comprehensive understanding of Newtonian mechanics and their applications and introduce the fundamental concepts of special relativity.

COURSE OUTCOMES

1. Understand the concept of Dynamics of rigid bodies.
2. Understand the concept of Rotational dynamics and elasticity.
3. Study the concept of Gravitational and central forces.
4. Study the concept of simple harmonic motion.
5. Understand the Concept of Special theory of relativity.

UNIT I:

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean in variance. Momentum of variable-mass system: motion of rocket. Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. Conservative and non- conservative forces. Potential Energy. Energy diagram. Elastic potential energy. Forces gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy.

UNIT II:

Rotational Dynamics and Elasticity: 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. Elastic constants, Relation between Elastic constants. Twisting torque on a Cylinder or Wire.

UNIT III:

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. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

UNIT IV:

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.

UNIT V:

Special Theory of Relativity: 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. Relativistic addition of velocities. Variation of mass with velocity. Mass less Particles. Mass-energy Equivalence.

TEXTBOOKS

1. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000.
2. UniversityPhysics.F.WSears,M.WZemansky,H.DYoung13/e,1986,AddisonWesley.

REFERENCE BOOKS

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

COURSE CODE & NAME: SCUCPH102P / MECHANICS LAB

COURSE OBJECTIVE

To familiar students with mechanical apparatus and their applications in measuring various physical quantities.

COURSE OUTCOMES

1. To get familiarized with measuring instruments and safety practice in laboratory.
2. To get a first-hand experience of random error in observations.
3. To understand the concept of Modulus of rigidity and Moment of Inertia.
4. To know about the Coefficient of Viscosity.
5. To know about Elastic Constants and their utility.

List of Experiments:

A minimum of six experiments from the following should be performed.

1. Measurements of length (or diameter) using Vernier callipers, 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 Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
9. To determine the value of g using Bar Pendulum.
10. To determine the value of g using Kater's Pendulum.

REFERENCE BOOKS

1. **Advanced Practical Physics for students**, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. **Advanced level Physics Practical**, 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.

COURSE CODE & NAME: CASCPSC10T / FUNDAMENTALS OF COMPUTER AND C - PROGRAMMING

COURSE OBJECTIVE

The course is designed to provide the foundation of logic development. This course will provide the base of further programming related courses. Students could develop their own logic and construct the programs & applications in C.

COURSE OUTCOMES

1. Develop efficient algorithms for solving a problem.
2. Use the various constructs of a programming language viz. conditional, iteration and recursion.
3. Implement the algorithms in "C" language.
4. Use simple data structures like arrays, stacks, and linked list in solving problems.
5. Handling File in "C".

UNIT I:

Introduction to Programming: The Basic Model of Computation, Algorithms, Flow-charts, Programming Languages, Compilation, Linking and Loading, Testing and Debugging, Documentation.

Algorithms for Problem Solving: Exchanging values of two variables, summation of a set of numbers, Decimal Base to Binary Base conversion, Reversing digits of an integer, GCD (Greatest Common Division) of two numbers, Test whether a number is prime, Organize numbers in ascending order, Find square root of a number, factorial computation, Fibonacci sequence, Evaluate 'sin x' as sum of a series, Reverse order of elements of an array, Find largest number in an array, Print elements of upper triangular matrix, multiplication of two matrices, Evaluate a Polynomial.

UNIT II:

Introduction to 'C' Language.: Character set, Variables and Identifiers, Built-in Data Types, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement, Simple 'C' programs.

Conditional Statements and Loops: Decision making within a program, Conditions, Relational Operators, Logical Connectives, if statement, if-else statement, Loops: while loop, do while, for loop, Nested loops, Infinite loops, Switch statement, structured Programming.

Arrays: One dimensional arrays: Array manipulation; Searching, Insertion, Deletion of an element from an array; Finding the largest/smallest element in an array; Two dimensional arrays, Addition/Multiplication of two matrices, Transpose of a square matrix; Null terminated strings as array of characters, Standard library string functions.

UNIT III:

Functions: Top-down approach of problem solving, Modular programming and functions, Standard Library of C functions, Prototype of a function: Formal parameter list, Return Type,

Function call, Block structure, Passing arguments to a Function: call by reference, call by value,

Recursive Functions, arrays as function arguments.

Storage Classes: Scope and extent, Storage Classes in a single source file: auto, extern and static, register, Storage Classes in multiple source files: extern and static.

UNIT IV:

Structures and Unions: Structure variables, initialization, structure assignment, nested structure, structures and functions, structures and arrays: arrays of structures, structures containing arrays, unions.

Pointers: Address operators, pointer type declaration, pointer assignment, pointer initialization, pointer arithmetic, functions and pointers, Arrays and Pointers, pointer arrays, pointers and structures, dynamic memory allocation.

UNIT V:

Self-Referential Structures and Linked Lists

Creation of a singly connected linked list, Traversing a linked list, Insertion into a linked list, Deletion from a linked list.

File Processing: Concept of Files, File opening in various modes and closing of a file, Reading from a file, Writing.

TEXTBOOKS

1. Byron S Gottfried "Programming with C" Second edition, Tata Mc Grawhill, 2007 (Paperback).
2. R.G. Dromey, "How to solve it by Computer", Pearson Education, 2008.
3. Kanetkar Y, "Let us C", BPB Publications, 2007.
4. Hanly J R & Koffman E.B, "Problem Solving and Program design in C", Pearson Education, 2009.

REFERENCE BOOKS

1. E. Balagurusamy, **"Programming with ANSI-C"**, Fourth Edition, 2008, Tata Mc GrawHill.
2. Venugopal K. R and Prasad S. R, **"Mastering 'C'**, Third Edition, 2008, Tata McGraw Hill.
3. B.W. Kernighan & D.M. Ritchie, **"The C Programming Language"**, Second Edition, 2001, Pearson Education.
4. ISRD Group, **"Programming and Problem-Solving Using C"**, Tata Mc GrawHill, 2008.

COURSE CODE & NAME: CASCPSC10P/ C- PROGRAMMING LAB

COURSE OBJECTIVE

The course aims to acquire logical thinking, Implement the algorithms, Identify the correct and efficient ways of solving problems.

COURSE OUTCOMES

1. Understand the logic for a given problem.
2. Write the algorithm of a given problem.
3. Draw a flow chart of a given problem.
4. Recognize and understand the syntax and construction of C programming code.
5. Gain experience of procedural language programming.

Note: A minimum of ten experiments from the following should be performed.

1. Write a program to find sum of all prime numbers between 100 and 500.

2. Write a program to obtain sum of the first 10 terms of the following series for any positive integer value of X:

$X + X^3/3! + X^5/5! + X^7/7! + \ldots$

3. Write a program to reverse the digits of a given number. For example, the number 9876 should be returned as 6789.

4. Write a program to compute the wages of a daily laborer as per the following rules:

Hours Worked	Rate Applicable
Upto first 8 hrs	Rs 50/-
For next 4hrs	Rs 10/- per hr extra
For next 4hrs	Rs 20/- per hr extra
For next 4hrs	Rs 25/- per hr extra
For rest	Rs 40/- per hr extra

Accept the name of the laborer and no. of hours worked. Calculate and display the wages. The program should run for N number of laborers as specified by the user.

5. Write a program to input 20 arbitrary numbers in one-dimensional array. Calculate Frequency of each number. Print the number and its frequency in a tabular form.

6. Define 2-dimensional array a (3,3), b (3,3), sum (3,3), diff (3,3), mult (3,3). Store 9 arbitrary numbers in a (3,3) and 9 arbitrary numbers in b (3,3). Do the following:

a) Calculate sum of a (3,3) and b (3,3) and store in sum (3,3) where sum (i,j)=a (i,j)+b (i,j)

b) Calculate difference of a (3,3) and b (3,3) and store in diff (3,3) where diff (i,j)=a (i,j)-b(i,j)

c) Calculate product of two arrays a (3,3) and b (3,3) and store in mult (3,3) where mult (i,j)= summation of a (i,k)*b (k,j) over k where k=1 to3.

Print the result in a tabular form.

7. Write a function, str_ search (char* s1, char* s2, int n), that takes two strings and an integer, as arguments and returns a pointer to the n^{th} occurrence of 1^{st} string s1 in 2^{nd} string s2, or NULL if it is not present.

8. Write a C function to remove duplicates from an ordered array. For example, if input array contains 10,10,10,30,40,40,50,80,80,100 then output should be 10,30,40,50,80,100.

9. Apply recursive call to do the following:

i. Input 'n'(1-200). Calculate sum of 'n'numbers.
ii. Input 'n'(1-20). Calculate product of 'n'numbers.
iii. Input 'n'(2-20). Print 'n' number of Fibonacci numbers.

In Fibonacci sequence the sum of two successive terms gives the third term. The following are few terms of Fibonacci sequence:-1 1 2 3 5 8 13 ……

10. Write a program which will arrange the positive and negative numbers in a one-dimensional array in such a way that all positive numbers should come first and then all the negative numbers will come without changing original sequence of the numbers.

Example:

Original array contains: 10, -15,1,3, -2,0, -2, -3,2, -9

Modified array :10,1,3,0,2, -15, -2, -2, -3, -9

11. Write a menu driven program to maintain a Telephone Directory having following file structure:

1. Name: Character type: Length =20 characters.
2. Address Character type: Length =40 characters.
3. Phone: Character type: Length =12 characters.

Menu

1. Addrecord(s)

2. Display record(s)
3. Search record(s)
4. Modify record(s)
5. Delete record(s)
6. Backup copy of File
7. Exit

Type your choice= 1,2,3,4,5,6,7— ->

COURSE CODE & NAME: ARSPCSC10T / INTRODUCTION TO PROFESSIONAL COMMUNICATION

COURSE OBJECTIVE

1. To put in use the basic mechanics of Grammar.
2. To provide an outline to effective Organizational Communication.
3. Understand the role of communication in personal & professional success.
4. Prepare and present messages with a specific intent.

COURSE OUTCOMES

1. Students would be able to create substantial base by the formation of strong professional vocabulary for its application at different platforms and through numerous modes as Comprehension, reading, writing, and speaking etc.
2. Students will be enabled to understand the basic objective of the course by being acquainted with specific dimensions of communication skills i.e., Reading, Writing, Listening, Thinking and Speaking.
3. Students will cultivate relevant technical style of communication & presentation at their workplace & also for academic uses.
4. Students will apply it at their workplace for writing purposes such as Presentation/official drafting/administrative communication and use it for document/project/report/research paper writing.
5. Students will apply it for practical and oral presentation purposes by being honed up in presentation skills and voice-dynamics. They will apply techniques for developing interpersonal communication skills and positive attitude leading to their professional competence.

UNIT I:

Components of Technical Writing and Functional Grammar: Words and Phrases: Word formation; Root words from foreign languages & their use in English; Prefixes & Suffixes: Derivatives; Modals; Infinitives; vocabulary development: technical vocabulary, vocabulary used in formal letters/emails and reports.

UNIT II:

Fundamentals of Technical Communication: Introduction to Communication; Process of Communication; Technical Communication: features: Distinction between General and Technical Communication; The flow of communication: Downward, Upward, Lateral/Horizontal (Peer group); Barriers to Communication; Dimensions of Communication: Reading, Listening & Comprehension: skills, types & methods.

UNIT III:

Technical Style & Written Communication: Technical Style: Features; types; Requisites of Sentence Construction; Types of Sentences; Paragraph Development: Techniques and Methods: Inductive, Deductive, Spatial, Linear, Chronological etc. Devices.

UNIT IV:

Written Business Communication: Letter writing: Principles, Type: Sales; Credit letters; Claim; Adjustment Letters; Job Application & official letter; Reports: Types; Significance; Structure & drafting of Reports. Technical Proposal; Types; Writing of Proposal; Significance; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Finding; Notices; Agenda; Minutes of Meeting.

UNIT V:

Presentation Strategies & Oral Communication: Analysis of Audience and Locale; Nuances and Modes of Delivery; Kinesics; Proxemics; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections; Flow in Speaking; Public Speaking: method; Techniques: Clarity of substance; emotion; Humour.

TEXTBOOKS

1. Improve your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
2. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
3. Functional skills in Language and Literature, by R.P. Singh, Oxford Univ. Press, 2005, New Delhi.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS

1. **Communication Skills for Engineers and Scientists**, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
2. **Business Correspondence and Report Writing** by Prof. R.C., Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd. , 2001, New Delhi.
3. **Word Power Made Easy** by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.
4. **Developing Communication Skills** by Krishna Mohan, Mecra Bannerji- Macmillan India Ltd. 1990, Delhi.

COURSE CODE & NAME: PTSPPSC10T / PROFESSIONAL PROFICIENCY

COURSE OBJECTIVE

Students should be able to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building.

COURSE OUTCOMES

1. Better representation of himself/herself in terms of communication skills, overall personality development and aptitude building required for jobs.
2. This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.

UNIT I:

Hard Skills: Revision: 1) Grammar (Basics) 2) Preposition 3) Tense 4) Subject-Verb Agreement 5) Synonyms & Antonyms

The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric, and the students should be able to apply the lessons learnt in their daily conversations.

UNIT II:

Soft Skills: Speaking: Etiquettes (not theoretical/written but practical) of Listening, Speaking, Writing, Speech Delivery.

The aim should be to attempt to make the students the centre of the learning process and break the ice with speaking the language. They should develop the confidence to speak and think in the language for further professional exposure. They should be engaging in intelligent conversation with the instructor and expressing themselves in English.

Practice Sheet: Questions (Subjective and Objective) based on the instruction given every week.

The aim should be to bring the instruction given in practice by making them write, speak, and think along the lines of the instruction given. The practice sheet should be evaluated, and necessary feedback must be given. Some exercise on compositional skills must be given so they develop a sense of writing and expressing themselves through the written word.

UNIT III:

Quantitative Aptitude & Logical Reasoning

- **Simplification & Approximation**
- **Alpha-Numeric Series & Miscellaneous**
- **Coding-Decoding**

COURSE DETAILS FOR SEMESTER – II

COURSE CODE & NAME: SCUCPH201T / ELECTRICITY AND MAGNETISM

COURSE OBJECTIVE

To familiarize students with fundamental concepts of Electricity, Magnetism and Electromagnetic field theory.

COURSE OUTCOMES

1. Understand the concept of Electric field and potential.
2. Understand the concept of Dielectrics.
3. Study the concept of Magnetic field and Magnetization.
4. Study the concept of Electrical Circuits.
5. Understand the Concept of Current and charge sensitivity.

UNIT I:

Electric Field and Electric Potential

Electric field. Electric flux. Gauss' Law with applications to charge distribution with spherical, cylindrical, and plane symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Potential and Electric Field dipole. Force and Torque and dipole.

UNIT II:

Electrostatic energy: 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.

UNIT III:

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 IV:

Magnetic Field and Magnetic Properties of Matter: Magnetic force between current elements and definition of Magnetic Field **B**. Biot- Savart's Law and its simple applications: straight wire and circular loop. 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. Magnetization vector (**M).** Magnetic Intensity (**H).** Magnetic Susceptibility and permeability. Relation between **B, H, M**. Ferro magnetism. B-H curve and hysteresis.

UNIT V:

Electromagnetic Induction and Electrical Circuits: 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. A C Circuits: Kirchhoff's laws for AC circuits. Complex Reactance and Impedance, Series L C R Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor, and (4) Band Width. Parallel L C R Circuit.

TEXTBOOKS

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
2. University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e,1986, Addison Wesley.

REFERENCE BOOKS

1. **Electricity, Magnetism & Electromagnetic Theory**, S. Mahajan and Choudhury, 2012, TataMcGraw.
2. **Electricity and Magnetism**, Edward M.Purcell, 1986 McGraw-Hill Education.
3. **Feynman Lectures** Vol.2,R.P.Feynman,R.B.Leighton, M.Sands, 2008, Pearson Education.
4. **Elements of Electromagnetics**, M.N.O. Sadiku, 2010, Oxford University Press.

COURSE CODE & NAME: SCUCPH201P/ ELECTRICITY AND MAGNETISM LAB

COURSE OBJECTIVE

To familiarize students with fundamental concepts of Electrical apparatus and using these to measure various electrical quantities.

COURSE OUTCOMES

1. To get familiarized with measuring instruments and safety practice in laboratory.
2. To get a first-hand experience of measuring the AC and DC current and voltages.
3. To understand the Measurement of field strength of Electric and Magnetic fields.
4. To know about the self-inductance and mutual inductance.
5. To know about various series and parallel circuits.

List of Experiments:

A minimum of six experiments from the following should be performed.

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. To determine an unknown Low Resistance using Potentiometer.
4. To determine a unknown Low Resistance using Carey Foster's Bridge.
5. Measurement of field strength Bandits variation in a solenoid (determined B/dx)
6. To verify the Thevenin and Norton theorems.
7. To verify the Superposition, and Maximum power transfer theorems.
8. To determine self-inductance of a coil by Anderson's bridge.
9. 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) Bandwidth.
10. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.

REFERENCE BOOKS

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

COURSE CODE & NAME: SCUCPH202T / WAVES AND OPTICS

COURSE OBJECTIVE

To familiarize students with fundamental concepts of waves, their propagation in different media and optical phenomenon.

COURSE OUTCOMES

1. Understand the concept of Waves and their propagation.
2. Understand the concept of radiation and its nature.
3. Study the concept of Interference.
4. Study the concept of Diffraction.
5. Understand the Concept of Holography.

UNIT I:

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 Transverse waves. 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 II:

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

UNIT III:

Interference: Division of amplitude and wave front. 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.

UNIT IV:

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

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.

UNIT V:

Holography: Principle of Holography. Recording and Reconstruction Method. Theory of Holography as Interference between two Plane Waves. Point source holograms.

TEXTBOOKS

1. The Physics of Vibrations and Waves, H.J.Pain, 2013, John Wiley and Sons.
2. Optics, Ajoy Ghatak, 2008, Tata McGraw-Hill.

REFERENCE BOOKS

1. **Waves: Berkeley Physics Course**, vol.3, Francis Crawford, 2007,Tata McGraw-Hill.
2. **Fundamentals of Optics**, F.A. Jenkins and H.E.White, 1981, McGraw-Hill.
3. **Principles of Optics**, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. **The Physics of Waves and Oscillations**, N.K.Bajaj, 1998, Tata McGrawHill.
5. **Fundamental of Optics**, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand.

COURSE CODE & NAME: SCUCPH202P / WAVES AND OPTICS LAB

COURSE OBJECTIVE

To familiarize students with fundamental concepts of optical instruments and using these to measure wavelength of light.

COURSE OUTCOMES

1. To get familiarized with measuring instruments and safety practice in laboratory.
2. To get an experience of measuring frequency and amplitude of waves.
3. To understand and measure wavelength of sources.
4. To know about the diffraction and measurement of wavelength.
5. To know about dispersive power and resolving power.

List of Experiments:

A minimum of six experiments from the following should be performed.

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify λ^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 Newton's Rings.
8. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
9. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
10. To determine dispersive power and resolving power of a plane diffraction grating.

REFERENCE BOOKS

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

COURSE CODE & NAME: CASCPSC20T/ FUNDAMENTALS OF DATA SCIENCE

COURSE OBJECTIVE

To create awareness towards various environmental issues like global warming, urbanization, pollutions, ozone layer depletion etc; their causes and remedial steps for protecting impacted society.

COURSE OUTCOMES

1. Apply principles of Data Science to the analysis of business problems.
2. Use data mining software to solve real-world problems.
3. Employ cutting edge tools and technologies to analyze Big Data.
4. Apply algorithms to build machine intelligence.
5. Demonstrate use of teamwork, leadership skills, decision making and organization theory.

UNIT I:

Introduction: What is Data Science? Data Science process; Matrices-Matrices to represent relations between data, and necessary linear algebraic operations on matrices-Approximately representing matrices by decompositions (SVD and PCA); Statistics: Descriptive Statistics: distributions and probability- Statistical Inference: Populations and samples- Statistical modeling-mean, median, mode & covariance, fitting a model- Hypothesis Testing, Intro to Python.

UNIT II:

Data preprocessing: Data cleaning- data integration- Data Reduction, Data Transformation and Data Discretization. Evaluation methods: Confusion matrix, Students T-tests and ROC curves-Exploratory Data Analysis (EDA): Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, Feature Generation and Feature Selection- Feature Selection algorithms- Filters; Wrappers.

UNIT III:

Basic Machine Learning Algorithms: Association Rule mining- Linear Regression- Logistic Regression- Classifiers- k-Nearest Neighbors (k-NN), k-means-Decision tree- Naive Bayes-Ensemble Methods- Random Forest. Decision Trees and Random Forests.

Data Visualization: Basic principles, ideas, and tools for data visualization.

UNIT IV:

Clustering: Choosing distance metrics- Different clustering approaches-hierarchical agglomerative clustering, k-means (Lloyd's algorithm),- DBSCAN- Relative merits of each method- clustering tendency and quality.

UNIT V:

Information Retrieval: Learn about structure and organization of various components of an IR system; Information representation models, term scoring mechanisms, etc. in the complete search system.

TEXTBOOKS

1. Cathy O'Neil and Rachel Schutt, "Doing Data Science, Straight Talk From The Frontline", O'Reilly, 2014.
2. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques", Third Edition. ISBN 0123814790, 2011.

REFERENCE BOOKS

1. Mohammed J. Zaki and Wagner Miera Jr, "**Data Mining and Analysis: Fundamental Concepts and Algorithms**", Cambridge University Press, 2014.
2. Matt Harrison, "**Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization**, O'Reilly, 2016.
3. Joel Grus, "**Data Science from Scratch: First Principles with Python**", O'Reilly Media, 2015.
4. Wes McKinney, "**Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython**", O'Reilly Media, 2012.

COURSE CODE & NAME: CASCPSC20P/FUNDAMENTALS OF DATA SCIENCE LAB

COURSE OBJECTIVES

The course should enable the students to:

1. Understand the basics of Python Programming Language.
2. Exposure on solving of data science problems.
3. Understand the visualization effect.

COURSE OUTCOMES

1. Analyze and interpret results from descriptive and predictive data analysis.
2. Apply their knowledge to a given problem domain and articulate potential data analysis problems.
3. Identify potential pitfalls, and social and ethical implications of data science.
4. Write, test, and debug simple Python programs.
5. Implement Python programs with conditionals and loops.
6. Develop Python programs stepwise by defining functions and calling them.

List of Experiments:

INTRODUCTION TO PYTHON-

1. A program to compute distance between two points taking input from the user Write a program add.py that takes 2 numbers as command line arguments and prints its sum.
2. Write a Program for checking whether the given number is an even number or not.
3. Write a Program to demonstrate list and tuple in python. Write a program using a for loop that loops over a sequence. Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.
4. Write a program to count the numbers of characters in the string and store them in a dictionary data structure Write a program to use split and join methods in the string and trace a birthday of a person with a dictionary data structure.
5. Write function to compute gcd, lcm of two numbers.

READING AND WRITING DIFFERENT TYPES OF DATASETS-

a. Reading different types of data sets (.txt, .csv) from web and disk and writing in file in specific disk Location.

b. Reading Excel data sheet.

c. Reading XML dataset.

VISUALIZATIONS -

a. Find the data distributions using box and scatter plot.

b. Find the outliers using plot.

c. Plot the histogram, bar chart and pie chart etc. on sample data.

COURSE CODE & NAME: SCUCEV201T / ENVIRONMENTAL SCIENCE

COURSE OBJECTIVES

1. To impart basic knowledge of environmental studies.
2. To develop an attitude of concern for the environment.
3. To acquire skills to help people identifying and creating solutions for the environment related problems.
4. To understand the significance of sustainable development.

COURSE OUTCOMES

1. Comprehend the importance of ecosystem and sustainable.
2. Demonstrate interdisciplinary nature of environmental issues.
3. Identify different types of environmental pollution and control measures.
4. Adopt cleaner productive technologies.
5. Identify the role of non-conventional energy resources in environmental protection.
6. Analyze the impact of human activities on the environment.

UNIT I:

Introduction to Environmental Studies: Multidisciplinary nature of environmental studies; Scope and importance; Environmental education; Concept of sustainability and sustainable development. Ecosystems: Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological pyramids. Nutrient cycle (carbon cycle, nitrogen cycle, Sulphur cycle, water cycle, oxygen cycle).

UNIT II:

Natural Resources: Renewable and non-renewable Resources, Land resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impact due to mining dam building on environment. Water: use and over exploitation of surface and ground water, floods, droughts. Water borne and water induced diseases.

UNIT III:

Environmental Pollution: air pollution, water pollution, thermal pollution, noise pollution, soil pollution; Solid Waste Management; Environmental Impact Assessment.

UNIT IV:

Biodiversity and Conservation: Levels of biological diversity: genetic, species and ecosystem diversity; hot spots; threats to biodiversity; Conservation of biodiversity: in-situ and ex -situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic, and informational value.

UNIT V:

Impact of energy usage on environment: Global warming, Climate change, Depletion of ozone layer, Acid rain. Environmental ethics, Role of NGOs, Environmental Laws: Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection. Act. Forest Conservation Act.

TEXTBOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Chemistry and Pollution Control by S.S. Dara; S Chand Publishing, New Delhi.
3. Environmental studies by Dr. Suresh K. Dhameja; S. K. Kataria & Sons, Delhi.
4. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi.
5. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.

COURSE CODE & NAME: PTSPPSC20T / PROFESSIONAL PROFICIENCY

COURSE OBJECTIVES

Listening, Speaking, Reading, and Writing skills to be developed to enable the students to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building.

COURSE OUTCOMES

1. Better representation of himself/herself in terms of communication skills, overall personality development and aptitude building required for jobs.
2. This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.

UNIT I:

Hard Skills: Transformation of Sentences (Simple, Complex, Compound), Direct-Indirect Speech, Active Passive Voice. Reading Comprehension.

The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric, and the students should be able to apply the lessons learnt in their daily conversations.

UNIT II:

Soft Skills: **Speaking:** Group Discussion, Role Play, Skit, Interviews.

The aim should be to develop the students' interpersonal skills though the activities and they should be in a position to better engage with their peers and also develop language speaking skills according to the situation that they are in. They should be comfortable in the use of the language by now and therefore should be in a better position to engage with their peers in the language.

Practice Sheet:

Questions (Subjective and Objective) based on the instruction given for hard skills to be distributed every week.

The aim should be to bring the instruction given in practice by making them write, speak and think along the lines of the instruction given. The practice sheet should be evaluated, and necessary feedback must be given. Some exercise on compositional skills must be given so that they develop a sense of writing and expressing themselves through the written word.

UNIT III:

Quantitative Aptitude & Logical Reasoning

- **Clock**
- **Average**
- **Calendar**

COURSE DETAILS FOR SEMESTER – III

COURSE CODE & NAME: SCUCPH301T / MATHEMATICAL PHYSICS-II

COURSE OBJECTIVE

To familiarize students with Fourier series, differential equations functions and errors.

COURSE OUTCOMES

1. Understand the concept of Fourier Series
2. Understand the concept of partial differential equation and its application
3. Understand Frobenius method and its applications to differential equations.
4. Understand the concept of special function.
5. Understand the concepts of theory or errors and special integrals.

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. Term-by-Term differentiation and integration of Fourier Series. Parseval Identity.

UNIT II: Partial Differential Equations:

Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients. Applications of Partial Differential Equations: Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Equations of Transmission lines

UNIT III: Frobenius Method:

Singular Points of Second Order LinearDifferential Equations and their importance. Frobenius method and its applications to differential equations.

UNIT IV: Special Functions:

Legendre, Bessel, Hermite and Laguerre Differential Equations.Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence

relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions and Orthogonality.

UNIT V: Some Special Integrals and Theory of Errors: Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral). Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error.

TEXTBOOKS

1. Mathematical Physics: H.K. Dass, 2021, S.Chand.

2. Engineering Mathematics, S. Pal and S.C. Bhunia, 2015, Oxford University Press Mathematical Physics, Goswami, 1st edition, Cengage Learning

REFERENCE BOOKS

1. Mathematical Methods for Physicists: Arfken, Weber, 2005,Harris, Elsevier.

2. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

3. Mathematical methods for Scientists & Engineers, D.A. Mc Quarrie, 2003, Viva Books

4. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

COURSE CODE & NAME: SCUCPH302T / THERMAL PHYSICS

COURSE OBJECTIVE

To familiarize students with laws of thermodynamics and concept of kinetic theory of gases.

COURSE OUTCOMES

1. Understand the concept of temperature and first law of thermodynamics
2. Understand the second law of thermodynamics.
3. Understand the concept of entropy and different processes.
4. Study the thermodynamic potentials.
5. Study the kinetic theory of gases.

UNIT I: Zeroth and First Law of Thermodynamics:

Extensive and intensive Thermodynamic Variables, 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 CP and CV, Work Done during Isothermal and Adiabatic Processes.

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, Refrigerator & coefficient of performance, Second Law of Thermodynamics: Kelvin-Planck and Clausius Statements and their Equivalence. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.

UNIT III: 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. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics

UNIT IV: Thermodynamic Potentials:

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

UNIT V: Kinetic Theory of Gases:

Maxwell's speed distribution, Mean free path, Elementary treatment of transport phenomena in ideal gases, Viscous flow and Thermal conduction in gases. Real gases, Andrew's curves, Equation of state, Virial coefficients, Van der Waals equation, values of critical constant.

TEXTBOOKS

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.

2. A Treatise on Heat, Meghnad Saha, and B.N.Srivastava, 1958, Indian Press

REFERENCE BOOKS

1. Thermal Physics: S. Garg, R. Bansal and Ghosh, 2nd Edition, Tata McGraw-Hill.

2. Thermal Physics: B.K. Agarwal.

3. Heat and Thermodynamics: Brij Lal and N. Subramanyam.

4. Heat and Thermodynamics: Dayal, Verma and Pandey.

COURSE CODE & NAME: ETSECSC31T / DIGITAL SYSTEMS AND APPLICATIONS

COURSE OBJECTIVES

To acquire the basic knowledge of digital logic levels & application of knowledge to understand digital electronics circuits and to prepare students to perform the analysis and design of various digital electronic circuits.

COURSE OUTCOMES

1. Understand the numerical information in different forms and Boolean Algebra theorems
2. Postulates of Boolean algebra and to minimize combinational functions
3. Design and analyze combinational and sequential circuits
4. Known about the logic families and realization of logic gates.
5. Acquire the basic knowledge about VLSI design flow using HDL & its use.

UNIT I: Introduction to Semiconductors and PN Junction Diode:

Introduction of digital systems. Number system, Properties of semiconductors, Intrinsic and extrinsic semiconductors, P and N type of impurities and doping, Charge densities and potential barrier, Draft and diffusion currents, PN junction work tug and characteristics, It's applications as Rectifier: Half wave, Full wave. Bridge Rectifier and their calculation for ripple, Efficiency and PIV; Clipper, Clamper and voltage doublets. Zener and Avalanche breakdown diodes, Tunnel diode, Varactor diode.

UNIT II: Number system and Logic Gates:

Number representation: BCD, floating point numbers Introduction of number systems, Radix, Radix Inter conversions. Radix Complement, Diminished radix complement. Basic theorem of Boolean algebra. Boolean function and minimization, Karnaugh map, Quine McCluskey method. Introduction to Verilog, combinational circuits and their analysis. Universal Gates, Realization of Primary gates using Universal gates only.

UNIT III: Combinational logic circuits:

Binary adder and Subtractor circuits, Magnitude comparator, Decoders, Encoders, Multiplexer and demultiplexer, Realization of switching expressions by decoders, encoders, multiplexer and Demultiplexer, Programmable logic circuits, Tri-state logic, Memory Elements, Arithmetic circuits: Adder, subtractor, multiplier, comparator.

UNIT IV: Sequential Logic Circuits:

Sequential circuits, latches and Flip Flops (SR, JK, T, D), counters, Registers, introduction to behavior modeling in Verilog. Analysis of clocked sequential circuits. State reduction and assignment, design of synchronous circuits, shift registers, ripple counters, synchronous counters, Finite state machine, state graphs and tables. Reduction of state table and state assignments. Arithmetic circuits using sequential design.

UNIT V: Digital Integrated Circuits: Characteristics of digital ICs, Introduction to logic families-RTL, DTL, TTL, ECL. MOS and CMOS circuits and comparison. Register transfer level (RTL) design, RTL design examples. FPGA, VLSI design flow using HDL, Introduction to behavior, logic and physical synthesis. Application of Digital System.

TEXTBOOKS

1. Digital Design: M.MorrisMario(PHI)

2. Digital circuits & logic design:S.C.Lee(PHI)

3. Digital electronics:W.H.Gothmann(PHI)

REFERENCE BOOKS

1. R.P.Jain,"ModernDigitalElectronics,"TataMcGrawHill,4thedition,2009.

2. Anand Kumar,"Fundamental of Digital Circuits,"PHI4thedition,2018.

3. W. H. Gothmann, "Digital Electronics- An Introduction to Theory and practice," PHI, 2Nd edition,2006.

4. D.V.Hall,"DigitalCircuitsandSystems,"TataMcGrawHill,1989.

5. A.K.Singh,"Foundation of Digital Electronics &LogicDesign,"NewAge Int.Publishers.

6. SubrataGhosal,"DigitalElectronics,"Cengagepublication,2nd edition,2018

COURSE CODE & NAME: ETSECS32T / NEURAL NETWORK

COURSE OBJECTIVE

The main objective of Neural Network Techniques to Improve Data Analysis Solutions.

COURSE OUTCOMES

1. To organize synaptic connectivity as the basis of neural computation and learning. Also learn the ideological basics of artificial neural networks.
2. To learn the origins of artificial neural networks.
3. To know some application of artificial neural networks. Also identify the different structures of artificial neural networks.
4. Perception and dynamical theories of recurrent networks including amplifiers, attractors, and hybrid computation would be studied.
5. To learn how to design and how to supervised and unsupervised artificial neural networks.

UNIT I: Introduction to ANN:

Features, structure and working of Biological Neural Network, Trends in Computing Comparison of BNN and ANN Basics of Artificial Neural Networks -History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perception, Adaline model, Basic learning laws, Topology of neural network architecture. What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

UNIT II: Back propagation networks:

(BPN) Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, back propagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning. Back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications. Activation & Synaptic Dynamics: Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks.

UNIT III: Basic functional units of ANN for pattern recognition tasks:

Basic feed forward, Basic feedback and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks.

a) Feedforward neural networks –

- Linear responsibility X-OR problem and solution.

- Analysis of pattern mapping networks summary of basic gradient search methods.

b) Feedback neural networks Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning Competitive learning neural networks: Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.

Associative Memory: Autocorrelators, Heterocorrelators, Wang et al's Multiple Training Encoding Strategy, Exponential BAM, Associative Memory for Real coded pattern pairs, Applications.

UNIT IV: Adaptive Resonance Theory: Cluster Structure, Vector Quantization, Classical ART Network, Simplified ART Architecture, ART1 and ART2 Architecture and algorithms, Applications, Sensitivities of ordering of data.

Introduction to Fuzzy logic, Genetic Algorithm. Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy logic, Fuzzy rule based system, Defuzzification Methods, Applications. Integration of Neural Network, Fuzzy logic and Genetic Algorithm: Hybrid system. Neural Networks, Fuzzy logic, and Genetic Algorithm Hybrids

UNIT V: Applications of ANN:

Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.

TEXTBOOKS

1. Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.

2. Neural Networks,Fuzzy Logic and Genetic Algorithms, by S.Rajasekaran and G.A. Vijayalakshmi Pai.

3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.

4. Build_Neural_Network_With_MS_Excel_sample by Joe choong

5. Yegnanarayana - Artificial neural network PHI Publication.

COURSE CODE & NAME: PTSPPSC30T / PROFESSIONAL PROFICIENCY

COURSE OBJECTIVES

Listening, Speaking, Reading, and Writing skills to be developed to enable the students to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building.

COURSE OUTCOMES

1. Better representation of him/her in terms of communication skills, overall personality development and aptitude building required for jobs.
2. This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.

UNIT I: Hard Skills

Phrasal Verbs, Idioms and Phrases, Interchange of Sentences (Affirmative to Negative), Composition (Expressing opinions and critical thoughts on current issues), Comprehension (Advanced Level), Cloze Test.

The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric and the students should be able to apply the lessons learnt in their daily conversations.

UNIT II: Soft Skills

Speaking activities, Describe a Picture: Tell a story around an idiom you have studied, Finish the sentence, Would you Rather and Why?, Talk about an activity you enjoy doing, Give directions, Timed discussion. The aim should be to attempt to immerse the students in the language so that they develop exposure to it and develop confidence for further professional exposure.

UNIT III: Practice Sheet

Questions (Subjective and Objective) based on the instruction given for hard skills to be distributed every week.

The aim should be to bring the instruction given in practice by making them write, speak and think along the lines of the instruction given. The practice sheet should be evaluated and necessary feedback must be given. Some exercise on compositional skills must be given so that they develop a sense of writing and expressing themselves through the written word.

UNIT IV: Quantitative Aptitude & Logical Reasoning

1. Blood Relation

2. Direction and Distance

3. Percentage

COURSE CODE & NAME: SCUCPH301P / MATHEMATICAL PHYSICS-II- LAB

COURSE OBJECTIVES

1. Develop computational skills in SCILAB for solving physics-related mathematical problems.
2. Simulate and visualize physical systems using numerical methods.
3. Enhance analytical thinking by comparing computational and theoretical results.

1. Introduction to Numerical computation software Sci lab

Introduction to Sci lab, Advantages and disadvantages, Sci lab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Sci lab, Multidimensional arrays, Sub array, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Sci lab functions, Introduction to plotting, 2D and 3Dplotting (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 Sci lab functions, Variable passing in Sci lab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Sci lab 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).

2. Curve fitting, Least square fit, Goodness of fit, standard deviation

- Ohms law to calculate R
- Hooke's law to calculate spring constant

3. Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems

- Solution of mesh equations of electric circuits (3meshes)
- Solution of coupled spring mass systems (3meshes)

4. 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
  - Transient and
  - Steady state solution
- Apply above to LCR circuits also

5. Using Sci cos / x cos

- Generating square wave, sine wave, sawtooth wave
- Solution to harmonic oscillator
- Study of beat phenomenon
- Phase space plots

Reference Books:

1. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014Springer
2. Sci lab by example: M.Affouf 2012,ISBN: 978-1479203444.
3. Getting started with Matlab, Rudra Pratap, 2010, Oxford University Press.
4. Scilab(AfreesoftwaretoMatlab):H.Ramchandran,A.S.Nair.2011S.Chand&Company.
5. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence,3rded.,2006,ambridge University Press.

COURSE CODE & NAME: SCUCPH302P / THERMAL PHYSICS LAB

COURSE OBJECTIVES

To familiarize students with different apparatus and their applications in measuring various physical quantities.

List of Experiments:

At least 5 experiments from the following:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne‟s constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle‟s Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom‟s Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton‟s disc method.
5. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
6. To study the variation of Thermo-emf of a Thermocouple with Difference of Temperature of its Two Junctions using a null method. And also calibrate the 24 Thermocouple in a specified temperature range.
7. To calibrate a thermocouple to measure temperature in a specified Range using Op-Amp difference amplifier and to determine Neutral Temperature.

Reference Books:

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

COURSE CODE & NAME: ETSECSC31P/DIGITAL SYSTEMS AND APPLICATIONS LAB

COURSE OBJECTIVE: To understand the digital logic and create various systems by using these logics.

List of Experiments:

At least 5 experiments from the following:

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet,
2. Concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.
3. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
4. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
5. Implementation and verification of Decoder/De-multiplexer and Encoder using logic gates.
6. Implementation of 4x1 multiplexer using logic gates.
7. Implementation of 4-bit parallel adder using 7483 IC.
8. Design, and verify the 4-bit synchronous counter.
9. Design, and verify the 4-bit asynchronous counter.

Textbooks:

1. A. AnandKumar,"FundamentalofDigital Circuits,"PHI4thedition,2018.
2. W. H. Gothmann, "Digital Electronics- An Introduction to Theory and practice," PHI, 2Nd edition,2006.
3. D.V.Hall,"DigitalCircuitsandSystems,"TataMcGrawHill,1989.

COURSE DETAILS FOR SEMESTER – IV

COURSE CODE & NAME: SCUCPH401T / MATHEMATICAL PHYSICS-III

COURSE OBJECTIVE

To familiarize students with Laplace Transform, Integral transform and Function of Complex Variable.

COURSE OUTCOMES

1. Understand the Laplace Transform and Inverse Laplace Transform.

2. Understand the concept of Fourier Transforms and Inverse Fourier Transforms

3. Illustrate the working methods of complex functions and apply for finding analytic functions.

4. Apply the complex functions for finding Taylor's series, Laurent's series and evaluation of definite integrals.

5. Understand about Orthogonal Curvilinear Coordinates & Dirac Delta function.

UNIT I: 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.

UNIT II: Integral Transform:
Fourier Transforms: Fourier Integral theorem. Fourier Transform. Examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier Integral. Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transforms (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat Flow Equations.

UNIT III: Function of Complex Variable-I:
Complex Numbers and their Graphical Representation, Functions of complex variable, Analytic functions, Cauchy- Riemann equations (Cartesian and Polar form), Harmonic function, Method to find Analytic functions.

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

UNIT V: Orthogonal Curvilinear Coordinates & Dirac Delta function:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

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.

TEXTBOOKS

1. Mathematical Physics: H.K. Dass, 2021, S.Chand.
2. Engineering Mathematics, S. Pal and S.C. Bhunia, 2015, Oxford University Press Mathematical Physics, Goswami, 1st edition, Cengage Learning

REFERENCE BOOKS

1. Mathematical Methods for Physicists: Arfken, Weber, 2005,Harris, Elsevier.
2. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
3. Mathematical methods for Scientists & Engineers, D.A. Mc Quarrie, 2003, Viva Books
4. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.

COURSE CODE & NAME: SCUCPH402T / Elements of Modern Physics

COURSE OBJECTIVE

To familiarize the students with the concept of wave – particle behavior, quantum mechanics, nuclear and radiation physics.

COURSE OUTCOMES

1. Understand the concept of radiation and wave particle duality.
2. Understand the concept of wave function and energy of a particle.
3. Study the nuclear structure.
4. Study the stability of nucleus and nuclear reactions.
5. Understand the concept of absorption and emission of radiation and working of optical fibers.

UNIT I: Wave Particle Duality: Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Heisenberg uncertainty principle.

UNIT II: Quantum Mechanics: Physical significance of wave function, probabilities and normalization, Schrödinger's wave equations, Momentum and energy operator, one dimensional box of infinitely rigid box, eigen values and eigen function.

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

UNIT IV: Radioactivity and Nuclear Reactions: Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay, Pauli's prediction of neutrino; Gamma ray emission. Fusion- mass deficit, generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions)

UNIT V: Laser: Absorption of radiation, Spontaneous and stimulated emission of radiation, Einstein's Coefficients, Population inversion, various levels of Laser, Ruby Laser, He-Ne Laser, laser applications.

Fiber Optics: Introduction to fibre optics, Acceptance angle, Numerical aperture, Normalised frequency, Classification of optical fibers, Attenuation and Dispersion in optical fibers.

TEXTBOOKS

1. Concepts of Modern Physics - Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education

REFERENCE BOOKS

1. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010,
2. Cengage Learning. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
3. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W.
3. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd. Quantum Physics, Berkeley Physics, Vol.4. 4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
4. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore,2003, McGraw Hill.

COURSE CODE & NAME: CASPYSC40T /PYTHON PROGRAMMING

COURSE OBJECTIVES

1. Master the fundamentals of writing Python programs.
2. Learn core Python scripting elements such as variables and flow control structures
3. Discover how to work with lists and sequence data
4. Write Python functions to facilitate code reuse
5. Use Python to read and write files
6. Work with the Python standard library and modules.

COURSE OUTCOMES

1. Understanding basic programming skills using Python programming language.
2. Understanding the notion of data types and complex data types such as lists, tuples etc.
3. Understanding the concept of decision making and iterative control structure in python.
4. Understanding the concepts of functions and file handling in Python.

UNIT I: Introduction to Python Language: Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc.

UNIT II: Control Structures: Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, For loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.

UNIT III: Strings, Lists, Tuples and Dictionaries,: Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary, Manipulations Building blocks of python programs, string manipulation methods, List manipulation. Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions.

UNIT IV: Functions & Modules: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables. Importing module, Math module, Packages and their composition

UNIT V: File Handling: Python File Operations: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations.

TEXTBOOKS

1. R Nageswar Rao, *Core Python Programming*, 2018.
2. Eric Mathews, Python Crash Course, 2019.

REFERENCE BOOKS

Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf. Exploring Python, Timothy A. Budd, Mc Graw Hill Education.

COURSE CODE & NAME: PTSPPSC40T / PROFESSIONAL PROFICIENCY

COURSE OBJECTIVES

Listening, Speaking, Reading, and Writing skills to be developed to enable the students to read and write correct English, attain reasonable fluency in the Language and should also be exposed to introductory lessons of Aptitude Building

COURSE OUTCOMES

1. Better representation of him/her in terms of communication skills, overall personality development and aptitude building required for jobs.
2. This program will help students employable and ready for Industries /corporate and other Public and Private Sector jobs.

UNIT I: Hard Skills

Phrasal Verbs, Idioms and Phrases, Interchange of Sentences (Affirmative to Negative), Composition (Expressing opinions and critical thoughts on current issues), Comprehension (Advanced Level), Cloze Test.

The goal is to teach Grammar implicitly through reading comprehensions. A short story/paragraph should be given for the students to identify the parts of speech and the other topics mentioned above. The classes should be learner centric and the students should be able to apply the lessons learnt in their daily conversations.

UNIT II: Soft Skills

Debate, Speech developing activities: The world in twenty years, Guess the word, Time Trials, Describing a game, brainstorming an idea, listening and repeating.

The aim should be to enable the students to express themselves in the language and gain proficiency and confidence in speaking the language. They should develop skills to be able to better present their ideas and openly express their thoughts and opinions. They should develop independent and critical thinking.

UNIT III: Practice Sheet

Questions (Subjective and Objective) based on the instruction given for hard skills to be distributed every week.

The aim should be to bring the instruction given in practice by making them write, speak and think along the lines of the instruction given. The practice sheet should be evaluated and necessary feedback must be given. Some exercise on compositional skills must be given so that they develop a sense of writing and expressing themselves through the written word.

Quantitative Aptitude & Logical Reasoning

- Order and Ranking
- Ratio and Proportion
- Time and Work

COURSE CODE & NAME: SCUCPH401P / MATHEMATICAL PHYSICS-III LAB

COURSE OBJECTIVES

To equip students with computational skills to solve and simulate complex Mathematical Physics problems and analyze results using numerical methods.

C^{++}/C/Sci lab based simulations experiments 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^2d^2y/dt^2 + 2 dy/dt = -yd^2y/dt^2+e^{-t}dy/dt=-y

2. Dirac Delta Function:
Evaluate $\frac{1}{\sqrt{2\pi}\sigma^2}\int e^{\frac{-(x-2)^2}{2\sigma^2}}.(x+3)dx$, for $\boldsymbol{\sigma}$=1,0.1,0.01 and show it tends to 5

3. Fourier Series: Evaluate the Fourier coefficients of a periodic function (square wave).

4. Frobenius method and Special functions:

$$\int_{-1}^{+1} P_n(\mu).P_m(\mu)d\mu = \delta_{m,n}$$

Plot $P_n(x)$, (x) Show recursion relation

5. Evaluation of trigonometric functions e.g. *sin θ,* Given Bessel's function at N points find its value at an intermediate point. Complex analysis: Integrate1/(x^2+2)numerically and check with computer integration.

6. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).

7. Calculation of least square fitting manually for a given data set and confirmation of least square fitting of data through computer program.

8. Integral transform: Fast Fourier Transform of e^{-x^2}

Reference Books:

1. MathematicalMethodsforPhysicsandEngineers,K.FRiley,M.P.HobsonandS.J.Bence,3rd ed.,2006,CambridgeUniversityPress**.**
2. MathematicsforPhysicists,P.DenneryandA.Krzywicki,1967,Dover Publications**.**
3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C. V.Fernández.2014SpringerISBN: 978-3319067896**.**
4. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press**.**
5. Getting started with Matlab, Rudra Pratap,2010,OxfordUniversityPress.

COURSE CODE & NAME: SCUCPH402P / ELEMENTS OF MODERN PHYSICS LAB

COURSE OBJECTIVE:

To familiarize students with different apparatus and their applications in measuring various physical quantities.

List of Experiments:

At least 06 experiments from following:

1. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
2. To determine the Planck's constant using LEDs of at least 4 different colours.
3. To determine the wavelength of H-alpha emission line of Hydrogen atom.
4. To determine the ionization potential of mercury.
5. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
6. To setup the Millikan oil drop apparatus and determine the charge of an electron.
7. To determine the wavelength of laser source using diffraction of single slit.
8. To determine the wavelength of laser source using diffraction of double slits.
9. To determine angular spread of He-Ne laser using plane diffraction grating.
10. To measure the DC voltage by using CRO.
11. To display the action of junction Diode as (a) Half wave rectifier and (b) Full wave rectifier using CRO.

Reference Books:

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

COURSE CODE & NAME: CASPYSC40P / PYTHON PROGRAMMING LAB

COURSE OBJECTIVES

1. To acquire programming skills in core Python.
2. To acquire Object Oriented Skills in Python.
3. To develop the skill of designing Graphical user Interfaces in Python.
4. To develop the ability to write database applications in Python.

COURSE OUTCOMES

1. Understand and comprehend the basics of python programming.
2. Demonstrate the principles of structured programming and be able to describe, design, implement, and test structured programs using currently accepted methodology.
3. Explain the use of the built-in data structures list, sets, tuples and dictionary.
4. Make use of functions and its applications.

List of Experiments:

Implement all the concepts taught in the Python Programming classes. Some experiments are:

1. Write a program to demonstrate different number data types in Python.
2. Write a program to compute distance between two points taking input from the user using Pythagorean Theorem.
3. Write a Program for checking whether the given number is an even number or not.
4. Write a Python script that prints prime numbers less than 20.
5. Write a program to create, concatenate and print a string and accessing sub-string from a given string.
6. Write a program to create, append, and remove lists in python.
7. Write a program to demonstrate working with tuples in python.
8. Write a python program to define a module to find Fibonacci Numbers and import the module to another program.
9. Write a python program to define a module and import a specific function in that module to another program
10. Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.
11. Write a Python class to implement pow(x, n) and other user defined functions.

COURSE DETAILS FOR SEMESTER – V

COURSE CODE & NAME: SCUCPH501T / QUANTUM MECHANICS AND APPLICATIONS

COURSE OBJECTIVE

In continuation with modern physics this course is an application of Schrodinger equation to various quantum mechanical problems. This gives fair idea of formulation of eigenvalues and eigen functions.

COURSE OUTCOMES

1. Understand the historical aspects of development of quantum mechanics.
2. Understand and explain the differences between classical and quantum mechanics.
3. Students will be able to understand the central concepts and principles in quantum mechanics, such as the Schrodinger equation, the wave function and its statistical interpretation.
4. Students will be able to apply Schrodinger equation to various quantum mechanical problems.
5. Understand the concepts of angular momentum and spin.

UNIT I:

Time dependent Schrodinger equation: Time dependent Schrodinger equation; Properties of Wave Function. Interpretation of Wave Function Probability and probability current densities in three dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigen functions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

UNIT II:

Time independent Schrodinger equation - Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle.

UNIT III:

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 eigen functions, Concept of spin, Hydrogen atom.

UNIT IV:

Atoms in Electric and Magnetic Fields: Electron angular momentum. Angular momentum quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Normal Zeeman Effect: Electron Magnetic Moment and Magnetic Energy.

UNIT V:

Many electron atoms: Pauli's Exclusion Principle. Symmetric and Antisymmetric Wave Functions. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Spin-orbit coupling in atoms-L-S and J-J couplings.

TEXTBOOKS

1. A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., 2010, McGraw Hill.
2. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education.

REFERENCE BOOKS

1. **Quantum Mechanics**, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
2. **Quantum Mechanics for Scientists & Engineers**, D.A.B. Miller, 2008, Cambridge University Press.

COURSE CODE & NAME: SCUCPH501P / QUANTUM MECHANICS LAB

COURSE OBJECTIVE: To utilize computational techniques to study and understand the behavior of quantum systems.

COURSE OUTCOMES

1. Develop the ability to model and simulate basic quantum mechanical systems
2. Acquire proficiency in using SCILAB to perform numerical solutions to the Schrodinger equations for various potentials.
3. Utilize SCILAB to visualize wave functions and probability densities.
4. Comparison with Analytical Solutions.
5. Build a strong foundation in both the theoretical and computational aspects of quantum mechanics.

List of Experiments:

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:

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

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)$^{1/2}$, ħc = 1973 (eVÅ) and m = 0.511x10^6 eV/c^2.

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

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

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

$$V(r) = -\frac{e^2}{r}e^{-r/a}$$

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 = 0.511x10^6 eV/c^2, and a = 3 Å, 5 Å, 7 Å. In these units ħc = 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:

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

For the anharmonic oscillator potential

$$V(r) = \frac{1}{2}kr^2 + \frac{1}{3}br^3$$

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/c^2, k = 100 MeV fm^{-2}, b = 0, 10, 30 MeV fm^{-3}In these units, cħ = 197.3 MeV fm. The ground state energy I 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:

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

Where μ is the reduced mass of the two-atom system for the Morse potential

$$V(r) = D\left(e^{-2\alpha r'} - e^{-\alpha r'}\right), r' = \frac{r - r_o}{r}$$

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 = 940x10^6eV/C^2, D = 0.755501 eV, α = 1.44, r_o = 0.131349 Å

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.

COURSE CODE & NAME: SCUCPH502T / SOLID STATE PHYSICS

COURSE OBJECTIVE: This syllabus introduces the basic phenomena in Solid State Physics. This aims to provide a general introduction to theoretical and experimental topics in solid state physics.

COURSE OUTCOMES

1. Students should be able to elucidate the main features of crystal lattices and phonons.
2. Understand the elementary lattice dynamics and its influence on the properties of materials.
3. Describe the main features of the physics of electrons in solids.
4. Explain the dielectric and magnetic properties of solids and understand the basic concept in superconductivity.

UNIT I:

Crystal Structure: Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis– Central and Non-Central Elements. Symmetry Elements Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. Laue Condition, Atomic and Geometrical Factor.

UNIT II:

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

UNIT III:

Electrons in Solids: Electrons in metals- Drude Model, Density of states (1-D,2-D,3-D), Elementary band theory: Kronig Penny model. Band Gap., Effective mass, mobility, Hall Effect (Metal and Semiconductor).

UNIT IV:

Dielectric and Magnetic Properties of Materials:

Electronic, ionic and dipolar polarizability, local fields, induced and oriented polarization-

molecular field in dielectric, Clausius - Mosotti relation.

Dia, Para and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains, B-H Curve. Hysteresis, soft and hard material and Energy Loss.

UNIT V:

Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Idea of BCS theory (No derivation)

TEXTBOOKS

1. Introduction to Solid State Physics, Charles Kittel, 8^{th} Edn., 2004, Wiley India Pvt. Ltd.

2. Elements of Solid-State Physics, J.P. Srivastava, 2^{nd} Edn., 2006, Prentice-Hall of India.

REFERENCE BOOKS

1. **Solid State Physics**, Rita John, 2014, McGraw Hill.
2. **Solid State Physics**, M.A. Wahab, 2011, Narosa Publications.

COURSE CODE & NAME: SCUCPH502P / SOLID STATE PHYSICS LAB

COURSE OBJECTIVE: To enhance understanding of solid-state physics through practical experimentation.

COURSE OUTCOMES

1. Students gain insights into the structural and electronic properties of various solid materials..
2. Familiarity with different experimental techniques.
3. Students will measure the resistivity of semiconductors at various temperatures and calculate the band gap.
4. Application of Theoretical Concepts.
5. Develop a strong foundation in solid – state physics through hands-on experiments.

List of Experiments:

A minimum of six experiments from the following should be performed.

1. To measure the Magnetic susceptibility of Solids.
2. To determine the Coupling Coefficient of a Piezoelectric crystal.
3. To measure the Dielectric Constant of a dielectric Materials with frequency.
4. To determine the refractive index of a dielectric using SPR technique.
5. To study the PE Hysteresis loop of a Ferroelectric Crystal.
6. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
7. To measure the resistivity of a semiconductor (Ge) with temperature (up to 150^{O}C) by four-probe method and to determine its band gap.
8. To determine the Hall coefficient of a semiconductor sample.
9. To measure the resistivity of a semiconductor (Ge) with temperature by two-probe method and to determine its band gap.
10. Analysis of X-Ray diffraction data in terms of unit cell parameters and estimation of particle size.

REFERENCE BOOKS

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

COURSE CODE & NAME: SCUCPH503T / ANALOG SYSTEMS AND APPLICATIONS

COURSE OBJECTIVE: To equip students with a strong foundation in analog electronics, enabling them to understand, design, and work with a wide range of analog circuits and systems in various fields.

COURSE OUTCOMES

1. To learn about the physics of bipolar junction transistors, transistor biasing and stabilization circuits.
2. Understand the concept of amplifiers.
3. Study the concept of coupled amplifier, feedback in amplifiers and oscillators.
4. Study the concept of operational amplifiers.
5. Understand the applications of operational amplifier.

UNIT I:

Bipolar Junction Transistors: n-p-n and p-n-p transistors, Characteristics of CB, CE and CC Configurations, Active, Cut-off and Saturation Regions. Current gains α and β, Relation between α and β, Load line analysis of Transistors, DC Load line and Q-point, Physical Mechanism of current flow.

Transistors Biasing: Transistor Biasing and Stabilization circuits, Fixed Bias, and Voltage Divider Bias.

UNIT II:

Amplifiers: Transistors 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 and C amplifiers, Push-pull amplifier (class B).

UNIT III:

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

Feedback in Amplifiers: Effect of Positive and Negative Feedback on In- put Impedance, Output Impedance, Gain Stability, Distortion and Noise. Sinusoidal

Oscillations: Barkhausens Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency, Hartley and Colpitts oscillators.

UNIT IV:

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical OP-AMP (IC741). Open-loop and Closed loop Gain. Frequency Response. CMRR,

Slew Rate and concept of virtual ground.

UNIT V:

Application of Op-Amps: Inverting and non-inverting amplifiers, Adder, Subtractor, Differentiator, Integrator, Log amplifier, Zero crossing detector, Wein bridge oscillator.

TEXTBOOKS

1. Electronic devices and circuits R.L.Boylstad (Pearson India)
2. Electronic Principles- A.P.Malvino (Tata Mc Graw Hill)
3. Principles of Electronics- V. K. Mehta and Rohit Mehta (S. Chand Publication)
4. OP-Amps and Linear Integrated Circuit-R. A. Gayakwad (Prentice Hall)
5. Physics of Semiconductor devices, Donald A Neamen (Prentice Hall)

REFERENCE BOOKS

1. Foundations of Electronics-Raskhit and Chattopadhyay (New age International Publication).
2. Concept of Electronics- D.C. Tayal (Himalay Publication)

COURSE CODE & NAME: SCUCPH503P / ANALOG SYSTEM AND APPLICATION LAB

COURSE OBJECTIVE: To familiarize students with different apparatus and their applications in measuring various physical quantities.

COURSE OUTCOMES

1. Proficiency in Circuit Design and Analysis.
2. Students will be able to apply theoretical concepts.
3. Enhance measurement and data interpretation skills.
4. Students will have a solid understanding of the practical applications of analog systems in various fields.

List of Experiments:

At least 06 experiments from following:

1. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
2. Study of V-I & power curves of solar cells and find maximum power point & efficiency.
3. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
4. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
5. To study the frequency response of voltage gain of a 2-stage RC-coupled transistor amplifier.
6. To design a Wien bridge oscillator for given frequency using an op-amp.
7. To design a digital to analog converter (DAC) of given specifications.
8. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain.
9. To investigate the use of an op-amp as an Integrator.
10. To investigate the use of an op-amp as a Differentiator.

REFERENCE BOOKS:

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

COURSE CODE & NAME: CASCPSC50T / AI AND MACHINE LEARNING

COURSE OBJECTIVE: To understand the basics of the theory and practice of Artificial Intelligence as a discipline and machine learning algorithms along with their strengths and weaknesses.

COURSE OUTCOMES

1. Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents.
2. The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.
3. Student should be aware of techniques used for classification and clustering.
4. To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

UNIT I:

Introduction to Artificial Intelligence: Definition, Future of Artificial Intelligence, Characteristics of Intelligent Agents, Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II:

Introduction to the basic concepts of Probability: Conditional Probability, Bayes theorem and naive bayes, Random Vectors, Expectation, Correlation, Covariance.

UNIT III:

Knowledge Representation: First Order Predicate Logic, Prolog Programming, Unification: Forward Chaining-Backward, Chaining, Resolution, Knowledge Representation, Ontological Engineering-Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.

UNIT IV:

Introduction to Machine Learning: Fundamentals of ML, supervised, unsupervised, reinforcement learning.

Supervised Learning:

Classification: kNN, Centroid Method, Perceptron, Support Vector Machines, Multi-level

Perceptron, Decision tree

Regression: Linear Regression

UNIT V:

Neural Network: Introduction to neural networks, Fundamental concepts- neuron models and basic learning rules; Single layer neural Networks, input layer, output layer, hidden layers, Multilayer Neural Networks, Backpropagation.

TEXTBOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, - Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational
3. Publishers Inc., 2011.
4. Biostatistics -A Foundation for Analysis in the Health Sciences' by Wayne E. Daniel and Chad L. Gross.
5. Fundamental of Biostatistics, by Bernard Rosner.
6. Kevin Murphy , Machine Learning: a Probabilistic Perspective, 2012.

COURSE CODE & NAME: CASCPSC50P / AI AND MACHINE LEARNING LAB

COURSE OBJECTIVE: To familiarize students with machine learning algorithms to solve problems of moderate complexity.

List of Experiments:

At least 06 experiments from following:

1. Write a python program to remove punctuations from the given string.
2. Write a program to implement Tic-Tac-Toe game using python.
3. Implement the rule base classifier.
4. Implement the Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
5. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set.
6. Implement the Decision Tree Representation for Appropriate Problems.
7. Write a program to demonstrate the working of the decision tree for a given data set.
8. Handling Training Examples with missing values.
9. Implement to Cluster the data using K-Means algorithm
10. To develop ANN classification model.

Reference Books:

1. S. Russell and P. Norvig, "**Artificial Intelligence: A Modern Approach**‖, Prentice Hall, Third Edition, 2009.
2. I. Bratko, ―Prolog: **Programming for Artificial Intelligence**‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

COURSE DETAILS FOR SEMESTER – VI

COURSE CODE & NAME: SCUCPH601T / ELECTROMAGNETIC THEORY

COURSE OBJECTIVE: To introduce the concepts of Maxwell's equations, propagation of electromagnetic (em) waves and their applications in practical problems, production and detection of different types of polarized em waves and general information as waveguides.

COURSE OUTCOMES

1. Understand the basic concepts related to electromagnetic fields.
2. Understand the concepts related to electromagnetic wave propagation.
3. Production and detection of detection of different types of polarized em waves.
4. Apply Maxwell's equations to solutions of problems relating to transmission lines and waveguides.

UNIT I:

Maxwell Equations: Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density. Momentum Density and Angular Momentum Density.

UNIT II:

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

UNIT III:

EM Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection.

UNIT IV:

Polarization of Electromagnetic Waves: Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction.

Nicol Prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Babinet Compensator and its Uses. Analysis of Polarized Light.

Rotatory Polarization: Optical Rotation. Biot's Laws for Rotatory Polarization.

Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.

UNIT V:

Wave Guides: Propagation of e.m. wave through transmission line, reflection coefficient, standing wave, characteristic impedance, propagation constant. Rectangular waveguides. Expressions for field components, TE, TM & TEM modes. Propagation properties, cutoff frequency, group & phase velocity.

TEXTBOOKS

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Optics, A. Ghatak, 5th Edn., 2012, Tata McGraw Hill Education.

REFERENCE BOOKS

1. **Electromagnetic field Theory**, R.S. Kshetrimayun, 2012, Cengage Learning.
2. **Classical Electrodynamics**, J.D. Jackson, 3rd Edn., 2010, Wiley

COURSE CODE & NAME: SCUCPH601P/ ELECTROMAGNETIC THEORY LAB

COURSE OBJECTIVE: 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.

COURSE OUTCOMES

1. To get familiarized with measuring instruments and safety practice in laboratory.
2. To get a first-hand experience of measuring the AC and DC current and voltages.
3. To understand the Measurement of field strength of Electric and Magnetic fields.
4. To know about the self-inductance and mutual inductance.
5. To know about various series and parallel circuits.

List of Experiments:

At least 06 experiments from following:

1. To verify the Stefan's law by electrical method.
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 determine the current sensitivity using ballistic galvanometer.
5. To determine the charge sensitivity using ballistic galvanometer.
6. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
7. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
8. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
9. To determine Boltzmann constant using V-I characteristics of PN junction diode.
10. To verify Brewster's Law and to find the Brewster's angle.

REFERENCE BOOKS

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

COURSE CODE & NAME: SCUCPH602T / STATISTICAL MECHANICS

COURSE OBJECTIVE: The main objective of this course work is to introduce the techniques of Statistical Mechanics which has applications in various fields including Astrophysics, Semiconductors, Plasma Physics, Biophysics, Chemistry and in many other directions.

COURSE OUTCOMES

1. Apply the principles of statistical mechanics to selected problems and to a range of situations.
2. Understand the statistics of particles and can easily distribute bosons, fermions and classical particles among energy levels.
3. Students will be able to employ fundamental physics concepts and theories to set up and formulate problems in thermodynamics and statistical mechanics.
4. After studying Fermi-Dirac statistics, student will be able deal with many electron system in real life.

UNIT I:

Classical Statistics: Macrostate and Microstate, Phase Space, Elementary Concept of Ensemble, Entropy and Thermodynamic Probability, Maxwell-Boltzmann Distribution Law, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox, Sackur-Tetrode equation, Law of Equipartition of Energy (with proof) – Applications to Specific Heat and its Limitations, Thermodynamic Functions of a Two- Energy Levels System, Negative Temperature.

UNIT II:

Systems of Identical particles: Collection of non-interacting identical particles. Classical approach and quantum approach: distinguishability and indistinguishability. Occupation number and MB distribution, emergence of Boltzmann factor. Composite system postulate and symmetry postulate of quantum mechanics (for a pair of particles only). Bosons and Fermions. Symmetric and Antisymmetric wave functions. state counting for bosons and fermions.

UNIT III:

Bose-Einstein Statistics: B-E distribution law, Thermodynamic functions of a strongly Degenerate Bose Gas, Bose Einstein condensation, properties of liquid He (qualitative description).

UNIT IV:

Fermi-Dirac Statistics: Fermi-Dirac Distribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals due to electrons.

UNIT V:

Theory of Radiation: Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Wien's Displacement law. Wien's Distribution Law. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Spectral Distribution of Black Body Radiation. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.

TEXTBOOKS

1. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2nd Ed.,1996, Oxford University Press.
2. Introductory Statistical Mechanics, R. Bowley and M. Sanchez, 2nd Edn., 2007, Oxford Univ. Press.
3. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill.

REFERENCE BOOKS

1. **An Introduction to Statistical Mechanics & Thermodynamics**, R. H. Swendsen, 2012, Oxford Univ. Press.
2. **Statistical Physics** , F. Mandl, 2nd Edn., 2003, Wiley.

COURSE CODE & NAME: SCUCPH602P/ STATISTICAL MECHANICS LAB

COURSE OBJECTIVE: To deepen students understanding of Statistical Mechanics.

COURSE OUTCOMES

1. Provide a comprehensive framework for students to apply computational techniques in statistical mechanics, enhancing their understanding of both theory and practical application.
2. Utilize SCILAB to compute partition functions for various statistical systems.
3. Implement and analyse distribution functions for different systems.
4. Enhance programming abilities in SCILAB.

List of Experiments:

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 (β) 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(β), average energy <E>, 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 Raleigh-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 ($dN/d\varepsilon$ versus ε) 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, 3$^{r\ d}$ Edn. 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.

COURSE CODE & NAME: SCUCPH603T / CLASSICAL MECHANICS

COURSE OBJECTIVE: This syllabus aims to introduce students to the Lagrangian and Hamiltonian formulations of Newtonian mechanics for providing a deeper understanding of the fundamental principles of physics.

COURSE OUTCOMES

1. Students acquire basic knowledge of Mechanics, skills, and techniques to solve a mechanical problem.
2. Students will gain the ability to identify appropriate generalized coordinates for a given mechanical system.
3. Students will be able to identify the motion of a mechanical system using Lagrange-Hamiltonian formalism.
4. Students will learn how to formulate and solve Hamilton's equations.
5. Provides deeper understanding of classical mechanics beyond Newtonian mechanics.

UNIT I:

Lagrangian: Generalised coordinates and velocities, Constraints, principle of virtual work Calculus of variation, Lagrange's equation, Applications to simple systems such as coupled oscillators. Cyclic coordinates, symmetries and conservation laws. Advantages of Lagrangian: electromechanical Analogies.

UNIT II:

Hamiltonian: Canonical momenta & Hamiltonian. Hamilton's equations of motion. Principle of least action. Applications: Hamiltonian for a harmonic oscillator, compound pendulum. Canonical transformation, Poisson Brackets, Hamilton-Jacobi theory, solution of harmonic oscillator using Hamilton-Jacobi theory.

UNIT III:

Motion under central force: Two body problem, reduction to the equivalent one body problem, Differential equation for the orbit, Condition for stable circular orbit, Kepler's law, centre of mass and lab frame of reference, Rutherford scattering.

UNIT IV:

Rigid body dynamics: moment of inertia and product of inertia, rotating top, precession and nutation, Euler angles.

UNIT V:

Rotating frame of reference: rotating frame of reference, centrifugal force, Coriolis force and its effects.

TEXTBOOKS

1. Intoduction to Classical mechanics, Nikhil Ranjan Roy, 2016, Vikash Pub House Pvt. Ltd.
2. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3rd Edn. 2002, Pearson Education.

REFERENCE BOOKS

1. **Mechanics**, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
2. **Classical Mechanics: An introduction**, Dieter Strauch, 2009, Springer.

COURSE CODE & NAME: SCUCPH603P/ CLASSICAL MECHANICS LAB

COURSE OBJECTIVE: To provide a hand – on and experimental approach to understanding and applying the principles of classical mechanics.

COURSE OUTCOMES

1. Apply fundamental principles of classical mechanics to real – world experiments.
2. Analyze and interpret experimental data to validate theoretical models.
3. Develop skills in using laboratory equipment for mechanics-based experiments.
4. Enhance problem-solving abilities through hands-on applications.

List of Experiments:

At least 06 experiments from following:

1. To determine the acceleration due to gravity by Simple Pendulum.
2. To determine the acceleration due to gravity with the help of Compound Pendulum.
3. To determine the radius of gyration and moment of inertia of a Compound Pendulum about its centre of gravity.
4. Determination of the moment of inertia of given body using inertia table.
5. Determination of the moment of inertia of given body using inertia table using lamp and scale arrangement.
6. Prove the perpendicular axis theorem of moment of inertia using inertia table.
7. Study two normal modes of Coupled Oscillator and record the oscillations to determine the time period for both the modes.
8. Record the oscillations for Resonance Mode. To determine the Coupled Time Period and Beat Time Period of the oscillation also compare the experimental values of time period with calculated values?
9. To determine the Spring Constant with the help of Coupled Oscillator.
10. To study the variation of magnetic field along the axis of current carrying circular coil and estimate the radius of coil.

REFERENCE BOOKS

1. **Advanced Practical Physics for students**, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. **A Textbook of Practical Physics**, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal.

COURSE CODE & NAME: SCUCPH604T / NANO MATERIALS AND APPLICATIONS

COURSE OBJECTIVE: The objective of this course is to introduce the essence of nano materials and their applications.

COURSE OUTCOMES

1. To correlate properties of nanostructures with their size, shape and surface characteristics.
2. Student will be able to understand the appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties.
3. Students will learn different methods of nano material characterization.
4. To provide scientific understanding of application of nanomaterials.

UNIT I:

Nanoscale Systems: Band structure and density of states of materials at nanoscale, size effects in nano systems, Quantum confinement Applications of Schrodinger equation-infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructure and its consequences.

UNIT II:

Synthesis of Nano structure Materials: Top down and bottom-up approach, Photo lithography Ballmilling. Gas phase condensation, Vacuum deposition, Physical vapour deposition (PVT): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition, Chemical vapour deposition (CVD), Sol-Gel Electro deposition, Spray pyrolysis.

UNIT III:

Characterization: X-Ray Diffraction, Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Scanning Tunneling Microscopy.

UNIT IV:

Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation). CNT based transistors. Nanomaterial Devices.

TEXTBOOKS

1. S.K. Kulkarni, Nanotechnology: Principles and Practices (Capital publishing Company)

2. Nano science and nano technology, K. K. Choudhury (Narosa).

REFERENCE BOOKS

1. **Nano Science and nanotechnology**, Sundar Singh (PragatiPrakashan)

2. C.P. Poole, Jr. Frank J. Owens, **Introduction to Nanotechnology** (Wiley India Pvt.Ltd.)

3. **Introduction to Nanoelectronics**, VV. Mitin, VA. Kochelap & M.A. Stroscio, 2011, Cambridge University Press.

4. Richard Booker, Earl Boysen, **Nanotechnology** (John Wiley and Sons).