# B.Sc. PHYSICS

## CHOICE BASED CREDIT SYSTEM (CBCS)

# Syllabus

**Students admitted from 2017 onwards**


**DEPARTMENT OF PHYSICS**
**KARPAGAM UNIVERSITY**
**KARPAGAM ACADEMY OF HIGHER EDUCATION**
**(Deemed to be University Established Under Section 3 of UGC Act, 1956)**
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SEMESTER – I

**17LSU101** **தமிழ் முதல் தாள்** **4H – 4C**

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

**Instruction Hours / week: L: 4 T: 0 P: 0** **Marks:** Internal: **40** External: **60** Total: **100**

**பாடத்திட்டப் பொதுநோக்கம்**

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கை மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

**பாடத்திட்டப் பயன் விளைவு**

1. இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.
6. மொழிபெயப்புத் துறைசார்ந்த வேலைவாய்புத் திறன் பெற்றிருத்தல்

**அலகு – I : இக்கால இலக்கியம்: (10 மணிநேரம்)**

**கல்வி :** மகாகவி பாரதியார் – சுயசரிதை - ஆங்கிலக் கல்வி.

**இன்றைய நிலை :** கவிமணி தேசிக விநாயகம் பிள்ளை – ஒற்றுமையே உயிர்நிலை.

**மனிதநேயம் :** கவிஞர் சிற்பி பாலசுப்பிரமணியன் –மலையாளக் காற்று.

**சூழலியல் : கவிஞர்** வைதீஸ்வரன் - விரல் மீட்டிய மழை.

**பெண்ணியம் : கவிஞர்** சுகந்தி சுப்பிரமணியம் – புதையுண்ட வாழ்க்கை.

**அலகு – II : அற இலக்கியம்: (10 மணிநேரம்)**

கொன்றை வேந்தன்: 1-50 பாடல்கள்

திருக்குறள்: பண்புடைமை, வினைத்திட்பம் – 20 குறள்கள்

பழமொழி நானூறு: 5 பாடல்கள்

**அலகு - III : சிற்றிலக்கியம்: (10 மணிநேரம்)**

மூவருலா: 1-26 கண்ணிகள்

திருச்செந்தூர் முருகன் பிள்ளைத்தமிழ்: 2 பாடல்கள்

கலிங்கத்துப் பரணி: போர்பாடியது - 9 பாடல்கள்

**அலகு – IV : கட்டுரை: (10 மணிநேரம்)**

1. **உயர்தனிச் செம்மொழி - பரிதிமாற்கலைஞர்**
2. **கட்டிடக்கலை** - அ. இராசமாணிக்கனார்
3. **வாழ்க்கை** - இளவழகனார்
4. ஆளுமைத்திறன் அறிவோம் - ஸ்ரீகண்ணன்
5. மணற்கேணி - நெ.து.சுந்தரவடிவேலு

**அலகு- V : மொழிப்பயிற்சி: (8 மணிநேரம்)**

1. படைப்பிலக்கியப் பயிற்சிகள் (கதை, கவிதை, கட்டுரை, உரைநடை)
2. மொழிபெயர்ப்பு
3. இலக்கணப் பயிற்சிகள்

**பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.** கற்பகம் பல்கலைக்கழகத் தமிழ்த் துறை வெளியீடு.

SEMESTER – I

**17ENU101** **ENGLISH** **4H – 4C**

**Course Objectives:**

- To help students enhance their Language skills
- To introduce different kinds of literary works
- To familiarize different genres of Literature
- To instruct moral values through literature.
- To improvise their productive and receptive skills
- To strengthen the basic knowledge about grammar

**Course Outcomes:**

1. Develop the four types of skills
2. Reading and comprehending literary works
3. Genres of literature to provide moral education
4. Develop communication skills in business environment
5. Interpersonal skills will be developed.
6. Betterment of language competence

**UNIT - I : PROSE**

1. Morals in the Indian Context - Francis Nicholas Chelliah
2. How Comic Books help us to relive our Childhood - Benoit Peeters
3. Let's Do What India Needs From Us - Dr.A.P.J. Abdul Kalam

**UNIT - II : POEM**

1. The Stolen Boat - William Wordsworth
2. A River - A.K. Ramanujan
3. The Sailor - Safaa Fathy

**UNIT - III : SHORT STORIES**

1. Rapunzel - Brothers Grimm
2. The Romance of a Busy Broker - O.Henry
3. The Nightingale and the Rose - Oscar Wilde.

**UNIT - IV** GRAMMAR

1. Tense
2. Auxiliaries (Primary and Modal)
3. Articles
4. Tag Questions

**UNIT - V** FUNCTIONAL ENGLISH

1. Filling the blanks with the suitable form of verb in a conditional sentence.
2. Dialogue Writing
3. Changing positive to negative without altering the meaning
4. Fill in the blank with suitable modal

5. Framing a question to a statement
6. Rewrite the sentences changing the underlined word as directed

**Prescribed Text**:

1. Reminisce, Published by the Department of English,Karpagam University.

**Suggested Reading**:

1. Hewings Martin,1999 Advanced English Grammar, Cambridge University Press.

**SEMESTER – I**

**MECHANICS** **L T P C**

**17PHU101** **5 - - 5**

**Course Objectives**

- To know how to use Newton's laws of motion
- To solve advanced problems involving the dynamic motion of mechanical systems and other advanced mathematics in the solution of the problems.
- To find the use of conservation of energy and linear and angular momentum
- To solve dynamics problems.
- To understand the concept of oscillations.
- To gain the knowledge on elasticity.

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. To enable the students to understand the basic concepts of mechanics
2. To understand the concepts of simple harmonic motion
3. Parameters defining the motion of mechanical systems and their degrees of freedom.
4. Study the interaction of forces between solids in mechanical systems.
5. Application of the vector theorems of mechanics and interpretation of their results.
6. Introduction to analytical mechanics as a systematic tool for problem solving.

**UNIT - I**

**Vectors:** Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. Ordinary Differential Equations: $1^{st}$ order homogeneous differential equations. $2^{nd}$ order homogeneous differential equations with constant coefficients.

**UNIT - II**

**Laws of Motion:** Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.

**UNIT - III**

**Gravitation:** Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Special Theory of Relativity: Constancy of speed of light. Postulates of special theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

**UNIT - IV**

**Oscillations:** Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

**UNIT - V**

**Elasticity:** Hooke's law- Stress-strain diagram - Elastic moduli-Relation between elastic constants- Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants- Work done in stretching & work done in twisting a wire- Twisting couple on a cylinder-Determination of Rigidity modulus by static torsion- Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q, $\eta$ & by Searles method.

**Suggested Readings:**

1. Upadhyaya J.C. (1969), General Properties of Matter, Vol- I., Agra, Ram Prasad & Sons.
2. Mathur D.S. (2014), Mechanics, New Delhi, S. Chand & Co.
3. Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
4. D. S. Mathur "Elements of Properties of Matter" S. Chand & Co.
5. University Physics. FW Sears, MW Zemansky & HD Young 13/e, 1986.Addison-Wesley
6. Mechanics Berkeley Physics course, v.1:Charles Kittel, et.al. 2007, Tata McGraw-Hill
7. Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
8. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
9. https://lecturenotes.in/notes/15822-note-for-mechanics-mech-by-amity-kumar

**SEMESTER – I**

**SOLID STATE PHYSICS** **L T P C**

**17PHU102** **5 - - 5**

**Course Objective:**

- This course integrates theory of Solid State Physics with experimental demonstrations in the Physics Lab.
- The course will provide a valuable theoretical introduction and an overview of the fundamental applications of the physics of solids.
- It includes theoretical description of crystal and electronic structure, lattice dynamics, and optical properties of different materials (metals, semiconductors, dielectrics, magnetic materials and superconductors), based on the classical and quantum physics principles.
- To calculate thermal and electrical properties in the free-electron model.
- To gain a basic knowledge of crystal systems and spatial symmetries.
- To know what phonons are, and be able to perform estimates of their dispersive and thermal properties.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Account for interatomic forces and bonds.
2. Have a basic knowledge of crystal systems and spatial symmetries.
3. Account for how crystalline materials are studied using diffraction, including concepts like form factor, structure factor, and scattering amplitude.
4. Know what phonons are, and be able to perform estimates of their dispersive and thermal properties.
5. Calculate thermal and electrical properties in the free-electron model.
6. Explain superconductivity using BCS theory
7. Outline the importance of solid state physics in the modern society.

**UNIT - I**

**Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis. Unit Cell. Miller Indices. Reciprocal Lattice. Types of Lattices. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg's Law. 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 (qualitative only). $T^3$ law

**UNIT - III**

**Magnetic Properties of Matter:** Dia-, Para-, Ferri- 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. Discussion of B-H Curve. Hysteresis and Energy Loss.

**UNIT - IV**

**Dielectric Properties of Materials:** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons.

**UNIT - V**

**Elementary band theory:** Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient. Superconductivity: Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors.

**Suggested Books**

1. Solid State Physics by S. O. Pillai, New Age Science Publisher, 2010, ISBN - 1906574103, 9781906574109.
2. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
3. Solid State Physics by R. J. Singh, Dorling Kindersley (India) Publisher, 2012, ISPN-978-81-317-5401-6.
4. Solid State Physics by J. R. Hook, H. E. Hall, John Wiley & Sons, Ltd, 2010, ISBN 9780471928041.
5. Solid State Physics, Rita John, 2014, McGraw Hill
6. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

**SEMESTER - I**

**MATHEMATICAL PHYSICS - I** **L T P C**

**17PHU103** **4 - - 4**

**Course Objectives**

- To provide students with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering.
- In addition, intended to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the applied physics
- To communicate mathematical and physical knowledge and ideas to the students.
- To learn the fundamentals and applications of Complex Variable, Analyticity, Cauchy-Riemann and Cauchy's Integral.
- To contribute innovations and application of basic research.
- To get knowledge to find the relationship between observation and theory and their use in building the basic concepts of computing.

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. To communicate mathematical and physical knowledge and ideas to the students.
2. Get introduced to Special functions like Gamma function, Beta function, Delta function, Bessel functions and their recurrence relations
3. Learn the fundamentals and applications of Complex Variable, Analyticity, Cauchy-Riemann and Cauchy's Integral.
4. Build connections between mathematical development and conceptual understanding.
5. Understand the relationship between observation and theory and their use in building the basic concepts of computing.
6. To contribute innovations and application of basic research.

**UNIT - I**

Euler's formula, RK Method (II & IV), Linear interpolation: Newton forward interpolation formula and backward interpolation formula - Bessel's Formula. Interpolation with unequal intervals: Lagrange's interpolation formula.

Trapezoidal rule - Simpson's 1/3 rule and 3/8 rule- Bisection method - method of successive approximations - Regula Falsi method - Newton-Raphson method

**UNIT - II**

**Basic of C language:** Introduction, Data types, Operators and Expressions, Conditional Statements, Input and output Statements (Exclude Program)

**UNIT - III**

**Frobenius Method and Special Functions:** Singular Points of Second Order Linear Differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Properties of Legendre Polynomials: Rodrigues Formula, Orthogonality. Simple recurrence relations.

**UNIT - IV**

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

**UNIT - V**

**Complex Analysis**: Brief revision of Complex numbers & their graphical representation. Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity. Integration of a function of a complex variable. Cauchy's Integral formula.

**SUGGESTED BOOKS:**

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
2. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
3. An Introduction to Ordinary Differential Equations, E.A Coddington, 1961, PHI Learning Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
4. Essential Mathematical Methods, K.F.Riley and M.P.Hobson, 2011, Cambridge University Press.
5. https://nptel.ac.in/courses/115/103/115103036/
6. https://www.physics.uu.se/digitalAssets/405/c_405910-l_1-k_notes_v3_0.pdf

**SEMESTER – I**

**MECHANICS PRACTICAL** **L T P C**

**17PHU111** **- - 2 1**

## Course Objective

1. To impart knowledge on various types of Mechanisms and instruments
2. To impart skills to analyze the position, velocity and acceleration.
3. To understand basic laws governing mechanics of a system.
4. To determine the acceleration due to gravity using various methods.
5. To determine the Moment of Inertia using various methods.
6. To know forces their relationship to engineering applications

### Course Outcomes (COs)

After successful completion of the course, the student is expected to

1. Understand and analyze basic theory and principles of forces in mechanics
2. Forces their relationship to engineering applications
3. Analyze motion, forces and motion, work and energy problems and their relationship to engineering applications
4. To understand basic laws governing mechanics of a system.

## ANY SIX EXPERIMENTS

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Height of a Building using a Sextant.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine g and velocity for a freely falling body using Digital Timing Technique
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g

## Suggested 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. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

**SEMESTER – I**

**SOLID STATE PHYSICS PRACTICAL** **L T P C**

**17PHU112** **- - 2 1**

**Course Objectives:**

- The course is to understand the basic knowledge on magnetic properties of materials.
- To understand the various parameters of the Hysteresis loop
- Acquire the knowledge of semiconducting and dielectric materials.
- To comprehend the concepts of superconductivity and magnetic properties of solids.
- To verify the dielectric constant of a material by experimentally.
- To understand the importance of new materials in modern technology.

**Course Outcome:**

After successful completion of the course, the student is expected to

1. Basic practical knowledge on magnetic materials.
2. Understand the basic idea about the dielectric Properties of Solids
3. Experience the behavior of Hysteresis loop of a crystal.
4. Measure the suceptability of magnetic materials.
5. Verify the dielectric constant of a material by experimentally.
6. Understand the importance of new materials in modern technology.

**ANY SIX EXPERIMENTS**

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon resonance (SPR) technique.
6. To determine the refractive index of a dielectric layer using SPR technique.
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature (up to $150^{o}$C) by four-probe method and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

**Suggested 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. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India

**SEMESTER – I**

**MATHEMATICAL PHYSICS PRACTICAL I** **L T P C**

**17PHU113** **- - 4 2**

**Course Objectives**

- To provide students with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering.
- In addition, intended to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the applied physics
- To communicate mathematical and physical knowledge and ideas to the students.
- To demonstrate the utility and limitations of a variety of powerful calculational techniques and to provide a deeper understanding of the mathematics underpinning theoretical physics.
- To find the solution through programming languages.
- To write the coding for physical problems

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. communicate mathematical and physical knowledge and ideas to the students.
2. demonstrate the utility and limitations of a variety of powerful calculation techniques
3. provide a deeper understanding of the mathematics underpinning theoretical physics.
4. Write algorithm of numerical problems.
5. Analytical thinking and correlation of the problems.
6. Understand the interpretation of physical problems.

**ANY SIX EXPERIMENTS**

| Topics | Descriptions with Applications |
|---|---|
| Introduction and Overview | Computer architecture and organization, memory and Input/output devices |
| Basics of scientific computing algorithms, Sequence, Selection and | Binary and decimal arithmetic, Floating point numbers, Repetition, single and double precision arithmetic, underflow and overflow - emphasize the importance of making equations in terms of dimensionless variables, Iterative methods |
| Errors and error Analysis | Truncation and roundoff errors, Absolute and relative errors, Floating point computations |
| | Introduction to Programming, constants, variables and data types, operators and Expressions, I/O |

| | |
|---|---|
| Review of C & C++ Programming fundamentals | statements, scanf and printf, cin and cout ,Manupulators for data formatting, Control statements (decision making and looping statements) *( if-statement, if-else statement, nested if statement, else-if statement, ternary operator, goto statement, switch statement, unconditional and conditional looping, while and do while loop, for loop,nested loops, break and continue statements*). Arrays (1D and 2D)and strings, user defined functions, Structures and Unions, Idea of classes and objects |
| Programs: using C/C++ language | Sum and average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search |
| Random number generation | Area of circle, area of square, volume of sphere, value of pi |
| Solution of Algebraic and Transcendental equations by Bisection, Newton Raphson and Secant methods | Solution of linear and quadratic equation, solving |
| Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation | Evaluation of trigonometric functions e.g. *sin* , *cos* , *tan* etc |
| Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules), Monte Carlo method | Given Position with equidistant time data calculate velocity and acceleration and vice versa. Find the area of BH Hysteresis loop |
| Solution of Ordinary Differential Equations (ODE) First order Differential | First order differential equation<br>Radioactive decay<br>Current in RC, LC circuits with DC source |

| | |
|---|---|
| equation Euler, modified Euler and Runge-Kutta (RK) second and fourth order methods | Newton's law of cooling<br>Classical equations of motion |

**Suggested Books**


1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw- Hill Pub.
2. Numerical Recipes in C++: The Art of Scientific Computing, W.H. Press et.al., 2nd Edn., 2013, Cambridge University Press.
3. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
4. An Introduction to computational Physics,T.Pang,2nd Edn., 2006,CambridgeUniv. Press

**SEMESTER – II**

**17LSU201 தமிழ் இரண்டாம் தாள் L T P C**

**(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)** 4 - - 4

**பாடத்திட்டப் பொதுநோக்கம்**

- கற்றல் வழி சிந்தனைத் திறனையும், கருத்து வெளிப்பாட்டுத் திறனையும், மேம்படுத்துதல்.
- ஆய்வுநோக்கை மேம்படுத்துதல்.
- இலக்கியங்கள் உணர்த்தும் வாழ்வின் நுட்பமான பகுதிகளை உணர்த்துதல்.
- மனித மனத்தினைப் பக்குவப்படுத்துதலில் இலக்கியம் தரும் பங்கினை உணர்த்துதல்.
- வளர்ந்து வரும் சமூகத்தில் அறஉணர்வு, பண்பாடு போன்றவை குறித்து அறிவூட்டல்.
- அரசுத் தேர்வுகளுக்கு மாணவர்களை ஆயத்தமாக்குதல்.

**பாடத்திட்டப் பயன் விளைவு**

1. இந்திய குடியுரிமைப் பணி முதலான போட்டித் தேர்வுகளில், விருப்பப் பாடமாக இடம்பெறுகின்ற, 'தமிழ் இலக்கிய வரலாறு' குறித்த முழுமையான அறிமுகம் பெற்றிருத்தல்.
2. கல்வெட்டியல், ஓலைச்சுவடியியல் மற்றும் தொல்லியல் சார்ந்த ஆவணத் தேடலுக்குரிய ஆய்வுமனப்பான்மையுடன், இலக்கியங்களை அணுகுதல்.
3. தமிழின் வளர்ச்சித் துறையாகிய, 'அறிவியல் தமிழ்' ; 'இணைய தமிழ்' குறித்த பன்நோக்கு அணுகுமுறையிலான ஆய்வுச் சிந்தனை மேம்பாடு.
4. வேலைவாய்ப்புக்குரிய சுயதிறன் மேம்பாட்டுடன், படைப்பாக்கத்திறன் மேம்பாடும் பெற்றிருத்தல் .
5. சமுதாய மற்றும் வாழ்வியல் மதிப்புகளைப் பேணுவதற்குக் கருவியாக இலக்கியங்களை நாடுகின்ற மனப்பான்மை வளர்ச்சி.
6. மொழிபெயப்புத் துறைசார்ந்த வேலைவாய்புத் திறன் பெற்றிருத்தல்

## அலகு – I : பக்தி இலக்கியம் (10 மணிநேரம்)

சைவ, வைணவ இலக்கியங்கள் - தோற்றம் ,வளர்ச்சி, வரலாறு.

**1. சைவம்** - பெரியபுராணம் - திருமூலநாயனார் புராணம்.

**2. வைணவம்** - பெரியாழ்வார் திருமொழி: 10 பாடல்கள்.

**அலகு – II : சங்க இலக்கியம் : (15 மணிநேரம்)**

சங்க இலக்கியங்கள் அறிமுகம்

அ). **எட்டுத்தொகை**

**நற்றிணை :** பிரசம் கலந்த – பாலை -110

**குறுந்தொகை :** கருங்கட்டாக் கலை – குறிஞ்சி- 69

**ஐங்குறுநூறு :** நெய்தல்-தொண்டிப்பத்து:

திரைஇமிழ் இன்னிசை-171

**பதிற்றுப்பத்து :** சிதைந்தது மன்ற - 27

**பரிபாடல்:** பரிபாடல் திரட்டு-மதுரை நகர்ச்சிறப்பு –உலகம் ஒரு நிறையாத்தான்-6, மாயோன் கொப்பூழ்-7, செய்யாட்கு இழைத்த-9, கார்த்திகை காதில்-10, ஈவாரைக் கொண்டாடி-11.

**கலித்தொகை :** சுடர்தொடீ கேளாய்: குறிஞ்சிக்கலி- 36

**அகநானூறு :** அன்னாய் வாழி வேண்டன்னை - குறிஞ்சி - 48

**புறநானூறு :** யாதும் ஊரே யாவருங் கேளிர் –பொதுவியல்- 192

ஆ). **பத்துப்பாட்டு**

திருமுருகாற்றுப்படை - பழமுதிர்ச்சோலையின் சிறப்பு முருகன் இருப்பிடங்கள் – 'சிறுதினை மலரொடு' என்பதிலிருந்துதொடங்கி, 'அறிந்தவாறே' என்பது வரையிலான தொடர்கள்: 218-249.

முருகன் அருள்புரிதல் – 'தெய்வம் சான்ற' என்பதிலிருந்து தொடங்கி, 'நல்குமதி' என்பது வரையிலான தொடர்கள்: 286-295.

**அலகு - III : காப்பியம் (6 மணிநேரம்)**

சிலப்பதிகாரம்:

மங்கல வாழ்த்துப் பாடல்: **(21-29)** – கண்ணகியின் சிறப்பு: 'நாகநீள் நகரொடு' என்பதிலிருந்து தொடங்கி, 'கண்ணகி என்பாண் மன்னோ' என்பது வரையிலான தொடர்கள்.

நடுகற்காதை: **(207-234)** - சேரன் செங்குட்டுவன் கண்ணகிக்குக் கோயில் எடுத்தல்: 'அருந்திறலரசர்' என்பதிலிருந்து தொடங்கி, 'மன்னவரேறென்' என்பது வரையிலான தொடர்கள்.

வாழ்த்துக்காதை: **(482-485)** - செங்குட்டுவனுக்குக் கண்ணகி காட்சியளித்தல்: 'என்னே' என்பதிலிருந்து தொடங்கி, 'விசும்பில் தோன்றுமால்' என்பது வரையிலான தொடர்கள்.

வழக்குரை காதை: பத்தினிப் பெண்டிர் எழுவர் கதை: 'நீர்வார் கண்ணை' என்பதிலிருந்து தொடங்கி, 'புகாரென் பதியே' என்பது வரையிலான தொடர்கள்.

வஞ்சினமாலை: 'வன்னி மரமும்' என்பதிலிருந்து தொடங்கி, 'பதிப்பிறந்தேன்' என்பது வரையிலான தொடர்கள்.

**அலகு – IV : சிறுகதை** **(10 மணிநேரம்)**

1. **குளத்தங்கரை அரசமரம் – வ.வே.சு.ஐயர்**
2. காட்டில் ஒரு மான் - அம்பை
3. நாற்காலி – கி.ராஜநாராயணன்
4. **நகரம் – சுஜாதா**

**அலகு- V : மொழிப்பயிற்சி** **(7 மணிநேரம்)**

படைப்பிலக்கியப் பயிற்சிகள் (கதை, கவிதை, கட்டுரை, உரைநடை)

மொழிபெயர்ப்பு

**பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.** கற்பகம் பல்கலைக்கழகத் தமிழ்த் துறை வெளியீடு.

**SEMESTER – II**

**ELECTRICITY AND MAGNETISM** **L T P C**

**17PHU201** **5 - - 5**

**Course Objectives**

- To establish grounding in electromagnetism in preparation for more advanced courses.
- The major concepts covered are: the abstraction from forces to fields using the examples of the gravitational, electric and magnetic fields, with some applications; the connection between conservative forces and potential energy; how charges move through electric circuits; the close connection between electricity and magnetism, leading to the discovery of electromagnetic waves.
- To use electromagnetic theory and principles in a wide range of applications.
- To understand the calculus along with physical principles
- To effectively solve problems encountered in everyday life, further study in science, and in the professional world.
- To gain confidence in their ability to apply mathematical methods to understand electromagnetic problems to real-life situations.

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. Apply knowledge of electricity and magnetism to explain natural physical processes and related technological advances.
2. Gain confidence in their ability to apply mathematical methods to understand electromagnetic problems to real-life situations.
3. Use an understanding of calculus along with physical principles to effectively solve problems encountered in everyday life, further study in science, and in the professional world.
4. Be able to use electromagnetic theory and principles in a wide range of applications.
5. Design experiments and acquire data in order to explore physical principles, effectively communicate results, and critically evaluate related scientific studies.
6. To develop an understanding of the principles of electricity and magnetism.

**UNIT – I**

**Electrostatics:** Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.

**UNIT - II**

Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

**UNIT - III**

**Magnetostatics**: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferro-magnetic materials.

**UNIT – IV**

**Electromagnetic Induction**: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

**UNIT – V**

**Maxwell`s equations and Electromagnetic wave propagation**: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

**Suggested Books:**

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
2. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
3. D.J.Griffiths, Introduction to Electrodynamics, 3rd Edn, 1998, Benjamin Cummings.
4. D Halliday, R Resnick and J Walker, Fundamentals of Physics (Extended) 6th ed., John Wiley, 2001.
5. https://ocw.mit.edu/courses/physics/8-02t-electricity-and-magnetism-spring-2005/lecture-notes/
6. https://cpb-us-e1.wpmucdn.com/cobblearning.net/dist/e/1364/files/2014/03/Magnets-webquest-answers-2jdthlu.pdf

**SEMESTER II**

**ANALOG SYSTEMS AND APPLICATIONS** **L T P C**

**17PHU202** **5 - - 5**

**Course Objectives**

- The objective of this paper is to give information about different analog electronic circuits and their applications.
- To understand operation of semiconductor devices.
- To understand DC analysis and AC models of semiconductor devices.
- To implement mini projects based on concept of electronics circuit concepts.
- To apply concepts for the design of Regulators and Amplifiers.
- To verify the theoretical concepts through laboratory and simulation experiments.

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. To apply concepts for the design of Regulators and Amplifiers.
2. Acquire knowledge about how a semiconductor diode rectifies an input ac signal
3. To verify the theoretical concepts through laboratory and simulation experiments.
4. Be able to know about the Field Effect Transistors, their principles and applications
5. Learn how to construct a transistor amplifier and how its gain varies with frequency
6. To implement mini projects based on concept of electronics circuit concepts.

**UNIT- I**

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

**UNIT -II**

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

**Bipolar Junction transistors:** n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Active, Cutoff and Saturation Regions. **(6 Lectures)**

**UNIT- III**

**Amplifiers:** Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage

CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers. Coupled Amplifier: Two stage RC-coupled amplifier and its frequency response.

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

**UNIT- IV**

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

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

**UNIT -V**

**Applications of Op-Amps:** Inverting and non-inverting amplifiers, Adder, Subtractor, Differentiator, Integrator, Log amplifier, Zero crossing detector, Wein bridge oscillator. **Conversion:** Resistive network (Weighted and R-2R Ladder). Accuracy and Resolution. A/D Conversion (successive approximation)

**Suggested Books:**

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
4. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
5. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
6. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
7. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
8. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
9. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning Electronic Devices, 7/e Thomas L. Floyd, 2008

**SEMESTER II**

**MATHEMATICAL PHYSICS – II** **L T P C**

**17PHU203** **4 - - 4**

**Course Objectives**

- To provide students with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering.
- In addition, intended to prepare the student with mathematical tools and techniques that are required in advanced courses offered in the applied physics.
- To contribute innovations and application of basic research.
- To communicate mathematical and physical knowledge and ideas to the students.
- To build connections between mathematical development and conceptual understanding.
- To get introduced to Special functions like Gamma function, Beta function, Delta function, Bessel functions and their recurrence relations

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. To communicate mathematical and physical knowledge and ideas to the students.
2. Get introduced to Special functions like Gamma function, Beta function, Delta function, Bessel functions and their recurrence relations
3. Learn the fundamentals and applications of Complex Variable, Analyticity, Cauchy-Riemann and Cauchy's Integral.
4. Build connections between mathematical development and conceptual understanding.
5. Understand the relationship between observation and theory and their use in building the basic concepts of computing.
6. To contribute innovations and application of basic research.

**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.

**UNIT- II**

**Special Functions**: 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.

**UNIT -III**

Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x))and Orthogonality.

**UNIT -IV**

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

**Theory of Errors:** Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Least-squares fit. Error on the slope and intercept of a fitted line.

**UNIT -V**

**Partial Differential Equations**: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string, rectangular and circular membranes. Diffusion Equation.

**Suggested Books:**

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
7. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books

**SEMESTER – II**

**ELECTRICITY AND MAGNETISM PRACTICAL L T P C**

**17PHU211 - - 2 1**

## Course Objectives

- To establish grounding in electromagnetism in preparation for more advanced courses.
- Assess the contributions of physics to our evolving understanding of global change and sustainability while placing the development of physics in its historical and cultural context.
- To gain practical knowledge on RC Circuit
- To develop skills in the basic concept of electric forces.
- To understand Gauss law and its applications.
- To gain practical knowledge on magnetic moment.

### Course Outcomes (COs)

After successful completion of the course, the student is expected to

1. To gain practical knowledge on RC Circuit
2. Develop skills in the basic concept of electric forces.
3. To understand Gauss law and its applications.
4. To gain practical knowledge on magnetic moment.
5. Determine a Low Resistance by Carey Foster's Bridge
6. Compare capacitances using De'Sauty's bridge

## ANY SIX EXPERIMENTS

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
    i. Measurement of charge and current sensitivity
    ii. Measurement of CDR
    iii. Determine a high resistance by Leakage Method
    iv. To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B & its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit and determine its (a) Resonant Frequency, (b) Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorem
10. To verify the Superposition, and Maximum Power Transfer Theorem

**Suggested Books**

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

**SEMESTER II**

**ANALOG SYSTEMS AND APPLICATIONS PRACTICAL** **L T P C**

**17PHU212** **- - 2 1**

## Course Objectives

- The objective of this paper is to give information about different analog electronic circuits and their applications.
- To understand operation of semiconductor devices.
- To study the characteristics of a Bipolar Junction Transistor in CE configuration.
- To study the various biasing configurations of BJT for normal class A operation.
- To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
- To design an inverting amplifier using Op-amp for dc voltage circuits

### Course Outcomes (COs)

After successful completion of the course, the student is expected to

1. Understand the basics of diode
2. Analyse the characteristics of Bipolar Junction Transistor
3. Perform the procedures for the working of RC-coupled transistor
4. Analyse the relationship between V-I & power curves
5. Understand the applications of Op-amp
6. Develop the ability to analyze and design analog electronic circuits using discrete components.
7. Acquire a basic knowledge in solid state electronics including diodes, MOSFET, BJT, and operational amplifier.

## Any 6 experiments

1. To study V-I characteristics of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
8. To design a Wien bridge oscillator for given frequency using an op-amp.
9. To design a phase shift oscillator of given specifications using BJT.
10. To study the Colpitt`s oscillator.
11. To design a digital to analog converter (DAC) of given specifications.
12. To study the analog to digital convertor (ADC) IC.
13. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain

14. To design inverting amplifier using Op-amp (741,351) and study its frequency response
15. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
16. To study the zero-crossing detector and comparator
17. To add two dc voltages using Op-amp in inverting and non-inverting mode
18. To design a precision Differential amplifier of given I/O specification using Op-amp.
19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.
21. To design a circuit to simulate the solution of a $1^{st}/2^{nd}$ order differential equation.

**Suggested Books:**

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

**SEMESTER II**

**MATHEMATICAL PHYSICS PRACTICAL – II** **L T P C**

**17PHU213** **- - 4 2**

**Course Objectives**

This course enables the students to learn

- To solve simultaneous linear algebraic equations using various methods.
- To evaluate definite integrals using numerical techniques.
- To problem-solving through (computer language) programming.
- To write the coding for physical problems
- To solve complex problems through modeling.
- To find the solution for given problems through computer programming.

**Course Outcomes (COs)**

On Successful completion of this course, the student will be able to

1. Familiarize with the programming environment for numerical methods.
2. Develop proficiency in skills to solve the algebraic equations.
3. Evaluate the definite integrals using computer programming techniques
4. Find the solution through programming.
5. Write the coding for physical problems
6. Solve complex problems through modeling.

**Introduction to Numerical computation software Scilab**

Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising, variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar, and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting, 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 User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program.

**Curve fitting, Least square fit**:

Goodness Ohms law to calculate R, Hooke's law to calculate spring of fit, standard deviation constant

**Solution of Linear system of equations**

Solution of mesh equations of electric circuits (3 meshes), by Gauss elimination method and Gauss, Seidal method. Diagonalization of Solution of coupled spring mass systems (3 masses matrices, Inverse of a matrix, Eigen vectors, eigen values problems

**Generation of Special functions using User defined functions in Scilab**
Generating and plotting Legendre Polynomials Generating and plotting Bessel function

**Solution of ODE** First order differential equation
**First order Differential equation Euler, modified Euler and Runge-Kutta second order methods:** Newton's law of cooling, Classical equations of motion
**Second order differential equation, Fixed difference method:** Second order Differential Equation Harmonic oscillator (no friction) Damped Harmonic oscillator Over damped, Critical damped, Oscillatory, Forced Harmonic oscillator, Transient and Steady state solution

**Suggested Books:**

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3rd ed., 2006, Cambridge University Press
2. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett
4. Computational Physics, D.Walker, 1st Edn., 2015, Scientific International Pvt. Ltd.
5. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
6. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer Scilab by example: M. Affouf 2012, ISBN: 978-1

**SEMESTER - II**

**ENVIRONMENTAL STUDIES** **L T P C**

**17AEC201** **4 - - 4**

**Course Objectives**

- To create the awareness about environmental problems among people.
- To develop an attitude of concern for the environment.
- To motivate public to participate in environment protection and improvement.
- To understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
- To apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- To gain knowledge on environmental issues.

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
7. Demonstrate proficiency in quantitative methods, qualitative analysis, critical thinking, and written and oral communication needed to conduct high-level work as interdisciplinary scholars and / or practitioners.

**UNIT-I**

**Environment:** Definition, scope and importance, components, Ecosystem Definition, Concept, Scope, importance, Structure and functions of ecosystem. Energy flow, Ecological succession Food chains and food webs. Classification of ecosystem.

**UNIT -II**

**Natural Resources**

**Renewable and Non-renewable Resources:** Natural resources and associated problems. Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources: Use and over-utilization, exploitation. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Fire accidents and prevention.

**UNIT -III**

**Biodiversity and Its Conservation:** Introduction, definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

**UNIT- IV**

**Environmental Pollution:** Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Diaster management: Foods, earthquake, cyclone and landslides.

**UNIT -V**

**Social Issues and the Environment:** From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Resettlement and rahabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health. Human rights. Value education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in environment and human health.

**Suggested Books**

1. Tripathy.S.N. & Sunakar Panda. (2004). Fundamentals of Environmental Studies. 2nd Edition. New Delhi: Vrianda Publications Private Ltd.
2. Arvind Kumar . (2004). A Textbook of Environmental Science. New Delhi: APH Publishing Corporation.
3. Verma P.S., & .Agarwal. V.K. (2001). Environmental Biology:Principles of Ecology. New Delhi: S.Chand and Company Ltd.
4. Anubha Kaushik, C.P. & Kaushik, (2004). Perspectives in Environmental Studies. New Delhi: New Age International Pvt. Ltd. Publications.
5. Singh, M.P., Singh, B.S. & Soma S. Dey, (2004). Conservation of Biodiversity and Natural Resources. Delhi: Daya Publishing House.
6. Daniel B.Botkin & Edward A.Keller. (1995). Environmental Science. NewYork: John Wiley and Sons, Inc.
7. Uberoi, N.K., (2005). Environmental Studies, New Delhi, India: Excel Books Publications.

**SEMESTER - III**

**THERMAL PHYSICS & STATISTICAL MECHANICS L T P C**

**17PHU301 4 - - 4**

**Course Objectives**

- The objective of this course is to give awareness on different laws of thermodynamics and its effect on different aspects in life.
- The aim of statistical mechanics is to give knowledge on the laws of classical thermodynamics for macroscopic systems using the properties of its atomic particles.
- To apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.
- To apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.
- To give knowledge on the statistical mechanics and explain the applications of thermodynamics.
- To provide the correlation of thermodynamical problems with statistical concepts.

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. Identify and describe the statistical nature of concepts and laws in thermodynamics, in particular: entropy, temperature, chemical potential, Free energies, partition functions.
2. Realize the importance of Thermo dynamical functions and their applications.
3. Statistical physics methods, such as Boltzmann distribution, Gibbs distribution, Fermi-Dirac and Bose-Einstein distributions to solve problems in some physical systems.
4. Become familiar with various thermodynamic process and work done in each of these process.
5. Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.
6. Apply the concepts and laws of thermodynamics to solve problems in thermodynamic systems such as gases, heat engines and refrigerators etc.

**UNIT - I**

**Laws of Thermodynamics:** Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, Applications of First Law: General Relation between $C_P$ and $C_V$, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law, Entropy, Carnot's cycle & theorem, Entropy changes in reversible and irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

**UNIT - II**

**Thermodynamic Potentials:** Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for ($C_P - C_V$), $C_P/C_V$, TdS equations.

**UNIT - III**

**Kinetic Theory of Gases**: Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

**UNIT - IV**

**Statistical Mechanics:**Introduction – Liouville's theorem – Measurement of macro-properties of a thermodynamic system – Ensemble – Microcanonical and Canonical ensembles – Entropy of an ideal gas – microcanonical ensemble – Application of Gibbs canonical ensembles – Fluctuations in thermodynamic variables – Stirling's approximation or Stirling's formula – Relation between entropy and probability – Boltzman theorem.

**UNIT – V**

**Statistical Mechanics:** Phase space, Macrostate Thermodynamic probability, Maxwell-Boltzmann Quantum statistics, Fermi-Dirac distribution law, comparison of three statistics. and Microstate, Entropy and law, distribution of velocity, Bose-Einstein distribution law.

**Suggested Books:**

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
2. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears and G.L.Salinger. 1988, Narosa
3. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
4. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications.
5. https://study.com/academy/lesson/introduction-to-thermal-physics.html.
6. https://farside.ph.utexas.edu/teaching/sm1/Thermal.pdf

**SEMESTER – III**

**PHYSICS OF DEVICES AND COMMUNICATION L T P C**

**17PHU302 4 - - 4**

**Course Objective**

- To know about power semiconductor devices frequently used in industries.
- To have an idea about the principle and operation of circuits using semiconductor devices to control various operations.
- To acquaint with industrial and domestic applications of power semiconductor devices.
- To understand the concepts of electronic devices and their communication systems.
- To develop their knowledge on digital communication technology.
- To design the electronic circuits and their block diagrams with number of different electronic components.

**Course outcomes**

After successful completion of the course, the student is expected to

1. Understand the construction and working of different semiconductor devices.
2. Study about Basics electronics Technology
3. Develop explicit problem-solving strategies that emphasize qualitative analysis steps to describe and clarify the problem.
4. Develop knowledge on design trade-offs in various digital electronic families with a view towards reduced power consumption
5. Realize the importance of different electronic communication systems.
6. Design power electronic circuit for real time application like rectifier and convertor etc.

**UNIT-I**

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

**UNIT -II**

**Power supply and Filters:** Block Diagram of a Power Supply, Qualitative idea of C and L Filters. IC Regulators, Line and load regulation, Short circuit protection. Active and Passive Filters, Low Pass, High Pass, Band Pass and band Reject Filters.

Multivibrators: Astable and Monostable Multivibrators using transistors.

**UNIT- III**

**Phase Locked Loop (PLL):** Basic Principles, Phase detector (XOR & edge triggered), Voltage Controlled Oscillator (Basics, varactor). Loop Filter– Function, Loop Filter Circuits, transient response, lock and capture. Basic idea of PLL IC (565 or 4046).

**Processing of Devices:** Basic process flow for IC fabrication, Electronic grade silicon. Crystal plane and orientation. Defects in the lattice. Oxide layer. Oxidation Technique for Si. Metallization technique. Positive and Negative Masks. Optical lithography. Electron lithography. Feature size control and wet anisotropic etching. Lift off Technique. Diffusion and implantation.

**UNIT- IV**

**Digital Data Communication Standards:** Serial Communications: RS232, Handshaking, Implementation of RS232 on PC. Universal Serial Bus (USB): USB standards, Types and elements of USB transfers. Devices (Basic idea of UART). Parallel Communications: General Purpose Interface Bus (GPIB), GPIB signals and lines, Handshaking and interface management, Implementation of a GPIB on a PC. Basic idea of sending data through a COM port.

**UNIT-V**

**Introduction to CRO:** Block Diagram of CRO. Applications of Oscilloscope: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency and Phase Difference.

**Power Supply:** Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, Zener Diode and Voltage Regulation Timer IC: IC 555 Pin diagram and its application as Astable and Monostable Multivibrator.

**Suggested Books:**

1. Physics of Semiconductor Devices, S.M. Sze & K.K. Ng, 3rd Ed.2008, John Wiley & Sons
2. Electronic devices and integrated circuits, A.K. Singh, 2011, PHI Learning Pvt. Ltd.
3. Op-Amps & Linear Integrated Circuits, R.A.Gayakwad,4 Ed. 2000,PHI Learning Pvt. Ltd
4. Electronic Devices and Circuits, A. Mottershead, 1998, PHI Learning Pvt. Ltd.
5. Electronic Communication systems, G. Kennedy, 1999, Tata McGraw Hill.
6. Introduction to Measurements & Instrumentation, A.K. Ghosh, 3rd Ed., 2009, PHI Learning Pvt. Ltd.
7. Semiconductor Physics and Devices, D.A. Neamen, 2011, 4th Edition, McGraw Hill
8. PC based instrumentation; Concepts & Practice, N.Mathivanan, 2007, Prentice-Hall of India.
9. https://www.electronics-tutorials.ws/
10. https://www.electrical4u.com/

**SEMESTER III**

**ELECTROMAGNETIC THEORY** **L T P C**

**17PHU303** **4 - - 4**

**Course Objective**

The aim and objective of the course

- The aim of this course is to provide the students with the fundamental principles of electrical energy (electro- magnetism).
- It is very important to understand the propagation of waves in different media, its transmission and reception.
- To understand the relation between electric and magnetic fields.
- To gain the knowledge on electromagnetic wave propagations.
- To describe simple models for electromagnetic interaction with media
- To experience the wave propagation in different media.

**Course Outcome**

After successful completion of the course, the student is expected to

1. calculate electric and magnetic fields from stationary and dynamic charge and current distributions.
2. Be able to use electromagnetic wave theory and principles in a wide range of applications.
3. Gain confidence in their ability to apply mathematical methods to understand electromagnetic problems to real-life situations.
4. Solve simple electrostatic boundary problems.
5. Describe simple models for electromagnetic interaction with media
6. Choose adequate models and solution methods for specific problems.

**UNIT- I**

**Maxwell Equations:** Review of Maxwell's equations. Displacement Current. Vector and Scalar Potentials. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media. 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. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

**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, evanescent waves. Metallic reflection (normal Incidence).

**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

**UNIT -V**

**Wave Guides:** Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.

**Optical Fibres:-** Numerical Aperture. Step and Graded Indices (Definitions Only).
Single and Multiple Mode Fibres (Concept and Definition Only).

**SUGGESTED BOOKS**


1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
7. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
8. https://fas.org/man/dod-101/navy/docs/es310/propagat/Propagat.htm
9. https://www.olympus-lifescience.com/en/microscope-resource/primer/java/polarized light/emwave/.
10. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/#:~:text=Electromagnetic%20Theory%20covers%20the%20basic,magnetic%20properties%20of%20matter%2C%20and

**SEMESTER – III**

**RENEWABLE ENERGY AND ENERGY HARVESTING L T P C**

**17PHU304A 3 - - 3**

**Course Objective**

- To understand the various forms of conventional energy resources.
- To learn the present energy scenario and the need for energy conservation
- To explain the concept of various forms of renewable energy
- Give outline division aspects and utilization of renewable energy sources for both domestics and industrial application.
- To provide the awareness and need of renewable energy.
- To describe the uses, needs and applications of various renewable energy sources.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Describe the environmental aspects of non-conventional energy resources. In Comparison with various conventional energy systems, their prospects and limitations.
2. Understand the concept of hydro energy resources and their classification.
3. Describe the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, power generation, drying, cooking etc.
4. Appreciate the need of Wind Energy and the various components used in energy generation and know the classifications.
5. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications.
6. Compare Solar, Wind and bio energy systems, their prospects, Advantages and limitations.

**UNIT -I**

**Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, solar energy, biomass, biochemical conversion, biogas generation,

**UNIT- II**

**Solar energy:** Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

**UNIT -III**

**Wind Energy harvesting:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies. Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

**UNIT - IV**

**Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Pezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

**UNIT - V**

**Electromagnetic Energy Harvesting:** Linear generators, physics mathematical models, recent applications, Geothermal Energy: Geothermal Resources, Geothermal Technologies. Carbon captured technologies, cell, batteries, power consumption, Environmental issues and Renewable sources of energy, sustainability.

**Suggested Books:**

1. Non-conventional energy sources, B.H. Khan, McGraw Hill
2. Solar energy, Suhas P Sukhative, Tata McGraw - Hill Publishing Company Ltd.
3. Renewable Energy, Power for a sustainable future, Godfrey Boyle, 3rd Edn., 2012, Oxford University Press.
4. Renewable Energy, 3rd Edition,
5. Solar Energy: Resource Assesment Handbook, P Jayakumar, 2009
6. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA).
7. https://www.edfenergy.com/for-home/energywise/renewable-energy-sources
8. https://www.nrdc.org/stories/renewable-energy-clean-facts
9. https://www.nationalgeographic.com/environment/energy/reference/renewable-energy/

**SEMESTER – III**

| | | |
|---|---|---|
| | **PHYSICS WORKSHOP SKILL** | **L T P C** |
| **17PHU304B** | | **3 - - 3** |

**Course Objectives**:

The objective of this course is

- To enable the students to familiar and experience with various mechanical and electrical tools through hands-on mode.
- To extend their skill on workshop tools and their usages.
- To apply their knowledge on making new materials by using various operating machines.
- To develop their knowledge about household electrical appliances, electric shock, etc.
- To use their knowledge towards industries.
- To think and correlate the physics of engineering materials and their applications.

**Course outcome**

After successful completion of the course, the student is expected to

1. Acquire knowledge about various types of wiring systems, wiring tools, lighting & wiring accessories, wiring estimation & costing, etc.
2. To get familiarized with the welding process.
3. Understand the concept of machining, forming and welding process.
4. Develop knowledge on Operation of oscilloscope.
5. Acquire knowledge about household electrical appliances, electric shock, etc.
6. To get familiarized with the properties of different materials- metals and non metals

**UNIT -I**

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

**UNIT -II**

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

**UNIT- III**

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

**UNIT -IV**

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

**UNIT -V**

**Introduction to prime movers**: Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever. braking systems, pulleys, working principle of power generation systems. Demonstration of pulley experiment.

**Suggested Books:**

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

**SEMESTER – III**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **17PHU311** | **THERMAL PHYSICS AND STATISTICAL MECHANICS PRACTICAL** | **-** | **-** | **4** | **2** |

**Course Objectives**

- The objective of this course is to learn how to apply thermodynamic principles in order to interpret thermodynamic systems and predict their behaviors.
- To determine Stefan's Constant.
- To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
- To apply the theoretical knowledge into the experiments and find the solutions.
- To apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.
- To experience the practical difficulties to find the physical constant values.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Understand the process of thermal conductivity, viscosity and diffusion in gases
2. Able to correlate theory and practical.
3. Understand the basic thermal properties via experiments.
4. Verify the Newton's law.
5. Analyse the characteristics of Bipolar Junction Transistor
6. Understand the applications of thermal condunduction materials.
7. Apply the laws of thermodynamics to real physical systems and processes.
8. Apply the concepts and principles of black-body radiation to analyze radiation phenomena in thermodynamic systems.

**Any 8 Experiments**

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
5. To determine the Coefficient of Thermal conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

**Suggested Books**

1. Advanced Practical Physics for students, B.L. Flint & 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, Indu Prakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi.
4. A Laboratory Manual of Physics for Undergraduate Classes, D.P.Khandelwal, 1985, Vani Publication.

**SEMESTER III**

| | | L | T | P | C |
|---|---|---|---|---|---|
| | **PHYSICS OF DEVICES AND COMMUNICATION** | | | | |
| **17PHU312** | **PRACTICAL** | **-** | **-** | **4** | **2** |

**Course Objective**

- To know about semiconductor devices frequently used in industries.
- To acquaint industrial and domestic applications of semiconductor devices.
- To experience the practical difficulties to find the physical constant values.
- To apply the theoretical knowledge into the experiments and find the solutions.
- To understand operation of diodes, transistors in order to design basic circuits.
- To design, fabricate and test the different electronic circuit.

**Course Outcome**

After successful completion of the course, the student is expected to

1. By the end of this subject, students should have acquired reasonable proficiency in the analysis and design of basic electronic circuits.
2. Apply the concepts of basic electronic devices to design various circuits.
3. Understand operation of diodes, transistors in order to design basic circuits.
4. Design small and large signal amplifier circuits for various practical applications.
5. The course as a whole outline some ways of thinking about analog circuits that hopefully will help to develop intuition.
6. Design, fabricate and test small electronic circuit.

**Any 8 Experiments**

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

**SUGGESTED BOOKS**

1. Ouseph C.C., U.J. Rao and V. Vijayendran 2007, PRACTICAL Physics and Electronics, S. Viswanathan (Printers & Publishers) Pvt. Ltd., Chennai
2. Singh S.P., 2003, Advanced PRACTICAL Physics – 1, 13th Edition, Pragathi Prakashan, Meerut
3. Singh S.P., 2000, Advanced PRACTICAL Physics – 2, 12th Edition, Pragathi Prakashan, Meerut
4. Ramakant A. Gayakwad, 2002, Op-amp and Linear Integrated Circuits, 4th Edition, Prentice Hall

**SEMESTER III**

**ELECTROMAGNETIC THEORY PRACTICAL L T P C**

**17PHU313 - - 4 2**

**Course Objective**

- The aim of this course is to provide the students by correlating the fundamental principles of electrical energy (electro- magnetism) practically.
- To experience the practical difficulties to find the physical constant values.
- To apply the theoretical knowledge into the experiments and find the solutions.
- To find the value of Boltzman constant.
- To calculate the wavelength and velocity of ultrasonic waves in a liquid by studying the diffraction through ultrasonic grating.
- To differentiate the experimental issues with theoretical aspects.

**Course Outcome**

After successful completion of the course, the student is expected to

1. find electric and magnetic fields from stationary and dynamic charge and current distributions.
2. Describe simple models for electromagnetic interaction with media
3. Be able to choose adequate models and solution methods for specific problems.
4. Operate the polarimeter to find the polarization behavior of liquid and crystalline materials.
5. Calculate the wavelength of monochromatics source Young's double slit method.
6. Verify the Faraday's law of electromagnetism.

**Any 8 experiments**

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

**Suggested Books**

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

**SEMESTER – III**

| | | L | T | P | C |
|---|---|---|---|---|---|
| | **RENEWABLE ENERGY AND ENERGY HARVESTING** | | | | |
| **17PHU314A** | **PRACTICAL** | **-** | **-** | **3** | **1** |

**Course Objective**

- To describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
- To experience the practical difficulties to find the physical constant values.
- To apply the theoretical knowledge into the experiments and find the solutions.
- To obtain knowledge on renewable energy sources.
- To experience the needs of renewable energy sources.
- To develop the new concept of renewable energy sources.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Demonstrate Training modules on Solar energy, wind energy, etc.
2. Convert units of energy-to quantify energy demands and make comparisons among energy uses, resources, and technologies.
3. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.
4. Understand the needs of renewable energy sources.
5. Experience the calculation of wind velocity.
6. Study of box type solar cooker.

**Any 5 Experiments**

1. Fuel value of wood/charcoal.
2. Study of sensible heat storage using liquid.
3. Selective and Non-selective coatings – Determination of Selectivity ratio.
4. Thermal efficiency of liquid – flat plate collector.
5. Study of box type solar cooker.
6. Determination of instantaneous thermal efficiency of parabolic collector.
7. Efficiency and fill factor of solar cells.

**Suggested Books:**

1. Non conventional Energy sources, G. D. RAI (4th edition), Khanna Publishers, Delhi.
2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc.Graw Hill Ltd, New Delhi.
3. Solar Energy Utilisation, G. D. RAI (5th edition), Khanna Publishers,Delhi.

| | | SEMESTER – III |
|---|---|---|
| | PHYSICS WORKSHOP SKILL | L T P C |
| 17PHU314B | PRACTICAL | - - 3 1 |

**Course Objectives**

- To understand concepts of various basic equipments and devices.
- To gain a knowledge and to understand fundamental physical concepts.
- To experience the practical difficulties to find the physical constant values.
- To apply the theoretical knowledge into the experiments and find the solutions.
- To develop the skill on operating the modern machines.
- To enhance their knowledge on foundry tools.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Develop skills in assessing the quality of one's own and others' work
2. Develop skills in observation, interpretation, reasoning, synthesis, generalizing, predicting, and questioning as a way to learn new knowledge.
3. Use the multimeters and other electronic kits.
4. Operate the oscilloscope and PCB.
5. Make different shape of materials using foundary tools.
6. Construct the circuit of regulated power supply. Timer circuit, Electronic switch using transistor and relay.

**Any 5 Experiments**

1. Screw guage, Vernier Calipers, Spherometer, Least count, Zero error, Measurement of thickness of the scale, breadth of scale, radius of curvature of a concave and convex surface.
2. Cutting of a metal sheet using blade. Smoothening of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block.
3. Use of bench vice and tools for fitting. Make funnel using metal sheet.
4. Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB.
5. Operation of oscilloscope. Making regulated power supply. Timer circuit, Electronic switch using transistor and relay.

**Suggested Books:**

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

**SEMESTER IV**

**WAVES AND OPTICS** **L T P C**

**17PHU401** **4 - - 4**

**Course Objective**

- This course builds the ideas of harmonic motion to cover in depth concept of waves in physics with particular emphasis on light waves as an example.
- The foundation of the course is Fourier theory, which will then be used to understand dispersion of waves, image formation in optics and diffraction and other aspects of Fourier optics.
- Understand how the principle of superposition is applied when two pulses meet
- Define three terms to describe periodic waves: speed, wavelength, and frequency
- Explain the characteristics of transverse and longitudinal waves.
- Identify the relationship between the speed, wavelength, and frequency of a wave.

**Course Outcome**

After successful completion of the course, the student is expected to

1. To develop an understanding of the principles of optics.
2. Understand linear, time-invariant systems.
3. Understand the role of the wave equation and appreciate the universal nature of wave motion in a range of physical systems
4. To build connections between mathematical development and conceptual understanding.
5. Understand dispersion in waves and model dispersion using Fourier theory.
6. Understand optical phenomena such as polarization, birefringence, interference and diffraction in terms of the wave model.

**UNIT - I**

**Superposition of Two Collinear Harmonic oscillations:** Simple harmonic motion (SHM). Linearity and Superposition Principle. (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats). Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods. Lissajous Figures (1:1 and 1:2) and their uses. Waves Motion- General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

**UNIT - II**

**Sound:** Sound waves, production and properties. Intensity and loudness of sound. Decibels. Intensity levels. musical notes. musical scale. Acoustics of buildings (General idea). Wave Optics: Electromagnetic nature of light. Definition and Properties of wave front. Huygens Principle.

**UNIT – III**

**Interference:** Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror & 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. Michelson's Interferometer: Construction and working. Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index, and Visibility of fringes.

**UNIT – IV**

**Diffraction:** Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Diffraction grating. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.

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**UNIT-V**

**Polarization:** Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization. Hygiene's explanation of double refraction, positive and negative uniaxial crystals, quarter and half wave plates, types of polarized light, production and analysis of plane, circularly and elliptically polarized light, optical activity (Sections 20.9,20.17-20.20,20.24 Brijlal, Subramaniyam, & Avadhanulu and Ajoy Ghatak)

**Suggested Books:**

1. Fundamentals of Optics, F.A Jenkins and H.E White, 1976, McGraw-Hill Principles of Optics, B.K. Mathur, 1995, Gopal Printing
2. Fundamentals of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. Chand Publications
3. University Physics. F.W. Sears, M.W. Zemansky and H.D. Young. 13/e, 1986. Addison-Wesley.
4. Pedrotti, Frank L.; Pedrotti, Leno S.; Pedrotti, Leno Matthew, Introduction to optics, 3.ed.: Harlow, Essex: Pearson, 2014.
5. Young, Hugh D.; Freedman, Roger A.; Ford, A. Lewis; Sears, Francis Weston 13th ed., international edition: San Francisco: Pearson Addison Wesley, cop. 2012.
6. https://www.cleariitmedical.com/2019/05/physics-notes-wave-optics.html
7. https://nucleoniitjeekota.com/topic-notes.php?topic=Wave%20Optics.

**SEMESTER – IV**

**NUCLEAR AND PARTICLE PHYSICS** **L T P C**

**17PHU402** **4 - - 4**

**Course Objective**

- This is a basic course in Physics which deals with the phenomena taking place in the nuclear domain. Students will be given an insight into the dimensions of a nucleus.
- The aim is to tell them about the stability of nucleus and various other properties.
- The students will learn about various types of radiations and their interaction with matter.
- Students will learn the methods to find the mass and charge of any nucleus by using some instruments.
- To gain knowledge in the content areas of nuclear and particle physics.
- Students will learn the concept of nuclear reactions.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Determine the charge, mass of any nucleus by using various spectrographs.
2. They are able to understand the size of nucleus and all its properties.
3. Develop and communicate analytical skills in subatomic physics.
4. This course has led the students to understand interaction of various types of radiation with matter which they observe in their daily life. It's easy for them now to relate the theory to practical.
5. Acquire knowledge in the content areas of nuclear and particle physics, focusing on concepts that are commonly used in this area.
6. Students now know various methods of accelerating various types of particles to perform scattering experiments.

**UNIT- I**

**General Properties of Nuclei:** Constituents of nucleus and their Intrinsic properties, quantitative facts about size, mass, charge density (matter energy), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excites states.

**UNIT- II**

**Nuclear Models:** Liquid drop model approach, semi empirical mass formula and significance of various terms, condition of nuclear stability. Two nucleon separation energies, Fermi gas model (degenerate fermion gas, nuclear symmetry potential in Fermi gas), evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model, concept of mean field, residual interaction, concept of nuclear force.

**UNIT- III**

**Nuclear Reactions:** Nuclear fission - Energy released in fission - Bohr and Wheeler's theory of nuclear fission - Chain reaction - Multiplication factor - Natural uranium and chain reaction - Design of nuclear reactor - Breeder reactor - Nuclear fusion - Source of stellar energy - Thermonuclear reactions - Transuranic elements.

Ionization chamber – Geiger-Muller counter – Proportional counter – Wilson's cloud chamber – Bubble chamber – Their principles and working.

**UNIT -IV**

**Nuclear Reactions:** Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).

**UNIT- V**

**Particle physics:** Particle interactions; basic features, types of particles and its families. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm, concept of quark model.

**Suggested Books:**

1. Introductory nuclear Physics by Kenneth S.Krane (Wiley India Pvt. Ltd., 2008). Concepts of nuclear physics by Bernard L.Cohen.(Tata Mcgraw Hill, 1998).
2. Introduction to the physics of nuclei & particles, R.A.Dunlap. (Thomson Asia, 2004)
3. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
4. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000)
5. Nuclear and Particle Physics, Axel Maas, Lecture in SS 2016 at the KFU Graz.
6. Nuclear and Particle Physics, B. R. Martin, Online ISBN:9780470035474, 2006 John Wiley & Sons, Ltd.
7. https://www.springer.com/gp/physics/particle-nuclear-physics
8. https://iopscience.iop.org/book/978-0-7503-1140-3
9. https://www.wiley.com/en-us/Nuclear+and+Particle+Physics%3A+An+Introduction-p-9780470035474.

**SEMESTER IV**

**DIGITAL SIGNAL PROCESSING** **L T P C**

**17PHU403** **4 - - 4**

**Course Objective**

- Digital signal processing has lot of applications in different fields of life.
- This paper is to give knowledge to students about the theory of signal processing and the different methods involved in it.
- Apply the principles of discrete-time signal analysis to perform various signal operations
- Apply the principles of z-transforms to finite difference equations.
- Apply the principles of Fourier transform analysis to describe the frequency characteristics of discrete-time signals and systems
- To understand the digital filters and their classifications based on the response, design and algorithm.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Fundamental classification of signals and systems based on the parameters which define them.
2. Concept of Discrete-Time Fourier Transform and Z-transform on signals and its properties.
3. Concept of Discrete Fourier Transform, different convolution techniques, filters and their classifications.
4. Fluency in using Fast Fourier Transform.
5. Understanding of Digital Filters and their classifications based on the response, design and algorithm.
6. Signal generation, realization of systems and finding their transfer function, characterization using pole-zero plots and designing digital filters using Scilab simulations.

**UNIT- I**

**Discrete-Time Signals and Systems:** Classification of Signals, Transformations of the Independent Variable, Periodic and Aperiodic Signals, Energy and Power Signals, Even and Odd Signals, Discrete-Time Systems, System Properties. Impulse Response, Convolution Sum; Graphical Method; Analytical Method, Properties of Convolution; Commutative; Associative; Distributive; Shift; Sum Property System Response to Periodic Inputs, Relationship Between LTI System Properties and the Impulse Response; Causality; Stability; Invertibility, Unit Step Response.

**UNIT- II**

**Discrete-Time Fourier Transform:** Fourier Transform Representation of Aperiodic Discrete-Time Signals, Periodicity of DTFT, Properties; Linearity; Time Shifting; Frequency Shifting; Differencing in Time Domain; Differentiation in Frequency Domain; Convolution Property.

**UNIT-III**

**The *z*-Transform:** Bilateral (Two-Sided) *z*-Transform, Inverse *z*-Transform, Relationship Between *z*-Transform and Discrete-Time Fourier Transform, *z*-plane, Region-of-Convergence; Properties of ROC, Properties; Time Reversal; Differentiation in the *z*-Domain; Power Series Expansion Method (or Long Division Method); Analysis and Characterization of LTI Systems; Transfer Function and Difference-Equation System. Solving Difference Equations.

**UNIT-IV**

**Filter Concepts:** Phase Delay and Group delay, Zero-Phase Filter, Linear-Phase Filter, Simple FIR Digital Filters, Simple IIR Digital Filters, All pass Filters, Averaging Filters, Notch Filters.

**Discrete Fourier Transform:** Frequency Domain Sampling (Sampling of DTFT), The Discrete Fourier Transform (DFT) and its Inverse, DFT as a Linear transformation, Properties; Periodicity; Linearity; Circular Time Shifting; Circular Frequency Shifting.

**UNIT-V**

**Fast Fourier Transform:** Direct Computation of the DFT, Symmetry and Periodicity, Properties of the Twiddle factor (*WN*), Radix-2 FFT Algorithms; Decimation-In-Time (DIT) FFT Algorithm; Decimation-In-Frequency (DIF) FFT Algorithm, Inverse DFT Using FFT Algorithms.

**Realization of Digital Filters:** Non-Recursive and Recursive Structures, Canonic and Non-Canonic Structures, Equivalent Structures (Transposed Structure), FIR Filter structures; Direct-Form; Cascade-Form; Basic structures for IIR systems; Direct-Form I.

**Suggested Books:**

1. Digital Signal Processing, Tarun Kumar Rawat, 2015, Oxford University Press, India
2. Digital Signal Processing, S. K. Mitra, McGraw Hill, India.
3. Modern Digital and Analog Communication Systems, B.P. Lathi, 1998, 3rd Edn. Oxford University Press.
4. Fundamentals of Digital Signal processing using MATLAB, R.J. Schilling and S.L. Harris, 2005, Cengage Learning.
5. Fundamentals of signals and systems, P.D. Cha and J.I. Molinder, 2007, Cambridge University Press.
6. Proakis, John G. Digital signal processing: principles algorithms and applications. Pearson Education India.
7. Hayes, Monson H. Digital signal processing Tata McGraw-Hill edition 2004
8. Digital Signal Processing Principles Algorithm & Applications, J.G. Proakis and D.G. Manolakis, 2007, 4th Edn., Prentice Hall.
9. Digital Signal Processing: Principles, Algorithms, and Applications by J. G. Proakis and D. G. Manolakis.
10. https://www.sciencedirect.com/book/9780750689762/digital-signal-processing.
11. https://www.dspguide.com/pdfbook.htm.

**SEMESTER IV**

**BASIC INSTRUMENTATION SKILL** **L T P C**

**17PHU404A** **3 - - 3**

**Course Objectives**

- This course is to get exposure with various aspects of instruments and their usage through hands-on mode.
- To impart physical measurement skills.
- To make the students understand coherence between theoretical and practical measurement.
- Identify the signals and systems.
- To use the techniques, skills and modern technical tools necessary for technical or engineering practice.
- The primary objective of this course is to provide a thorough understanding and working knowledge of design, implementation and analysis of instruments.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Develop skills to impart practical knowledge in real time solutions.
2. Understand principle, concept, working and application of new technology and comparison of results with theoretical calculations.
3. Understand the terminology used in various instruments.
4. Gain knowledge of new concept in the solution of practical oriented problems and to understand more deep knowledge about the solution to theoretical problems.
5. Connect concepts with the instruments to enhance understanding.
6. Understand measurement technology, usage of new instruments and real time applications in engineering studies.

**UNIT-I**

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

**UNIT- II**

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

**UNIT- III**

**Cathode Ray Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance.

**UNIT- IV**

**CRO Measurement:** Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes. Digital storage Oscilloscope: Block diagram and principle of working.

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

**UNIT- V**

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

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

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

**SUGGESTED BOOKS**

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

SEMESTER IV

**RADIATION SAFETY** **L T P C**

**17PHU404B** **3 - - 3**

**Course Objective**

- To identify the parts of the x-ray machine and explain their purpose and function.
- Explain how x-rays are produced and how they travel.
- Compare the effects that x-radiation has on a variety of biological and non-biological materials.
- Describe the spectrum of electromagnetic radiation.
- The goal is for the students to develop a basic knowledge of the methods employed in veterinary hospitals and clinics to protect employees and the veterinarians themselves against radiation exposure.
- Discuss the difference between a rotating anode and a fixed anode.
- Discuss which types of machines today have fixed and which have rotating anodes.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. List and describe the function the parts of the x-ray machine
2. Describe the spectrum of electromagnetic radiation.
3. Understand the terminology used in radiation safty.
4. Gain knowledge of new concept in the field of radiation.
5. They are able to understand the Interaction of Radiation with matter.
6. Impact knowledge on different radiation detector.

**UNIT- I**

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

**UNIT -II**

**Interaction of Radiation with matter: Types of Radiation:** Alpha, Beta, Gamma and Neutron and their sources, sealed and unsealed sources, **Interaction of Photons** - Photo-electric effect, Compton Scattering, Pair Production, Linear and Mass Attenuation Coefficients, **Interaction of Charged Particles:** Heavy charged particles - Beth-Bloch Formula, Scaling laws, Mass Stopping Power, Range, Straggling, Channeling and Cherenkov radiation. Beta Particles- Collision and Radiation loss (Bremsstrahlung), **Interaction of Neutrons**- Collision, slowing down and Moderation.

**UNIT -III**

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

**UNIT -IV**

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

**UNIT- V**

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

**Suggested Books:**

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
2. G.F.Knoll, Radiation detection and measurements
3. Thermoluninescense Dosimetry, Mcknlay, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
4. W.J. Meredith and J.B. Massey, "Fundamental Physics of Radiology". John Wright and Sons, UK, 1989.
5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981.
6. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowental and P.L. Airey, Cambridge University Press, U.K., 2001
7. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981.
8. NCRP, ICRP, ICRU, IAEA, AERB Publications.
9. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical Publishers Inc. London, 1981.
10. http://www.barc.gov.in/publications/nl/2003/200301-2.pdf

**SEMESTER – IV**

**WAVES AND OPTICS PRACTICAL** **L T P C**

**17PHU411** **- - 4 2**

**Course Objective**

- Understand and working of polarimeter.
- Understand the resolving power of different optical instruments.
- To experience the practical difficulties to find the physical constant values.
- To apply the theoretical knowledge into the experiments and find the solutions.
- Students will be observe the readings practically.
- Students will experience the phenomena of reflection, refraction, etc.,

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Gain knowledge on various theories of light.
2. Acquire skills to identify and apply formulas of optics and wave physics.
3. Understand the properties of light like reflection, refraction, interference, and diffraction etc.,
4. Understand the applications of diffraction and polarization.
5. Determine the different optical properties by using various apparatus.
6. Know the importance of optical materials in the industrials.

**Any 8 Experiments**

1. To investigate the motion of coupled oscillators
2. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify $\lambda^2$ – T Law.
3. To study Lissajous Figures
4. Familiarization with Schuster`s focussing; determination of angle of prism.
5. To determine the Refractive Index of the Material of given Prism using Na Light.
6. To determine Dispersive Power of the Material of a given Prism using Hg Light
7. To determine the value of Cauchy Constants of a material of a prism.
8. To determine the Resolving Power of a Prism.
9. To determine wavelength of sodium light using Fresnel Biprism.
10. To determine wavelength of sodium light using Newton's Rings.
11. To determine the wavelength of Laser light using Diffraction grating.
12. To determine wavelength of (1) Sodium and (2) Mercury light using plane diffraction Grating
13. To determine the Resolving Power of a Plane Diffraction Grating.

**Suggested 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, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

**SEMESTER IV**

**17PHU412 NUCLEAR AND PARTICLE PHYSICS PRACTICAL L T P C**

**- - 4 2**

**Course Objectives**

- To understand the operation of G.M. counter.
- To study the general properties of nucleus
- To study the nuclear forces and nuclear reactions.
- To analyse the B-H curve and their concepts practically.
- To introduce the concept of elementary particles practically.
- To apply the theoretical knowledge into the experiments and find the solutions.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Acquire basic knowledge about nuclear and particle physics
2. Develop the nuclear reactions and neutron physics.
3. Know the calculations of e/m and their applications.
4. Understand the operation of G.M. counter
5. Verify the B-H curve of radiative materials.
6. Understand the difference between Magnetron and Thomson methods.

**Any 4 Experiments**

1. Young's Modulus – Elliptical Fringes (Cornu's method).
2. Viscosity of liquid – Mayer's oscillating disc method.
3. Michelson Interferometer – Determination of $\lambda$ and $d\lambda$.
4. 'e/m' by Thomson's method and Magnetron method.
5. Young's Modulus – Hyperbolic Fringes (Cornu's method).
6. 'e' by Millikan's method.
7. Young's Double slit – Determination of Wavelength of monochromatic source.
8. G.M.Counter-Absorption co-efficient and inverse square law.

**Suggested Books**

1. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000)
2. Nuclear and Particle Physics, Axel Maas, Lecture in SS 2016 at the KFU Graz.
3. Nuclear and Particle Physics, B. R. Martin, Online ISBN:9780470035474, 2006 John Wiley & Sons, Ltd.

**SEMESTER IV**

**17PHU413 DIGITAL SIGNAL PROCESSING PRACTICAL L T P C**

**- - 4 2**

**Course Objectives**

- Digital signal processing has lot of applications in different fields of life.
- This objective of this paper is to give knowledge to students about the practical knowledge of signal processing and the different methods involved in it.
- To experience the practical difficulties to find the physical constant values.
- To apply the theoretical knowledge into the experiments and find the solutions.
- Students will learn writing program and perform the analysis using scilab software.
- Write the computer programme and verify the results by manipulation of data.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Fluency in writing program and perform the analysis using scilab software.
2. Verify the data using scilab programs.
3. Concept of Discrete-Time Fourier Transform and Z-transform on signals and its properties.
4. Concept of Discrete Fourier Transform, different convolution techniques, filters and their classifications.
5. Apply the knowledge on Fourier Transform and verify the results by manipulation of data.
6. Understanding of Digital Filters and their classifications based on the response, design and algorithm.
7. Signal generation, realization of systems and finding their transfer function, characterization using pole-zero plots and designing digital filters using Scilab simulations.
8. Write the program and algorithm of Scilab.

**Any 8 Experiments**

***Scilab based simulations experiments based problems like***

1. Write a program to generate and plot the following sequences: (a) Unit sample sequence $\delta(n)$, (b) unit step sequence $u(n)$, (c) ramp sequence $r(n)$, (d) real valued exponential sequence $x(n) = (0.8)^n u(n)$ for $0 \le n \le 50$.

2. Write a program to compute the convolution sum of a rectangle signal (or gate function) with itself for N = 5

$$x(n) = rect\left(\frac{n}{2N}\right) = \Pi\left(\frac{n}{2N}\right) = \begin{cases} 1 & -N \le n \le N \\ 0 & otherwise \end{cases}$$

3. An LTI system is specified by the difference equation
$$y(n) = 0.8y(n-1) + x(n)$$
(a) Determine $H(e^{jw})$
(b) Calculate and plot the steady state response $y_{ss}(n)$ to
$$x(n) = \cos(0.5\pi n)u(n)$$

4. Given a casual system
$$y(n) = 0.9y(n-1) + x(n)$$
(a) Find $H(z)$ and sketch its pole-zero plot
(b) Plot the frequency response $|H(e^{jw})|$ and $\angle H(e^{jw})$

5. Design a digital filter to eliminate the lower frequency sinusoid of $x(t) = \sin 7t + \sin 200t$. The sampling frequency is $f_s = 500\,Hz$. Plot its pole zero diagram, magnitude response, input and output of the filter.

6. Let $x(n)$ be a 4-point sequence:
$$x(n) = \underset{\uparrow}{\{1,1,1,1\}} = \begin{cases} 1 & 0 \le n \le 3 \\ 0 & otherwise \end{cases}$$
Compute the DTFT $X(e^{jw})$ and plot its magnitude
(a) Compute and plot the 4 point DFT of $x(n)$
(b) Compute and plot the 8 point DFT of $x(n)$ (by appending 4 zeros)
(c) Compute and plot the 16 point DFT of $x(n)$ (by appending 12 zeros)

7. Let $x(n)$ and $h(n)$ be the two 4-point sequences,
$$x(n) = \underset{\uparrow}{\{1,2,2,1\}}$$
$$h(n) = \underset{\uparrow}{\{1,-1,-1,1\}}$$
Write a program to compute their linear convolution using circular convolution.

8. Using a rectangular window, design a FIR low-pass filter with a pass-band gain of unity, cut off frequency of 1000 Hz and working at a sampling frequency of 5 KHz. Take the length of the impulse response as 17.

9. Design an FIR filter to meet the following specifications:
passband edge $F_p = 2\,KHz$
stopband edge $F_s = 5\,KHz$
Passband attenuation $A_p = 2\,dB$
Stopband attenuation $A_s = 42\,dB$
Sampling frequency $F_s = 20\,KHz$

10. The frequency response of a linear phase digital differentiator is given by
$$H_d(e^{jw}) = jwe^{-j\tau w} \qquad |w| \le \pi$$
Using a Hamming window of length M = 21, design a digital FIR differentiator. Plot the amplitude response.

**Suggested Books:**

1. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press, India.
2. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press.

3. Fundamentals of Digital Signal Processing using MATLAB, R.J.Schilling and S.L. Harris, 2005, Cengage Learning.
4. Digital Signal Processing, S.K. Mitra, McGraw Hill, India.
5. Fundamentals of signals and systems, P.D. Cha and J.I. Molinder, 2007, Cambridge Unversity Press.
6. Simulation of ODE/PDE models with MATLAB, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wonwer, P. Saucez, C.V. Fernanderz. 2014 Springer ISBN: 978-3319067896.
7. Scilab by example: M. Affouf, 2012, ISBN: 978-1479203444.
8. Scilab Image Processing: L.M. Surhone, 2010, Betascript Pub., ISBN: 978-6133459274

**SEMESTER IV**

**17PHU414A BASIC INSTRUMENTATION SKILL PRACTICAL L T P C**

**- - 3 1**

**Course Objectives**:

- To familiarize the students with working, design and analysis of basic amplifier circuits.
- To design and analyze wave shaping circuits, rectifiers and power supply circuits
- Introduce the basic concept of qualitative and quantitative analysis of an instruments.
- Study the concept of separation science and its applications.
- To demonstrate their knowledge in designing the control loops for these processes.
- To apply the theoretical knowledge into the experiments and find the solutions.

**Course Outcomes:**

After successful completion of the course, the student is expected to

1. Handle any kind of process by framing it in block diagram, mathematical model and different process variables.
2. Use modern engineering tools and techniques in the practice of electronic devices.
3. Know all the industrial processes and demonstrate their knowledge in designing the control loops for these processes.
4. Understand the working of various types of amplifiers, oscillators, wave shaping and power supply circuits
5. Design and Analyze the various types of amplifiers, oscillators, wave shaping and power supply circuits for any practical situation.
6. Discuss the terms, principle, instrumentation, operation and applications of instruments.

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

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

**Laboratory Exercises:**

1. To observe the loading effect of a multimeter while measuring voltage across a
2. low resistance and high resistance.
3. To observe the limitations of a multimeter for measuring high frequency voltage and

currents.

4. To measure Q of a coil and its dependence on frequency, using a Q- meter.
5. Measurement of voltage, frequency, time period and phase angle using CRO.
6. Measurement of time period, frequency, average period using universal counter/ frequency counter.
7. Measurement of rise, fall and delay times using a CRO.
8. Measurement of distortion of a RF signal generator using distortion factor meter.
9. Measurement of R, L and C using a LCR bridge/ universal bridge.

**Open Ended Experiments**

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

**Suggested Books:**

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

**SEMESTER IV**

| | | |
|---|---|---|
| | **RADIATION SAFETY PRACTICAL** | **L T P C** |
| **17PHU414B** | | **- - 3 1** |

**Course Objectives:**

- Student will get idea about the basic radiation principle.
- To know the nuclear interactions with matter and detection.
- To identify the Biological effects of radiation and measurement.
- To give the demonstration of Gamma spectrum of Gas Light mantle
- To know the Shielding of nuclear radiation.
- To know the importance of background radiation levels using Radiation meter.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Understood the concepts of nuclear radiation.
2. Know the interaction of nuclear radiation with matter.
3. Detect the nuclear radiation.
4. Be familiar with dosimeters and measurements.
5. Know the importance of background radiation levels using Radiation meter.
6. Identify the α particles using reference source & determining its half life using spark counter

**Any 4 Experiments**

1. Study the background radiation levels using Radiation meter
2. Characteristics of Geiger Muller (GM) Counter:
3. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
4. Study of counting statistics using background radiation using GM counter.
5. Study of radiation in various materials (e.g. KSO4 etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage.
6. Study of absorption of beta particles in Aluminum using GM counter.
7. Detection of α particles using reference source & determining its half life using spark counter
8. Gamma spectrum of Gas Light mantle (Source of Thorium)

**Suggested Books:**

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
2. G.F.Knoll, Radiation detection and measurements
3. Thermoluninescense Dosimetry, Mcknlay, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
4. W.J. Meredith and J.B. Massey, “Fundamental Physics of Radiology”. John Wright and Sons, UK, 1989.

5. J.R. Greening, "Fundamentals of Radiation Dosimetry", Medical Physics Hand Book Series, No.6, Adam Hilger Ltd., Bristol 1981.
6. Practical Applications of Radioactivity and Nuclear Radiations, G.C. Lowental and P.L. Airey, Cambridge University Press, U.K., 2001
7. Martin and S.A. Harbisor, An Introduction to Radiation Protection, John Willey & Sons, Inc. New York, 1981.
8. NCRP, ICRP, ICRU, IAEA, AERB Publications.
9. W.R. Hendee, "Medical Radiation Physics", Year Book – Medical Publishers Inc. London, 1981

**SEMESTER V**

**COMPUTATIONAL PHYSICS** **L T P C**

**17PHU501A** **3 - - 3**

**Course Objective**

- The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.
- Students should be able to tackle with problems in the physical science using computer and different software.
- Identify and describe the characteristics of various numerical methods.
- Independently program computers using leading-edge tools,
- Formulate and computationally solve a selection of problems in physics,
- Use the tools, methodologies, language and conventions of physics to test and communicate ideas and explanations.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Demonstrate basic knowledge of numerical methods.
2. Demonstrate basic programming skills.
3. Demonstrate an understanding of the applicability of numerical methods for modeling physical systems and its advantages and disadvantages.
4. Demonstrate the ability to estimate the errors in the use of numerical methods.
5. Demonstrate skills to write and develop simple programs in FORTRAN.
6. Understand the Importance of graphical analysis and its limitations.

**UNIT -I**

**Introduction:** Importance of computers in Physics, paradigm for solving physics problems for solution**.** Usage of linux as an Editor. Algorithms and Flowcharts**:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical Polar Coordinates, Roots of Quadratic Equation, Sum of two matrices, Sum and Product of a finite series, calculation of sin(x) as a series, algorithm for plotting (1) lissajous figures and (2) trajectory of a projectile thrown at an angle with the horizontal.

**UNIT -II**

**Scientific Programming**: Some fundamental Linux Commands (Internal and External commands). Development of FORTRAN, Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements, Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Examples from physics problems.

**UNIT- III**

**Control Statements:** Types of Logic (Sequential, Selection, Repetition), Branching Statements (Logical IF, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DO-WHILE, Implied and Nested DO Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements, open a file, writing in a file, reading from a file. Examples from physics problems.

**UNIT- IV**

**Scientific word processing: Introduction to LaTeX:** TeX/LaTeX word processor, preparing a basic LaTeX file, Document classes, Preparing an input file for LaTeX, Compiling LaTeX File, LaTeX tags for creating different environments, Defining LaTeX commands and environments, Changing the type style, Symbols from other languages. **Equation representation:** Formulae and equations, Figures and other floating bodies, Lining in columns- Tabbing and tabular environment, Generating table of contents, bibliography and citation, Making an index and glossary, List making environments, Fonts, Picture environment and colors, errors.

**UNIT- V**

**Visualization:** Introduction to graphical analysis and its limitations. Introduction to Gnuplot. importance of visualization of computational and computational data, basic Gnuplot commands: simple plots, plotting data from a file, saving and exporting, multiple data sets per file, physics with Gnuplot (equations, building functions, user defined variables and functions), Understanding data with Gnuplot

**Suggested Books:**


1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).
3. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
4. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
5. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
6. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999)
7. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
8. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007, Wiley India Edition.
9. https://onlinecourses.nptel.ac.in/noc20_ph20/preview
10. https://iopscience.iop.org/book/978-1-6817-4896-2

**SEMESTER V**

**WEATHER FORECASTING** **L T P C**

**17PHU501B** **3 - - 3**

**Course Objective**:

- The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness
- To understand the causes and effects of different weather phenomenon and basic forecasting techniques.
- To know the role of air, water, and wind in weather systems.
- Assess variability and change within this expanded, extended and quality assured network.
- To explain what causes different types of weather.
- To understand the concept of Ecosystems and climate interactions

**Course Outcome**

After successful completion of the course, the student is expected to

1. Ecosystems and climate interactions
2. Effects of climate change on life cycles
3. Biodiversity, Weather vs climate
4. The greenhouse effect, Treaty rights
5. Traditional ecological knowledge
6. Understand the claimate change and relted issues.

**UNIT -I**

**Introduction to atmosphere:** Elementary idea of atmosphere: physical structure and composition; compositional layering of the atmosphere; variation of pressure and temperature with height; air temperature; requirements to measure air temperature; temperature sensors: types; atmospheric pressure: its measurement; cyclones and anticyclones: its characteristics.

**UNIT -II**

**Measuring the weather:** Wind; forces acting to produce wind; wind speed direction: units, its direction; measuring wind speed and direction; humidity, clouds and rainfall, radiation: absorption, emission and scattering in atmosphere; radiation laws.

**UNIT- III**

**Weather systems:** Global wind systems; air masses and fronts: classifications; jet streams; local thunderstorms; tropical cyclones: classification; tornadoes; hurricanes.

**UNIT -IV**

**Climate and Climate Change:** Climate: its classification; causes of climate change; global warming and its outcomes; air pollution; aerosols, ozone depletion, acid rain, environmental issues related to climate.

**UNIT -V**

**Basics of weather forecasting:** Weather forecasting: analysis and its historical background; need of measuring weather; types of weather forecasting; weather forecasting methods; criteria of choosing weather station; basics of choosing site and exposure; satellites observations in weather forecasting; weather maps; uncertainty and predictability; probability forecasts.

**Suggested Books:**

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.
4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur.
5. https://www.sciencedirect.com/science/article/abs/pii/S0065268708603118
6. https://cimss.ssec.wisc.edu/satmet/modules/7_weather_forecast/wf-1.html
7. https://www.outdoorproject.com/articles/weather-forecasting-101-how-predict-weather-go

**SEMESTER V**

**ELEMENTS OF MODERN PHYSICS** **L T P C**

**17PHU502A** **4 - - 2**

**Course Objective**

- To identify the circumstances, in Modern Physics. Enumerate and understand the postulate of relativity.
- To learn about the speed of light as a natural limit to speed.
- To understand the work of Planck, Bohr, Heisenberg, uncertainty principle and the other features of Quantum Mechanics.
- Acquaintance with basic fields of modern physics
- Ability of searching solutions of physical problems in scientific and technical literature.
- Understanding of physical processes and technology

**Course Outcome**

After successful completion of the course, the student is expected to

1. Recall and apply knowledge in the areas of optics and waves, special relativity and quantum physics (developing the knowledge capability dimension);
2. Conduct relevant experiments, analyse data and report results in written form (developing the technical capability and communication dimensions).
3. Analyse the plank's constant using different experimental technique.
4. Find the wavelength of any laser sources.
5. Differentiate the interference and diffraction properties by the experiments.
6. Understand the theory and practical knowledge of light and other properties.

**UNIT-I**

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

**UNIT-II**

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction.

**UNIT- III**

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

**UNIT-IV**

One dimensional infinitely rigid box- energy eigenvalues and eigenfunctions, normalization; Quantum dot as example; Quantum mechanical scattering and tunneling in one dimension-across a step potential & rectangular potential barrier. 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- V**

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.

**Suggested Books:**


1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.
2. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
3. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education.
4. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
6. Quantum Mechanics: Theory & Applications, A.K.Ghatak & S.Lokanathan, 2004, Macmillan
7. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
8. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2nd Edn, Tata McGraw-Hill Publishing Co. Ltd.
9. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.
10. Basic ideas and concepts in Nuclear Physics, K.Heyde, 3rd Edn., Institute of Physics Pub. Six Ideas that Shaped Physics: Particle Behave like Waves, T.A.Moore, 2003, McGraw Hill.
11. https://www.arsdcollege.ac.in/wp-content/uploads/2020/04/Presentation_1-11_compressed.pdf
12. http://web.sbu.edu/physics/courses/physics-203p.pdf

SEMESTER V

**MEDICAL PHYSICS** L T P C

**17PHU502B** 4 - - 2

**Course Objective**

- The objective of the course is to educate and to train students to a competency level sufficient to practice radiation oncology physics independently.
- This prepares the students for clinical practices in radiation therapy (RT) physics through a structured clinical trainings and didactic courses.
- To know the energetic charged particle interactions and transport in matter.
- The program is supervised and mentored by highly qualified clinical practitioners.
- This paper is aimed at giving idea to the students regarding the nature of human body and usage of different radiations for the treatment of body.
- To active participation in clinical research, teaching, and training.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Different areas of research in Medical Physics
2. Understand and apply key concepts specific to energy deposition for both ionizing photon interactions and transport in matter
3. Know the energetic charged particle interactions and transport in matter.
4. Understanding the working of a manual optical eye-testing machine
5. Familiarization with the Use of a Vascular Doppler.
6. Realize the real time examples of medical instruments.

**UNIT – I**

**PHYSICS OF THE BODY-I**

**Basic Anatomical Terminology:** Standard Anatomical Position, Planes. Familiarity with terms like- Superior, Inferior, Anterior, Posterior, Medial, Lateral, Proximal and Distal. **Mechanics of the body:** Skeleton, forces, and body stability. Muscles and dynamics of body movement. Physics of Locomotors Systems: joints and movements, Stability and Equilibrium. **Energy household of the body:** Energy balance in the body, Energy consumption of the body, Heat losses of the body, Thermal Regulation. **Pressure system of body:** Physics of breathing, Physics of cardiovascular system.

**UNIT – II**

**PHYSICS OF THE BODY-II**

**Acoustics of the body:** Nature and characteristics of sound, Production of speech, Physics of the ear, Diagnostics with sound and ultrasound. **Optical system of the body:** Physics of the eye. **Electrical system of the body:** Physics of the nervous system, Electrical signals and information transfer.

**UNIT - III**

**PHYSICS OF DIAGNOSTIC AND THERAPEUTIC SYSTEMS-I**

**X-RAYS:** Electromagnetic spectrum, production of x-rays, x-ray spectra, Brehmsstrahlung, Characteristic x-ray. **X-ray tubes & types** : Coolidge tube, x-ray tube design, tube cooling stationary mode, Rotating anode x-ray tube, Tube rating, quality and intensity of x-ray. X-ray generator circuits, half wave and full wave rectification, filament circuit, kilo voltage circuit. Single and three phase electric supply. Power ratings. Types of X-Ray Generator, high frequency generator, exposure timers and switches, HT cables.

**UNIT - IV**

**RADIATION PHYSICS:** Radiation units exposure, absorbed dose, units: rad, gray, relative biological effectiveness, effective dose- Rem & Sievert, inverse square law. Interaction of radiation with matter Compton & photoelectric effect, linear attenuation coefficient. **Radiation Detectors**: ionization (Thimble chamber, condenser chamber), chamber. Geiger Muller counter, Scintillation counters and Solid State detectors, TFT.

**UNIT - V**

**MEDICAL IMAGING PHYSICS:** Evolution of Medical Imaging, X-ray diagnostics and imaging, Physics of nuclear magnetic resonance (NMR), NMR imaging, MRI Radiological imaging, Ultrasound imaging, Physics of Doppler with applications and modes, Vascular Doppler. Radiography: Filters, grids, cassette, X-ray film, film processing, fluoroscopy. **Computed tomography scanner**- principle and function, display, generations, mammography. Thyroid uptake system and Gamma camera (Only Principle, function and display)

**Suggested Books:**

1. Medical Physics, J.R. Cameron and J.G.Skofronick, Wiley (1978)
2. Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
3. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry Lippincot Williams and Wilkins (1990)
4. Physics of the human body, Irving P. Herman, Springer (2007).
5. Physics of Radiation Therapy : F M Khan - Williams and Wilkins, 3rd edition (2003)
6. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
7. Handbook of Physics in Diagnostic Imaging: R.S.Livingstone: B.I. Publication Pvt Ltd.
8. The Physics of Radiology-H E Johns and Cunningham.
9. https://sites.google.com/a/northgeorgia.edu/ngcsu-physics-note-sharing/home/medical
10. http://www.sprawls.org/ppmi2/IMGCHAR/
11. http://www.sprawls.org/ppmi2/

SEMESTER V

**MATHEMATICS-I** L T P C

**17PHU503** 4 - - 4

**Course Objectives**

This course enables the students to learn

- The concepts of Matrices and their properties.
- Techniques of differentiation and integration.
- The transform of a periodic function.
- The applications of the inverse Laplace transform.
- To know the properties of definite integrals.
- To understand the concept of Beta and Gamma integrals.

**Course Outcomes (COs)**

On successful completion of this course, the students will be able to

1. Solve simultaneous equations with the help of matrices.
2. Mastery in the concepts of vector and scalar fields.
3. Gain the intellectual knowledge of complex functions and their applications.
4. Acquire fundamental knowledge in the techniques of differentiation.
5. Know the properties of definite integrals.
6. Understand the concept of Beta and Gamma integrals.

**UNIT I**

Curvature in Cartesian coordinates-centre and radius of curvature in Cartesian and polar forms- Total differentiation

**UNIT II**

Integration of $\frac{f'(x)}{f(x)}$, $f'\sqrt{f(x)}$, $(px+q)/\sqrt{(ax^2+bx+c)}$, $\left(\sqrt{(x-a)/(b-x)}\right)$, $1/\left(\sqrt{(x-a)/(b-x)}\right)$, $(1/a\cos x+b\sin x+c)$, $1/(a\cos^2 x+b\sin^2 x+c)$, Integration by parts.

**UNIT III**

Reduction formulae- problems- evaluation of double and triple integrals- applications to calculations of areas and volumes-areas in polar coordinates.

**UNIT IV**

Change of order of integration in double integral- change of variables in double and triple integrals.

**UNITV**

Beta and Gamma integrals-their properties, relation between them- evaluation of multiple integrals using Beta and Gamma functions.

**SUGGESTED READINGS**

1. S.Narayanan and T.K.M. Pillai. Calculus Vol 1 and Vol 2,Viswanathan Publishers.
2. P.Kandasamy & K.Thilagarathy,Mathematics for BSc .Vol I and. II(2000), S.Chand and Co.
3. Shanthi Narayanan & J.N.Kapoor, A Text book of calculus,S.Chand & Co

**SEMESTER V**

**CHEMISTRY-I** **L T P C**

**17PHU504** **4 - - 4**

**Course Objectives**

- Students will learn about the molecular orbital theory, preparation and properties of inorganic compounds.
- To know the theory of covalent bond, polar effects and stereochemistry of organic compounds.
- Gain knowledge on important industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
- Acquire concept on the elements of photochemistry, chemical kinetics and chromatography.
- To understand the nature of bonding in simple molecules.
- To understand the basic concepts in chemistry

**Course Outcome**

The student understand

1. The molecular orbital theory, preparation and properties of inorganic compounds.
2. Theory of covalent bond, polar effects and stereochemistry of organic compounds.
3. About important of industrial chemicals like silicones, fuel gases.
4. About the fertilizers and their impact on environment.
5. Elements of photochemistry, chemical kinetics and chromatography.
6. About the dyes, chemotherapy and vitamins.

**UNIT-I**

**Chemical Bonding:** Molecular orbital theory-linear combination of atomic orbitals-bonding and antibonding molecular orbitals-energy level diagram-bond order- M.O. configuration of $H_2$, $N_2$ and $F_2$ molecules. Diborane: Preparation, properties and structure. $NaBH_4$: Preparation and uses. Borazole: Preparation and properties. Interhalogen compounds: ICl, $BrF_3$, $IF_5$ - preparation, properties, uses and structure. Basic properties of iodine. Compounds of sulphur: Sodium hydrosulphite- preparation, properties, uses and structure. Per acids of sulphur: Preparation, properties, uses and structure.

**UNIT- II**

**Covalent Bond and Stereoisomerism: Covalent Bond:** Orbital overlap, hybridization and geometry of $CH_4$, $C_2H_4$ and $C_2H_2$. Polar effects: Inductive effect-electromeric effect-mesomeric effect- steric effect- hyperconjugation. **Stereoisomerism:** Elements of symmetry-polarised light and optical activity-isomerism in tartaric acid-racemisation- resolution-geometrical isomerism of maleic and fumaric acids-keto-enol tautomerism of acetoacetic esters.

**UNIT-III**

**Industrial Chemistry:** Silicones: Synthesis, properties and uses. Fuels gases: Natural gas-water gas-semi water gas-carbureted water gas-producer gas- oil gas (Manufacturing details not required).Fertilizers: NPK fertilizer-ammonium sulphate-urea-superphosphate of lime-triple superphosphate- potassium nitrate-ammonium nitrate. Pollution: Water, air and soil pollution-sources and remedies-acid rain-ozone hole-greenhouse effect.

**UNIT-IV**

**Elements of Photochemistry, Chemical Kinetics and Chromatography: Elements of Photochemistry:** Photochemical laws-Beer Lambert's law-Grotthuss-Draper law-Stark-Einstein law (statement only). **Chemical Kinetics:** Rate-order-molecularity-pseudo first order reactions-zero order reactions-determination of order of reaction-measurement of order and rates of reactions-effect of temperature on reaction rate-energy of activation. **Chromatography:** Principles and applications of Column, Paper and Thin Layer Chromatography.

**UNIT- V**

**Dyes, Chemotherapy and Vitamins: Dyes:** Terms used chromophore, auxochrome, bathachromic shift and hypsochromic shift- classification of dyes– based on chemical structure and application-one example each for azo, triphenylmethane, vat and mordant dyes-preparation.

**Chemotherapy:** Preparation, uses and mechanism of action sulpha drugs- preparation and uses of prontosil, sulphadiazine and sulphafurazole-structure and uses of pencillins and Chloromycetin. **Vitamins:** Diseases caused by the deficiency of vitamins A, $B_1$, $B_2$, C and D-sources of these vitamins.

**SUGGESTED BOOKS**


1. Thangamani, A. (2018). *Text Book on Allied Chemistry* (1st Edition). Coimbatore: Karpagam Publication.
2. Puri, B.R., Sharma, L. R., & Kalia, K. C. (2017). *Principles of Inorganic Chemistry* (33rd Edition). Jalandar: Vishal Publishing Company.
3. Bahl, A., & Bahl, B.S. (2015). *A Textbook of Organic Chemistry* (21st Revised Edition). New Delhi: S.Chand & Company Pvt. Ltd.
4. Puri, B. R., Sharma, L. R. & Pathania, M. S. (2014). *Elements of Physical Chemistry* (46th Edition). Jalandhar: Vishal Publishing Company.
5. Gopalan, R., & Sundaram, S. (2013). *Allied Chemistry* (III Edition). New Delhi: Sultan Chand & Sons.

**SEMESTER V**

**COMPUTATIONAL PHYSICS PRACTICAL** **L T P C**

**17PHU511A** **- - 3 1**

**Course Objective**

- The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.
- Both experimental and theoretical physics are incomplete without the option to compute whenever it is necessary.
- The goal of computational physics is not to replace theory or experiment, but to enhance our understanding of physical processes.
- The aim of this course is to lay the grounds for the development of the computational skills.
- To apply the theoretical knowledge into the experiments and find the solutions.
- To understand the applicability of numerical methods for modeling physical systems and its advantages and disadvantages.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Demonstrate basic knowledge of numerical methods.
2. Demonstrate basic programming skills.
3. Demonstrate an understanding of the applicability of numerical methods for modeling physical systems and its advantages and disadvantages.
4. Solve the problems by computing.
5. Understand the differences of theory, computing and experiments.
6. Solve the complex equations using different software packages.

**Hands on exercises**

1. To compile a frequency distribution and evaluate mean, standard deviation etc.
2. To evaluate sum of finite series and the area under a curve.
3. To find the product of two matrices
4. To find a set of prime numbers and Fibonacci series.
5. To write program to open a file and generate data for plotting using Gnuplot.
6. Plotting trajectory of a projectile projected horizontally.
7. Plotting trajectory of a projectile projected making an angle with the horizontally.
8. Creating an input Gnuplot file for plotting a data and saving the output for seeing on the screen. Saving it as an eps file and as a pdf file.
9. To find the roots of a quadratic equation.
10. Motion of a projectile using simulation and plot the output for visualization.
11. Numerical solution of equation of motion of simple harmonic oscillator and plot the outputs for visualization.
12. Motion of particle in a central force field and plot the output for visualization.

**Suggested Books:**


1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).
3. LaTeX–A Document Preparation System", Leslie Lamport (Second Edition, Addison-Wesley, 1994).
4. Gnuplot in action: understanding data with graphs, Philip K Janert, (Manning 2010)
5. Schaum's Outline of Theory and Problems of Programming with Fortran, S Lipsdutz and A Poe, 1986Mc-Graw Hill Book Co.
6. Computational Physics: An Introduction, R. C. Verma, et al. New Age International Publishers, New Delhi(1999)
7. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
8. Elementary Numerical Analysis, K.E. Atkinson, 3rd Edn., 2007 , Wiley India Edition.

**SEMESTER V**

**WEATHER FORECASTING PRACTICAL** **L T P C**

**17PHU511B** **3 - - 3**

**Course Objective**:

- The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness
- To understand the causes and effects of different weather phenomenon and basic forecasting techniques.
- To know the role of air, water, and wind in weather systems.
- Assess variability and change within this expanded, extended and quality assured network.
- To explain what causes different types of weather.
- To understand the concept of Ecosystems and climate interactions

**Course Outcome**

After successful completion of the course, the student is expected to

1. Know the idea on Ecosystems and climate interactions
2. Know the Effects of climate change on life cycles
3. Know the Biodiversity, Weather vs climate
4. Understand the greenhouse effect, Treaty rights
5. Understand traditional ecological knowledge
6. Understand the importance of weather changes.

**Demonstrations and Experiments:**

1. Study of synoptic charts & weather reports, working principle of weather station.
2. Processing and analysis of weather data:
3. To calculate the sunniest time of the year.
4. To study the variation of rainfall amount and intensity by wind direction.
5. To observe the sunniest/driest day of the week.
6. To examine the maximum and minimum temperature throughout the year.
7. To evaluate the relative humidity of the day.
8. To examine the rainfall amount month wise.
9. Exercises in chart reading: Plotting of constant pressure charts, surfaces charts, upper wind charts and its analysis.
10. Formats and elements in different types of weather forecasts/ warning (both aviation and non aviation)

**Suggested books**

1. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur.
2. https://www.sciencedirect.com/science/article/abs/pii/S0065268708603118
3. https://cimss.ssec.wisc.edu/satmet/modules/7_weather_forecast/wf-1.html

4. https://www.outdoorproject.com/articles/weather-forecasting-101-how-predict-weather-go
5. https://www.weatheronline.in/.
6. https://www.weatheronline.in/weather/maps/city?WMO=43321&CONT=inin&LAND=II&ART=PRE&LEVEL=162&MOD=tab
7. https://www.worldweatheronline.com/hwd/

**SEMESTER V**

**ELEMENTS OF MODERN PHYSICS PRACTICAL L T P C**

**17PHU512A - - 4 2**

**Course Objective**

- To identify the circumstances, in Modern Physics. Enumerate and understand the postulate of relativity.
- To learn about the speed of light as a natural limit to speed.
- To understand the work of Planck, Bohr, Heisenberg, uncertainty principle and the other features of Quantum Mechanics.
- Acquaintance with basic fields of modern physics
- Ability of searching solutions of physical problems in scientific and technical literature.
- Understanding of physical processes and technology

**Course Outcome**

After successful completion of the course, the student is expected to

1. Recall and apply knowledge in the areas of optics and waves, special relativity and quantum physics (developing the knowledge capability dimension);
2. Conduct relevant experiments, analyse data and report results in written form (developing the technical capability and communication dimensions).
3. Analyse the plank's constant using different experimental technique.
4. Find the wavelength of any laser sources.
5. Differentiate the interference and diffraction properties by the experiments.
6. Understand the theory and practical knowledge of light and other properties.

**Any 8 Experiments**

1. Measurement of Planck's constant using black body radiation and photo-detector
2. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
3. To determine work function of material of filament of directly heated vacuum diode.
4. To determine the Planck's constant using LEDs of at least 4 different colours.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the ionization potential of mercury.
7. To determine the absorption lines in the rotational spectrum of Iodine vapour.
8. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
9. To setup the Millikan oil drop apparatus and determine the charge of an electron.

10. To show the tunneling effect in tunnel diode using I-V characteristics.
11. To determine the wavelength of laser source using diffraction of single slit.
12. To determine the wavelength of laser source using diffraction of double slits.
13. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

**Suggested Books:**

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

**SEMESTER V**

**MEDICAL PHYSICS PRACTICAL** **L T P C**

**17PHU512B** **- - 4 2**

**Course Objective**

- The objective of the course is to educate and to train students to a competency level sufficient to practice radiation oncology physics independently.
- This prepares the students for clinical practices in radiation therapy (RT) physics through a structured clinical trainings and didactic courses.
- To know the energetic charged particle interactions and transport in matter.
- The program is supervised and mentored by highly qualified clinical practitioners.
- This paper is aimed at giving idea to the students regarding the nature of human body and usage of different radiations for the treatment of body.
- To active participation in clinical research, teaching, and training.

**Course Outcomes**

After successful completion of the course, the student is expected to

1. Different areas of research in Medical Physics
2. Understand and apply key concepts specific to energy deposition for both ionizing photon interactions and transport in matter
3. Know the energetic charged particle interactions and transport in matter.
4. Understanding the working of a manual optical eye-testing machine
5. Familiarization with the Use of a Vascular Doppler.
6. Realize the real time examples of medical instruments.

**Any 8 experiments**

1) Understanding the working of a manual Hg Blood Pressure monitor and measure the Blood Pressure.
2) Understanding the working of a manual optical eye-testing machine and to learn eye-testing procedure.
3) Correction of Myopia (short sightedness) using a combination of lenses on an optical bench/breadboard.
4) Correction of Hypermetropia/Hyperopia (long sightedness) using a combination of lenses on an optical bench/breadboard.
5) To learn working of Thermoluminescent dosimeter (TLD) badges and measure the background radiation.
6) Familiarization with Geiger-Muller (GM) Counter and to measure background radiation.
7) Familiarization with Radiation meter and to measure background radiation.
8) Familiarization with the Use of a Vascular Doppler.

**Suggested Books:**

1. Basic Radiological Physics, Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
2. Christensen's Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
3. Physics of Radiation Therapy: F M Khan - Williams and Wilkins, 3rd edition (2003)
4. The essential physics of Medical Imaging: Bushberg, Seibert, Leidholdt and Boone Lippincot Williams and Wilkins, Second Edition (2002)
5. Handbook of Physics in Diagnostic Imaging: Roshan S. Livingstone: B. I. Publications Pvt Ltd.
6. The Physics of Radiology-H E Johns and Cunningham.

**SEMESTER V**

**MATHEMATICS - I PRACTICAL** **L T P C**

**17PHU513** **- - 4 2**

**Course Objectives**

This course enables the students

- To develop skills for quantitative estimation using computer language.
- To code various differentiation and integration methods in a modern computer language.
- To plot the graphs of function
- Problem-solving through programming.
- Hands-on training using lab components.
- The usage of program to solve the differential equations.

**Course Outcomes (COs)**

On successful completion of this course, the student will be able to

1. Solve complicated matrix related problems like matrix inverse and matrix multiplication.
2. Acquire problem-solving skills through computer programming.
3. Plot various functions and parametric curves.
4. Solve the differential equations for physics problems
5. Gain the intellectual knowledge of complex functions and their applications.
6. Apply the mathematical concepts to physics problems with the aid of computer programming
7. Solve the geometry and plot variations of complex functions.

**LIST OF PRACTICALS**

1. Plotting of graphs of function $e^{ax+b}$, log(ax + b), 1/(ax + b), sin(ax + b), cos(ax + b), |ax +b| and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of polynomial of degree 4 and 5, the derivative graph.
3. Sketching parametric curves. (Eg. Circle, Ellipse, Cycloid and Asteroid).
4. Evaluating definite integrals.(Line integral)
5. Evaluating integrals using Reduction formulae.
6. Evaluating integration of an expression by Quadrature.
7. Plotting the double integral of $z = f(x, y) = x + y$ in $0 < x < 2;\ 0 < y < 2$.
8. Plotting area under any curve using line integral.

**SUGGESTED READINGS**

1. S.Narayanan and T.K.M. Pillai. Calculus Vol 1 and Vol 2,Viswanathan Publishers.
2. P.Kandasamy & K.Thilagarathy,Mathematics for BSc .Vol I and. II(2000), S.Chand and Co.
3. Shanthi Narayanan & J.N.Kapoor, A Text book of calculus,S.Chand & Co

SEMESTER V

**CHEMISTRY PRACTICAL - I** L T P C

**17PHU514** - - 4 2

**Course Objective**

- To make the student able to identify the elements and the functional groups present in an organic compound.
- Experimental practice of quantitative and qualitative analysis.
- The objective of the titration is the determination of the concentration or the mass of the minimum formula from the titrated chemical material composing a pure liquid or a solution.
- The main objective of volumetric analysis is to determine the amount of a substance in a given sample.
- When dealing with volumetric analysis the concept of concentration cannot be avoided.
- Molarity i.e. moles per litre or decimeter is widely used unit of concentration.

**Course Outcome**

On successful completion of the course the students able to

1. Learnt about the qualitative analysis of organic compounds.
2. Learnt the detection of elements and functional groups present in an organic compound by systematic analysis.
3. Gain knowledge on basic test of organic compounds.
4. Differentiate the chemicals and their families.
5. Identify the compound wheather it is aromatic or aliphatic.
6. Confirm different functional group by confirmation studies.

**Systematic analysis of an organic compound**

1. Preliminary tests
2. Detection of elements present
3. Aromatic or aliphatic
4. Saturated or unsaturated
5. Nature of the functional group,
6. Confirmatory tests– aldehydes, ketones, amines, amides, diamide, carbohydrates, phenols, acids, esters & nitro compounds.

Note: Each student should analyse minimum 6 compounds.

**SUGGESTED BOOKS**

1. Thomas, A.O. (2012). Practical Chemistry for B.Sc. Main Students. Cannanore: Kerala, Scientific Book Centre.
2. Ramasamy, R. (2011). Allied Chemistry Practical Book. Karur: Priya Publications.
3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A. R. (2015). Basic Principles of Practical Chemistry (2nd ed.). New Delhi: S. Chand Publications.

**SEMESTER VI**

**NANO MATERIALS AND APPLICATIONS** **L T P C**

**17PHU601A** **4 - - 4**

**Course Objective:**

- This course covers the different classes of nanomaterials that have been developed in recent years in light of various technological applications.
- In order to understand the behavior of these nanomaterials, quantum phenomena and the limitations of basic physical laws that are important at the nanometer length scale are introduced and developed.
- In particular, properties that exhibit size effects (including electronic, magnetic, photonic, and mechanical) at the nanometer length scale will be presented so that nanomaterials becoming increasing relevant to modern technologies can be better understood.
- The course will cover recent breakthroughs and assess the impact of this burgeoning field.
- Specific nanofabrication topics include epitaxy, beam lithographies, self- assembly, biocatalytic synthesis, atom optics, and scanning probe lithography.
- The course consists of topics in fundamental nanoscale science, plus an overview of areas in nanotechnology.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Explain the fundamental principles of nanotechnology and their application to biomedical engineering.
2. Apply engineering and physics concepts to the nano-scale and non-continuum domain.
3. Identify and compare state-of-the-art nanofabrication methods
4. perform a critical analysis of the research literature.
5. Design processing conditions to engineer functional nanomaterials.
6. Evaluate current constraints, such as regulatory, ethical, political, social and economical, encountered when solving problems in living systems.

**UNIT - I**

**NANOSCALE SYSTEMS**: Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), 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, 1Dnanostructures and its consequences.

**UNIT - II**

**SYNTHESIS OF NANOSTRUCTURE MATERIALS:** Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD).Sol-Gel. Electro deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots.

**UNIT - III**

**CHARACTERIZATION:** X-Ray Diffraction. Optical Microscopy. Scanning Electron Microscopy. Transmission Electron Microscopy. Atomic Force Microscopy.Scanning Tunneling Microscopy. Fourier Transform Infrared spectroscopy, UV-visible spectroscopy

**UNIT – IV**

**OPTICAL PROPERTIES:** Coulomb interaction in nanostructures. Concept of dielectric constant for nanostructures and charging of nanostructure. Quasi-particles and excitons. Excitons in direct and indirect band gap semiconductor nanocrystals. Quantitative treatment of quasi-particles and excitons, charging effects. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

**UNIT - V**

**ELECTRON TRANSPORT:** Carrier transport in nanostrcutures. Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

**APPLICATIONS:** Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots -magnetic data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

**Suggested Books:**

1. C.P.Poole, Jr. Frank J.Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.). S.K. Kulkarni,
2. Nanotechnology: Principles & Practices (Capital Publishing Company) K.K. Chattopadhyay and A. N. Banerjee,
3. Introduction to Nanoscience and Technology (PHI Learning Private Limited).
4. Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011, Cambridge University Press.
5. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).
6. Mark C. Hersam (2006), "MSE 376 Nanomaterials," https://nanohub.org/resources/1914.

7. https://nanohub.org/resources/7313.
8. https://ocw.mit.edu/courses/mechanical-engineering/2-674-micro-nano-engineering-laboratory-spring-2016/lecture-notes/MIT2_674S16_Lec7Nano.pdf

**SEMESTER VI**

| 17PHU601B | BIOLOGICAL PHYSICS | L T P C |
|---|---|---|
| | | 4 - - 4 |

**Course Objectives**:

- The course aims to provide students with a foundation in the basic concepts of Biophysics.
- Biophysics is an interdisciplinary science that employs and develops theories and methods of the physical sciences for the investigation of biological systems.
- Topics will include canonical and non-canonical structures of nucleic acids, structure of proteins, enzymes etc.
- Fundamental concepts that underlie biomolecular interactions will be discussed and biophysical methods that are employed for the structural analysis of these systems will be introduced at an elementary level.
- To Understand the concept of life of molecules.
- The physical quantities such as temperature, energy, enthalpy, entropy, and free energy will be employed to understand why a biological system choses particular state at conditions under study.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Demonstrate knowledge of the fundamental concepts in physics and chemistry that underlie biological processes.
2. Define the structural characteristics of nucleic acids and proteins
3. Examine parameters that variously determine their stability and function(s).
4. Describe the principles that govern biomolecular interactions
5. Appreciate how established methods of research and enquiry are employed to analyze the different aspects of these interactions.
6. Understand the oncept of life of molecules.

**UNIT -I**

**Overview:** The boundary, interior and exterior environment of living cells. Processes: exchange of matter and energy with environment, metabolism, maintenance, reproduction, evolution. Self-replication as a distinct property of biological systems. Time scales and spatial scales. Universality of microscopic processes and diversity of macroscopic form. Types of cells. Multicellularity. Allometric scaling laws.

**UNIT- II**

**Molecules of life:** Metabolites, proteins and nucleic acids. Their sizes, types and roles in structures and processes. Transport, energy storage, membrane formation, catalysis, replication, transcription, translation, signaling. Typical populations of molecules of various types present in cells, their rates of production and turnover. Energy required to make a

bacterial cell. Simplified mathematical models of transcription and translation, small genetic circuits and signaling pathways. Random walks and applications to biology. Mathematical models to be studied analytically and computationally.

**UNIT -III**

**The complexity of life:** At the level of a cell: The numbers of distinct metabolites, genes and proteins in a cell. Complex networks of molecular interactions: metabolic, regulatory and signaling networks. Dynamics of metabolic networks; the stoichiometric matrix. Living systems as complex organizations; systems biology. Models of cellular dynamics. The implausibility of life based on a simplified probability estimate, and the origin of life problem.

**UNIT -IV**

**At the level of a multicellular organism:** Numbers and types of cells in multicellular organisms. Cell types as distinct attractors of a dynamical system. Stem cells and cellular differentiation. Pattern formation and development. Brain structure: neurons and neural networks. Brain as an information processing system. Associative memory models. Memories as attractors of the neural network dynamics.

**UNIT -V**

**At the level of an ecosystem and the biosphere:** Foodwebs. Feedback cycles and self-sustaining ecosystems.

**Evolution:** The mechanism of evolution: variation at the molecular level, selection at the level of the organism. Models of evolution. The concept of genotype-phenotype map. Examples.

**Suggested Books:**

1. Physics in Molecular Biology; Kim Sneppen & Giovanni Zocchi (CUP 2005)
2. Biological Physics: Energy, Information, Life; Philip Nelson (W H Freeman & Co, NY, 2004)
3. Physical Biology of the Cell (2nd Edition), Rob Phillips et al (Garland Science, Taylor & Francis Group, London & NY, 2013)
4. An Introduction to Systems Biology; Uri Alon (Chapman and Hall/CRC, Special Indian Edition, 2013)
5. Evolution; M. Ridley (Blackwell Publishers, 2009, 3rd edition)
6. http://www.physics.drexel.edu/~brigita/COURSES/BIOPHYS_2011-2012/
7. https://www.easybiologyclass.com/biophysics-free-online-classes-lecture-notes-references-study-materials/

SEMESTER VI

**MATHEMATICS - II** L T P C

**17PHU602** 4 - - 4

**Course Objective**

This course enables the students to learn

- The Concept of Fourier analysis and solving boundary value problems.
- Techniques of Fourier and Laplace transform
- To solve differential equations.
- Numerical techniques of differentiation and integration.
- The basic concepts of Reduction of second order Linear Equations to canonical forms
- The Systems of linear differential equations and its applications.
- The concept of second order linear homogeneous, non-homogeneous differential equations with constant coefficients.

**Course Outcomes (COs)**

On successful completion of this course, the students will be able to

1. Appreciate the physical significance of Fourier series
2. Understand the mathematical principles on transforms.
3. Apply mathematical foundation to formulate and solve problems arising in physics
4. Synthesize numerical techniques for practical problems.
5. Solve the numerical problem for physics
6. Apply the numerical methods to solve the real-life problem

**UNIT I**

Ordinary Differential Equations: Equations of First Order and of Degree Higher than one – Solvable for p, x, y – Clairaut's Equation – Simultaneous Differential Equations with constant coefficients of the form i) $f_1 D(x) + g_1 D(y) = \phi_1(t)$ ii) $f_2 D(x) + g_2 D(y) = \phi_2(t)$, where $f_1$, $g_1$, $f_2$ and $g_2$ are rational functions $D = \frac{d}{dt}$ with constant coefficients $\phi_1$ and $\phi_2$ explicit functions of $t$.

**UNIT II**

Finding the solution of Second and Higher Order with constant coefficients with Right Hand Side is of the form $Ve^{ax}$, where $V$ is a function of $x$ – Euler's Homogeneous Linear Differential Equations – System of simultaneous linear differential equations with constant coefficients.

**UNIT III**

Partial Differential Equations: Formation of Partial Differential Equation by eliminating arbitrary constants and arbitrary functions – Solutions of Partial Differential Equations by direct integration – Solution of standard types of first order partial differential equations.

**UNIT IV**

Laplace transforms: Definition – Laplace Transforms of standard functions – First Shifting Theorem – Transform of $tf(t), \frac{f(t)}{t}, f'(t), f''(t)$ - Inverse Laplace Transforms – Applications to solutions of First Order and Second Order Differential Equations with constant coefficients.

**UNIT V**

Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Interpolation with equal intervals – Newton's forward and backward difference formulae.

**SUGGESTED READINGS**

1. Treatment as in Kandasamy. P, Thilagavathi. K "Mathematics for B.Sc – Branch – I Volume III", S. Chand and Company Ltd, New Delhi, 2004.
2. S. Narayanan and T.K. Manickavasagam Pillai, Calculus, S. Viswanathan (Printers and Publishers) Pvt. Ltd, Chennai 1991
3. N.P. Bali, Differential Equations, Laxmi Publication Ltd, New Delhi, 2004
4. Dr. J. K. Goyal and K.P. Gupta, Laplace and Fourier Transforms, Pragali Prakashan Publishers, Meerut, 2000.
5. Sankara Rao K., Numerical methods for scientists and Engineers, Prentice Hall of India Private, 3rd Edition, New Delhi, 2007.

**SEMESTER VI**

**CHEMISTRY-II** **L T P C**

**17PHU603** **4 - - 4**

**Course Objectives**

- To make the student to be conversant with the extraction of metals, coordination chemistry, preparation, properties uses and structure of naphthalene and heterocyclic compounds.
- To make the student acquire sound knowledge of electrochemistry, biological functions of amino acids and proteins, thermodynamic laws, entropy, enthalpy change and the principles of electroplating.
- To understand types and structure of different compounds.
- To understand types and structure of inorganic carbon compounds.
- To distinguish between intra and inter molecular hydrogen bonding.
- To understand the electro chemistry of chemicals.

**Course Outcome**

After successful completion of the course, the student is expected to

1. The student understand the metallurgy of metals and the theories of coordination compounds and the industrial importance of EDTA, haemoglobin and chlorophyll.
2. Understand the concept of aromaticity and preparation of aromatic compounds including heterocyclic compounds.
3. Understand the preparation, classifications and properties of amino acids, proteins and carbohydrates.
4. Understand the concepts of first and second laws of thermodynamics.
5. Understand the fundamentals of electrochemistry.
6. Know the concept and applications of the glucose and fructose.

**UNIT-I**

**Metals and Coordination Chemistry:**

**Metals:** General methods of extraction of metals-methods of ore dressing-types of furnaces-reduction methods-electrical methods-types of refining-Van Arkel process-Zone refining.

**Coordination Chemistry:** Nomenclature-theories of Werner, Sidgewick and Pauling-chelation and its industrial importance-EDTA-haemoglobin-chlorophyll-applications in qualitative and quantitative analysis.

**UNIT-II**

**Aromatic Compounds and Heterocyclic Compounds:**

**Aromatic Compounds:** Aromaticity-Huckel's (4n+2) rule- aromatic electrophilic substitution in benzene- mechanism of nitration, halogenation, alkylation, acylation and sulphonation.

Naphthalene: Isolation, preparation, properties and structure.

**Heterocyclic Compounds:** Preparation and properties of pyrrole, furan, thiophene and pyridine.

**UNIT-III**

**Amino acids, Proteins and Carbohydrates:**

**Amino acids:** Classification, preparation and properties. Peptides-preparation of peptides (Bergmann method only).

**Proteins:** Classification, properties, biological functions and structure.

**Carbohydrates:** Classification, preparation and properties of glucose and fructose-discussion of open chain and ring structures of glucose and fructose-glucose-fructose interconversion.

**Unit-IV**

**Energetics:** Type of systems-processes and their types - isothermal, adiabatic, reversible, irreversible and spontaneous processes-statement of first law of thermodynamics-need for the second law of thermodynamics-heat engine-Carnot cycle-efficiency-Carnot theorem-thermodynamics scale of temperature-Joule-Thomson effect- Enthalpy- Entropy and its significance-Free energy change.

**Unit-V**

**Electrochemistry:** Kohlrausch law-conductometric titrations-hydrolysis of salts-galvanic cells-E.M.F.-standard electrode potentials-reference electrodes- electrochemical series and its applications-buffer solution-buffer solution in the biological systems-pH and its determination-principles of electroplating.

**SUGGESTED BOOKS**

1. V.Veeraiyan & A.N.S. Vasudevan, Text Book of Allied Chemistry (II Edition), Highmount Publishing House, Chennai (2005).
2. B.R.Puri and L.R.Sharma, Principles of Inorganic Chemistry, Shobanlal& Company Ltd., Jalandar (2002).
3. B.S.Bahl & ArunBahl, Advanced Organic Chemistry, S.Chand& Company Ltd., New Delhi (2005).
4. Puri, Sharma & Pathania, Physical Chemistry, Vishal Publishing Company Ltd., Jalandhar (2003).
5. R.Gopalan &S.Sundaram, Allied Chemistry (III Edition), Sultan Chand & Sons., New Delhi (2003).

**SEMESTER VI**

| | | L | T | P | C |
|---|---|---|---|---|---|
| **17PHU611A** | **NANO MATERIALS AND APPLICATIONS PRACTICAL** | **-** | **-** | **4** | **2** |

**Course Objective**

- To provide knowledge of the Nanoscience and related fields.
- To make the students acquire an understanding the Nanoscience and Applications
- To help them understand in broad outline of Nanoscience and Nanotechnology.
- The course will cover recent breakthroughs and assess the impact of this burgeoning field.
- Specific nanofabrication topics include epitaxy, beam lithographies, self- assembly, biocatalytic synthesis, atom optics, and scanning probe lithography.
- The course consists of topics in fundamental nanoscale science, plus an overview of areas in nanotechnology.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Understand the methods synthesis of nanomaterials
2. Understand their application and the impact of nanomaterials on environment
3. Apply their learned knowledge to develop Nanomaterials.
4. Bring new materials to the socity.
5. Gain knowledge on different spectroscopic techniques.
6. Apply their learned knowledge to develop the new devices.

**Any 8 experiments**

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. To prepare composite of CNTs with other materials.
7. Growth of quantum dots by thermal evaporation.
8. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
9. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
10. Prepare a thin film capacitor and measure capacitance as a function of temperature or frequency.
11. Fabricate a PN diode by diffusing Al over the surface of N-type Si and study its V-I characteristic.

**Suggested Books:**

1. C.P.Poole, Jr. Frank J.Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.). S.K. Kulkarni,
2. Nanotechnology: Principles & Practices (Capital Publishing Company). K.K. Chattopadhyay and A.N. Banerjee,
3. Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

**SEMESTER VI**

**BIOLOGICAL PHYSICS PRACTICAL** **L T P C**

**17PHU611B** **- - 4 2**

**Course Objective**

- To provide knowledge of the Nanoscience and related fields.
- To make the students acquire an understanding the Nanoscience and Applications
- To help them understand in broad outline of Nanoscience and Nanotechnology.
- Fundamental concepts that underlie biomolecular interactions will be discussed and biophysical methods that are employed for the structural analysis of these systems will be introduced at an elementary level.
- To Understand the concept of life of molecules.
- The physical quantities such as temperature, energy, enthalpy, entropy, and free energy will be employed to understand why a biological system choses particular state at conditions under study.

**Course Outcome**

After successful completion of the course, the student is expected to

1. Understand the methods synthesis of nanomaterials
2. Understand their application and the impact of nanomaterials on environment
3. Apply their learned knowledge to develop Nanomaterials.
4. Bring new materials to the socity.
5. Gain knowledge on different spectroscopic techniques.
6. Apply their learned knowledge to develop the new devices.

**Any 8 Experiments**

1. Measurement of the skin temperature by thermistor
2. Estimation of relative humidity
3. Continual spectrum of visible light
4. Measurement of concentration in coloured solution
5. Measurement of human hair thickness by microscope
6. Blood pressure measurement
7. Estimation of audibility threshold by audiometer
8. Recording and analysis of ECG signals
9. Verification of Beers and Lambert’s Law
10. Absorption spectrum of Blood/Chlorophyll.
11. PH Value of Amino acids.
12. Study of DNA melting
13. Bimolecular model building using standard kits.

**Suggested Books:**

1. Introduction to Biophysics - by P. Narayanan.New Age P.
2. Medical Instrumentation - by Khandpur, TMH
3. Laboratory Manuals of Biophysics Instruments - by P.B. Vidyasagar
4. Biophysics -by VatsalaPiramal, Dominant Publisher and Distributors, New Delhi-110002
5. Textbook of Biophysics - by R.N. Roy 6. Photosynthesis - by Hall and Rao.

SEMESTER VI

**MATHEMATICS -II PRACTICAL** L T P C

**17PHU612** - - 4 2

**Course Objectives**

This course enables the students to learn

- To solve simultaneous linear algebraic equations using various methods.
- To evaluate definite integrals using numerical techniques.
- Problem-solving through (computer language) programming.
- The basic concepts of Reduction of second order Linear Equations to canonical forms
- The Systems of linear differential equations and its applications.
- The Equations with non-homogeneous boundary conditions.

**Course Outcomes (COs)**

On successful completion of this course, the student will be able to

1. Familiarize with the programming environment for numerical methods.
2. Develop proficiency in skills to solve the algebraic equations.
3. Evaluate the definite integrals using computer programming techniques
4. Find the solution through programming.
5. Write the coding for physical problems
6. Solve complex problems through modeling.

**List of Practical**

1. Plotting of second order solution family of differential equation.
2. Growth model (exponential case only).
3. Decay model (exponential case only).
4. Solving first order ordinary differential equations.
5. Solution of second order ordinary differential equations with initial conditions.
6. Solving system of linear differential Equations.
7. Computing Lagrange's interpolating polynomial.
8. Computing interpolating polynomial using Newton's formula.

**SEMESTER VI**

**CHEMISTRY PRACTICAL -II** **L T P C**

**17PHU613** **- - 4 2**

**Course Objective**

- The student on successful completion of the course should learn the principles of volumetric analysis.
- To estimate the compounds by acidimetry, alkalimetry and permanganometry.
- To acquire practical skills in volumetric analysis.
- To understand the basic principles of volumetric analysis.
- To estimate the Acidimetry & Alkalimetry by volumetric analysis

**Course Outcome**

After successful completion of the course, the student is expected to

1. Learnt about the qualitative analysis of organic compounds.
2. Learnt the detection of elements and functional groups present in an organic compound by systematic analysis.
3. Gain knowledge on basic test of organic compounds.
4. Differentiate the chemicals and their families.
5. Estimate the Acidimetry & Alkalimetry by volumetric analysis
6. Experience the practical knowledge of Acidimetry & Alkalimetry, Permanganometry

**Contents**

**Volumetric analysis**

**A. Acidimetry & Alkalimetry**

1. Estimation of sodium carbonate using standard sodium hydroxide.
2. Estimation of sodium hydroxide using standard sodium carbonate.
3. Estimation of sulphuric acid using standard oxalic acid.
4. Estimation of potassium permanganate using standard sodium hydroxide.

**B. Permanganometry**

1. Estimation of ferrous sulphate using standard Mohr's salt.
2. Estimation of oxalic acid using standard ferrous sulphate.
3. Estimation of calcium-direct method.

**References:**

1. Thomas, A.O. (2012). Practical Chemistry for B.Sc. Main Students. Cannanore: Kerala, Scientific Book Centre.
2. Ramasamy, R. (2011). Allied Chemistry Practical Book. Karur: Priya Publications.
3. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu A. R. (2015). Basic Principles of Practical Chemistry (2nd edition). New Delhi: S. Chand Publications.

**SEMESTER VI**

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|---|---|---|
| | **PROJECT** | **L T P C** |
| **17PHU691** | | **- - 6 4** |

**Course Objectives**

- The aim of the B.Sc. project work is to expose the students to preliminaries and methodology of research in Theoretical Physics and Experimental Physics.
- Students get the opportunity to participate in some ongoing research activity and development of a laboratory experiment.
- To explain the physics problem and its solution in both words and appropriately specific equations to both experts and non-experts.
- To understand the objective of a physics laboratory experiment, properly carry out the experiments, and appropriately record and analyze the results.
- To use computers in data acquisition and processing and how to use available software as a tool in data analysis.
- To think creatively about scientific problems and their solutions.
- To design experiments, and to constructively question results they are presented with, whether these results are in a newspaper, in a classroom, or elsewhere.

**Course Outcomes (COs)**

After successful completion of the course, the student is expected to

1. Complete an independent research project, resulting in research outputs in terms of publications in journals and conference proceedings.
2. To apply his/her knowledge and skills to carry out advanced tasks and projects.
3. Apply their knowledge to develop the instruments.
4. Verify the basic principles and laws experimentally as a project.
5. Demonstrate knowledge of contemporary issues in their chosen field of research.
6. Demonstrate an ability to present and defend their research work.
7. Successfully pursue career objectives in graduate school or professional schools, in a scientific career in government or industry, in a teaching career, or in a related career.
8. Think creatively about scientific problems and their solutions.
9. Design experiments, and to constructively question results they are presented with, whether these results are in a newspaper, in a classroom, or elsewhere.
10. Explain the physics problem and its solution in both words and appropriately specific equations to both experts and non-experts.
11. Understand the objective of a physics laboratory experiment, properly carry out the experiments, and appropriately record and analyze the results.
12. Use computers in data acquisition and processing and how to use available software as a tool in data analysis.