

B.Sc. PHYSICS

CHOICE BASED CREDIT SYSTEM (CBCS)

Syllabus

Students admitted from 2019 onwards



DEPARTMENT OF PHYSICS

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University Established Under Section 3 of UGC Act, 1956)

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முதல் பருவம்

19LSU101

பகுதி - I தமிழ்ப் 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 பன்னோக்கு 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 வேலைவாய்ப்புத் திறன் பெற்றிருத்தல்.

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

- | | |
|---------------------------------|---------------------------|
| 1. மகாகவி பாரதியார் | – பரம்பொருள் வாழ்த்து . |
| 2. புரட்சிக்கவிஞன் பாரதிதாசன் | – தமிழின் இனிமை. |
| 3. கவிமணி தேசிக விநாயகம் பிள்ளை | – கோவில் வழிபாடு. |
| 4. கவிக்கோ. அப்துல்ரகுமான் | – பாருக்குள்ளே நல்ல நாடு. |
| 5. சிற்பி பாலசுப்பிரமணியன் | – காலம். |
| 6. கவிஞர் தாமரை | – தொலைந்து போனேன். |

அலகு – II : அற இலக்கியம்:**(8 மணிநேரம்)**

- ஒளவையார் – கொன்றை வேந்தன் (1- 50 பாடல்கள்)
அன்னையும் பிதாவும் – புலையும் கொலையும் களவும் தவிர்
- வேதநாயகம்பிள்ளை - நீதிநூல் – (5 பாடல்கள்)
சின்னவோர் பொருள், கடவுளை வருந்தி, எப்புவிதளும், வைத்தவர், ஈன்றவர்
- திருவள்ளுவர்- திருக்குறள்- பண்புடைமை, வினைத்திட்டம்
- முன்றுறையரையனார் – பழமொழி நானூறு 5 பாடல்கள்

உணற்கு இனிய, பரந்த திறலாரை, நெடியது காண்கிலாய், இனி யாரும், உரைசான்ற

அலகு – III : சிற்றிலக்கியம்:**(8 மணிநேரம்)**

- முக்கூடற் பள்ளு- 2 பாடல்கள் - சித்திரக் காலிவாலான் (நெல்வகைகள்) குற்றாலத் திரிகூட மால்வரை (மீன் வகைகள்)
- நந்தி கலம்பகம்- 5 பாடல்கள்- என்னையே புகழ்ந்தேன், பதிதொறு புயல்பொழி, இந்தப்புவிடில், அடிவிளக்கும் துகில், வானுறுமதியை.
- மதுரைச் சொக்கநாதர் தமிழ்விடு தூது –தமிழின் சிறப்பு பாடியருள பத்துப்பாட்டும்-விளம்பக்கேள்.

அலகு – IV : சிறுகதை:**(8 மணிநேரம்)**

- | | |
|---------------------|-------------------|
| 1. மகாமசானம் | – புதுமைப்பித்தன் |
| 2. அப்பாவின் வேஷடி | – பிரபஞ்சன் |
| 3. அந்நியர்கள் | – ஆர். சூடாமணி |
| 4. இந்நாட்டு மன்னர் | – நாஞ்சில்நாடன் |

அலகு – V : மொழிப்பயிற்சி:**(6 மணிநேரம்)**

- பொருத்தமான தமிழ்ச் சொற்களைப் பயன்படுத்துதல்

2. செய்யுள் பொருளுணர் திறன்
3. மொழிபெயர்ப்புப் பயிற்சிகள்
4. கடிதங்கள் மற்றும் விண்ணப்பங்கள் எழுதுதல்

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.

கற்பகம் உயர்கல்வி கலைக்கழகத் தமிழ்த்துறை வெளியீடு.

Instruction Hours / week: L: 4 T: 0 P: 0**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives:**

- To train students to acquire proficiency in English.
- To explore different genres of literature and learning grammar.
- To provide aesthetic pleasure through literature.
- To inculcate moral values through literature.
- To develop ethical values.
- To give basic grammar knowledge.

Course Outcome:

1. Develop the knowledge of interpersonal skills.
2. Establish and maintain social relationships.
3. Genres of literature will give moral values of life.
4. Develop communication skills in business environment
5. Communication skills will get developed.
6. Develop to have 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. Telephone Conversation- Wole Soyinka
3. A River - A.K. Ramanujan

UNIT - III : SHORT STORIES

1. Rapunzel - Brothers Grimm
2. The Ant and The Grasshopper- W. Somerset Maugham
3. The Nightingale and the Rose - Oscar Wilde.

UNIT - IV: Drama

1. The Merchant of Venice- Act 4-Scene 1
2. The Death Trap- Saki

UNIT - V: Grammar and Composition**GRAMMAR :**

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

Composition:

1. Reading to Comprehend
2. Letter Writing
3. Resume Writing
4. General Essay

Prescribed Text:

Reminisce, Published by the Department of English, Karpagam Academy of Higher Education.

Suggested Reading:

Hewings Martin, 1999 Advanced English Grammar, Cambridge University Press

19PHU101	SEMESTER – I			
	MECHANICS			5H – 5C
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Instruction Hours / week: L: 5 T: 0 P: 0	Marks: Internal: 40	External: 60	Total: 100	

End Semester Exam: 3 Hours**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. Understand the basic concepts of mechanics
2. Understand the concepts of simple harmonic motion
3. Define 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. Analyse the 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: 1st order homogeneous differential equations. 2nd 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.

Friction-Static Friction - Laws of Friction-Angle and cone of Friction - Motion up and down on a rough inclined plane.

UNIT V- MOTION OF RIGID BODY

Moment of inertia of a rod, disc, spherical shell, solid and hollow spheres - Theory of compound pendulum and Kater's pendulum - Determination of 'g' - Derivation of expressions for angular momentum and kinetic energy of a system of N particles.

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>
10. <https://www.coursera.org/learn/rigid-body-dynamics>
11. <https://ocw.mit.edu/courses/physics/8-01sc-classical-mechanics-fall-2016/week-10-rotational-motion/28.1-rigid-bodies/>

SEMESTER – I

19PHU102**PROPERTIES OF MATTER AND ACOUSTICS****5H – 5C**

Instruction Hours / week: L: 5 T: 0 P: 0**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 understand the surface tension and viscosity of fluid.
- 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

- Understand the basic concepts of elastivity.
- Understand the concepts of simple harmonic motion
- Study the elastic behaviour and working of torsional pendulum
- Understand the surface tension and viscosity of fluid
- Know the theorems of viscosity and interpretation of their results.
- Analyze the acoustics as a systematic tool for problem solving.

UNIT I - KINETIC THEORY OF GASES

Assumption of Kinetic theory of gases, pressure of an ideal gas (no derivation), Boyle's law, Charles' law, Reganults law, Avagadro law, Kinetic interpretation of Temperature, Ideal Gas equation, Degree of freedom, Law of equipartition of energy and its application for specific heat of gases, Real gases, Vander wall's equation, Brownian motion(Qualitative).

UNIT II- 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 - η & by Searles method.

UNIT III- SURFACE TENSION

Surface tension and Surface energy- Pressure difference across a spherical surface- Pressure difference across a curved surface - Angle of contact - Angle of contact for water in a glass - Vapour pressure over a flat and curved surface - Variation of Surface tension with temperature - Jaegar's method - Quincke's method.

UNIT IV- VISCOSITY

Streamline flow and Turbulent flow - Stoke's law - Stoke's method for the coefficient of viscosity - Poiseuille's method for the coefficient of viscosity - correction to Poiseuille's equation - Ostwald's viscometer - Variation of viscosity with temperature and pressure - Friction and Lubrication - Searle's viscometer - Viscosity of gases - Modification of Poiseuille's formula for gases - Rankine's method for determining the coefficient of viscosity of a gas.

UNITV - ULTRASONICS

Intensity and Loudness of sound – decibels – Intensity level – Laws of Transverse Vibrations – Melde's String – Sonometer.

Ultrasonics – Production of ultrasonic wave – Piezoelectric crystal method – Magnetostriction method – Properties – detection – Applications.

SUGGESTED READINGS

1. Mathur. D.S, 11th edition 2010, Elements of properties of matter, S. Chand .& company, New Delhi
2. A text book of Sound – Subramanyam and Brijlal – Vikas publishing House Pvt. Ltd, II Edition 1982.
3. Murugesan. R, Revised edition 2004, Properties of matter, S. Chand & Company, New Delhi.
4. Brijlal and N. Subramanyam, 1st edition 2004, Properties of matter, S. Chand & Company, NewDelhi.
5. Mathur.D.S., 2004 edition, Mechanics, S. Chand & Company, New Delhi.
6. Uppadahayay. J. C., 2003, Properties of Matter, Ram Prakash and Sons, Agra.
7. Katie Dicker 1st edition 2011 properties of matter Wind Mills book Ltd
8. A text book of Sound – Khanna and Bedi Atma Ram & Son's, New Delhi.
9. <https://www.askiitians.com/revision-notes/physics/flow-of-liquids-and-viscosity/>
10. https://www.engineeringtoolbox.com/dynamic-absolute-kinematic-viscosity-d_412.html
11. <https://mbi-ctac.sites.medinfo.ufl.edu/files/2017/02/ultrasound-basics.pdf>
12. <http://web.mit.edu/1.63/www/Lec-notes/Surfacetension/Lecture1.pdf>
13. http://web.mit.edu/16.unified/www/FALL/fluids/Lectures/surf_tension.pdf

Instruction Hours / week: L: 4 T: 0 P: 0**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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

Matrices: Different types of matrices – Inverse of a matrix – Solution of simultaneous equations by matrix method- Cayley-Hamilton theorem(Statement only)-Verification.

UNIT II

Vector calculus: Concepts of vector and scalar fields- Derivative of a vector - The Del operator, Gradient – Divergence of a vector – Curl of a vector- Directional derivative – Formula involving ∇ operator. Laplacian Operator.

UNIT III

Complex variables: Analytical function –Cauchy –Riemann equations – The necessary and sufficient condition for $f(z)$ to be analytic – Polar form of C-R equation-Properties of analytic function – Construction of analytic functions – Milne Thomson method.

UNIT IV

Differential calculus: Differentiation- Curvature and radius of Curvature in Cartesian and Polar form – Evolutes – Involute.

UNIT V

Integral Calculus: Definite and Indefinite integrals – Methods of Integration – Integration by substitution – Integration by parts.

SUGGESTED READINGS

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

Instruction Hours / week: L: 0 T: 0 P: 2**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Know forces their relationship to engineering applications
3. Analyze motion, forces and motion, work and energy problems and their relationship to engineering applications
4. Understand basic laws governing mechanics of a system.
5. Determine the acceleration due to gravity using various methods.
6. Determine the Moment of Inertia using various methods.

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 g by compound pendulum
5. To determine g by simple pendulum
6. To determine g by Bar Pendulum.
7. To determine g by Kater's Pendulum.
8. To determine g and velocity for a freely falling body using Digital Timing Technique
9. To study the Motion of a Spring and calculate Spring Constant
10. To determine the moment of inertia of a solid sphere

SUGGESTED READINGS

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**19PHU112 PROPERTIES OF MATTER AND ACOUSTICS PRACTICAL 2H – 1C**

Instruction Hours / week: L: 0 T: 0 P: 2**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objective**

- To be able to identify solids, liquids and gases, and their main properties.
- To be able to identify changes of state.
- To be able to discuss changes of state in terms of the energy of molecules.
- Analyze motion, forces and motion, work and energy problems and their relationship to engineering applications.
- Conduct experiments on wooden bar and to identify its the strength
- Test a wire or cylindrical rod for its strength.

Course Outcomes (COs)

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

1. Study the elastic behavior and working of torsional pendulum.
2. Study the bending behavior of beams and analyse the expression for young's modulus.
3. Understand about the surface tension and viscosity of fluid.
4. Use different methods to determine the Young's modulus of different materials.
5. Use different methods to determine the Rigidity modulus of different materials.
6. Experience the practical knowledge on different matters.

ANY SIX EXPERIMENTS

1. To determine the Young's Modulus of the wooden by Optical Lever Method.
2. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
3. To determine the Young's modulus of the bar using pin and microscope – Non-uniform method.
4. To determine the Young's modulus of the bar using cantilever – Non-uniform method.
5. To determine the surface tension of water – capillary rise method
6. To determine the coefficient of viscosity by Stoke's method
7. Verification of laws of transverse vibration and frequency of tuning fork – Sonometer
8. Rigidity modulus – Torsion pendulum
9. To determine the Young's modulus of the bar – Koenig's method
10. To determine the coefficient of viscosity of the liquid – Poiseuille's method

SUGGESTED READINGS

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

2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. Elements of Properties of Matter by D.S. Mathur, S.Chand & Co.

Instruction Hours / week: L: 0 T: 0 P: 4**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours**

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 of the and plot variations of complex functions.

List of Practical

1. Matrix addition.
2. Matrix multiplication.
3. Inverse of a matrix.
4. Transpose of a matrix
5. 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.
6. Plotting the graphs of polynomial of degree 4 and 5 and the derivative graph.
7. Sketching parametric curves. (Eg. Circle, Ellipse, Cycloid and Asteroid).
8. Evaluating definite integrals.(Line integral)

SUGGESTED READINGS

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, Cambridge Univ. Press

இரண்டாம் பருவம்

19LSU201

பகுதி - I தமிழ்ப் இரண்டாம் தாள்

4H – 4C

(இளநிலை அறிவியல் பட்ட வகுப்புகளுக்குரியது)

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40

External: 60

Total: 100

End Semester Exam: 3 Hours

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 பன்னோக்கு 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 வேலைவாய்ப்புத் திறன் பெற்றிருத்தல்.

அலகு - I : பக்தி இலக்கியம்

(7 மணிநேரம்)

சைவ, வைணவ இலக்கியங்கள் - தோற்றம் ,வளர்ச்சி, வரலாறு.

1. சைவம் - (15 பாடல்கள்) பெரியபுராணம் - திருமூலநாயனார் புராணம் -அந்தி இளம்பிறைக் கண்ணி, மற்று அவர்தாம் அணிமா, காவிரி நீர் பெருந்தீர்த்தம், அந்நிலைமைத் தானத்தை, அந்தணர்தம் சாத்தனார், மற்று அதன் தன் உடம்பினை, இவன் உயிர்பெற் றெழில், பாய்த்திய பின் திருமூலராய், வெய்ய சுடர் கதிரவனும், அங்கவளும், பித்து உற்ற மையல் அன்று, இந்த நிலைமையில், ஆவடு தண்துறை, ஊன்உடம்பில், முன்னிய அப்பொருள்.
2. வைணவம் - ஆண்டாள் நாச்சியார் திருப்பாவை: (11 பாடல்கள்): மார்கழித்திங்கள், வையத்து வாழ்வீர்காள், ஓங்கி உலகளந்த, ஆழி மழைக்கண்ணா, மாயனை மன்னுவட மதுரை, சிற்றம் சிறுகாலே, ஒருத்தி மகனாய், மாலே மணிவண்ணா, கூடாரை வெல்லும், கறவைகள் பின்சென்று, வங்கக்கடல் கடைந்த.

அலகு - II : சங்க இலக்கியம்

(14 மணிநேரம்)

சங்க இலக்கியங்கள் - அறிமுகம்

அ). எட்டுத்தொகை

நற்றிணை : கொண்டல் மாமழை - குறிஞ்சி - தலைவன் - 140

குறுந்தொகை : வாரார் ஆயினும், வரினும் - முல்லை - தலைவி - 110

ஐங்குறுநூறு : மருதம் - தோழி - வேட்கைப்பத்து: வாழி ஆதன் வாழி அவனி - 6

பதிற்றுப்பத்து : சிதைந்தது மன்ற - 27

பரிபாடல்: பரிபாடல் திரட்டு-வையை -10: மலைவரை மாலை- கரை நண்ணி 10:1-25, ஆங்க அணிநிலை மாடத்து- நீ கானும் போன்ம் 10: 41-55, இலம்படு புலவர் - ஏத்தினர் தொழுவே 10: 126-130.

கலித்தொகை : பாலைக்கலி- செவிலி - எறித்தரு கதிர்தாங்கி-9

அகநானூறு : அன்னை அறியினும் அறிக-தோழி-நெய்தல்-110

புறநானூறு : யாதும் ஊரே யாவருங் கேளிர்-பொதுவியல்- 192

ஆ). பத்துப்பாட்டு: நெடுநல்வாடை - கார்காலச் சிறப்பு : வையகம் பனிப்ப -1-70

அலகு - III : காப்பியம்

(6 மணிநேரம்)

(அ). சிலப்பதிகாரம்:

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 □□□□ □□□□□□□□□ .

ஞ்சின மாலை: (5-34) - வன்னிமரமும் - பிறந்த பதிப் பிறந்தேன்.

நடுகற் காதை: (207-234) - அருத்திற லரசர் - மன்னவ ரேறென்.,

வாழ்த்துக்காதை: (9) - என்னேயிஃ தென்னே - மீவிசும்பிற்றோன்றுமால்.

(ஆ). மணிமேகலை:

பசியின் கொடுமை: பாத்திரம் பெற்ற காதை:

‘போதி நீழல்’ - ‘பெருகியதன்றோ’ , ‘ஆற்றுநர்க்களிப்போர்’ - ‘நல்லறம் கண்டனை’ (73-98).

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□□□□□□□’ (116-163).

அலகு – IV : கட்டுரைகள்

(8 மணிநேரம்)

1. தமிழிசை இயக்கம் – பேரா. க. வெள்ளைவாரணர்
2. தனிப்பாடல்கள் - பேரா. வ. சுப. மாணிக்கனார்
3. கலைச்சிறப்பு - முத்தமிழ்க் காவலர் கி.ஆ.பெ. விசுவநாதம்
4. காளத்திவேடனும் கங்கைவேடனும் – சொல்லின்செல்வர் ரா.பி.சேதுப்பிள்ளை
5. ஏட்டில் இல்லாத இலக்கியம் – ஒளவை துரைசாமி

அலகு- V : மொழிப்பயிற்சி

(5 மணிநேரம்)

(பேச்சுப்பயிற்சி & படைப்பாக்கப் பயிற்சி)

படைப்பிலக்கியப் பயிற்சிகள் (கதை, கவிதை, கட்டுரை, உரைநடை எழுதுதல், நேர்காணல்)

மொழிபெயர்ப்பு

பாட நூல்: கற்பகச்சோலை – தமிழ் ஏடு.

கற்பகம் உயர்கல்வி கலைக்கழகத் தமிழ்த்துறை வெளியீடு.

SEMESTER – II

19PHU201

ELECTRICITY AND MAGNETISM

6H – 6C

Instruction Hours / week: L: 6 T: 0 P: 0**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 READINGS

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

SEMESTER – II

19PHU202

ANALOG SYSTEMS AND APPLICATIONS

5H – 5C

Instruction Hours / week: L: 5 T: 0 P: 0**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Apply concepts for the design of Regulators and Amplifiers.
2. Acquire knowledge about how a semiconductor diode rectifies an input ac signal
3. 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.

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 READINGS

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
10. [ilectureonline.com/lectures/subject/ENGINEERING/28/255](https://www.lectureonline.com/lectures/subject/ENGINEERING/28/255)
11. <https://www.coursera.org/lecture/electronics/2-1-introduction-to-op-amps-and-ideal-behavior-Q5Di2>
12. https://www.electronics-tutorials.ws/opamp/opamp_1.html

SEMESTER – II

19PHU203

MATHEMATICS - II

4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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

Fourier series: Definition – Finding Fourier coefficients for a given periodic function with period 2π – Odd and Even functions – Half Range Series

UNIT II

Fourier Transforms: Definition of Fourier Transform-Properties of Fourier Transform-Inverse Fourier transform-Convolution theorem-Finite Fourier Sine & Cosine Transform – Parseval's theorem.

UNIT III

Laplace Transforms: Definition of Laplace Transform - Properties of Laplace Transform, Inverse Laplace Transform. Application of Laplace Transform.

UNIT IV

Differential Equations: Types of Linear differential equations with constant coefficients – Simultaneous differential equations with constant coefficient.

UNIT V

Numerical methods: Solving simultaneous equations–Gauss Elimination method, Gauss Jordan method, Gauss Jacobi Method, Gauss – Seidel method. Numerical Integration – Trapezoidal Rule, Simpson's Rule.

SUGGESTED READINGS

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
8. <https://tutorial.math.lamar.edu/classes/de/fourierseries.aspx>
9. <https://math.mit.edu/~gs/cse/websections/cse41.pdf>
10. <http://www.csun.edu/~ac53971/courses/math650/fourier.pdf>

SEMESTER – II

19PHU211**ELECTRICITY AND MAGNETISM PRACTICAL****2H – 1C****Instruction Hours / week: L: 0 T: 0 P: 2****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Gain practical knowledge on RC Circuit
2. Develop skills in the basic concept of electric forces.
3. Understand Gauss law and its applications.
4. 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. 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,
7. To determine a Low Resistance by Carey Foster's Bridge.
8. TAN A – Determination of magnetic moment of the bar magnet
9. TAN B – Determination of magnetic moment of the bar magnet
10. Measurement of charge and current sensitivity of Ballistic galvanometer
11. Calibration of low range voltmeter - Potentiometer

SUGGESTED READINGS

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

19PHU212 ANALOG SYSTEMS AND APPLICATIONS PRACTICAL 2H – 1C

Instruction Hours / week: L: 0 T: 0 P: 2 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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.
2. To study the V-I characteristics of a Zener diode.
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 design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
6. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
7. To design a phase shift oscillator of given specifications using BJT.
8. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain

9. To design inverting amplifier using Op-amp (741,351) and study its frequency response
10. To design non-inverting amplifier using Op-amp (741,351) & study its frequency response

SUGGESTED READINGS

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

SEMESTER – II

19PHU213

MATHEMATICS PRACTICAL– II

4H – 2C

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40

External: 60

Total: 100

End Semester Exam: 3 Hours

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.

List of Practical

1. Compute Fourier Coefficients.
2. Solution of simultaneous linear algebraic equations – Gauss Elimination method
3. Solution of simultaneous linear algebraic equations – Gauss Jordan method
4. Solution of simultaneous linear algebraic equations – Gauss Jacobi method
5. Solution of simultaneous linear algebraic equations – Gauss Seidal method
6. Numerical Integration – Simpson's one third rule
7. Numerical Integration – Simpson's three eighth rule
8. Numerical Integration – Trapezoidal rule

SUGGESTED READINGS

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

19AEC201**ENVIRONMENTAL STUDIES****3H – 3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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**INTRODUCTION - ENVIRONMENTAL STUDIES & ECOSYSTEMS**

Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II

NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES

Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources - Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources - Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT III**BIODIVERSITY AND ITS CONSERVATION**

Levels of biological diversity - genetic, species and ecosystem diversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. Bio-geographical classification of India. Biodiversity patterns (global, National and local levels). Hot-spots of biodiversity. India as a mega-diversity nation. Endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. 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, Noise pollution. Nuclear hazards and human health risks. Solid waste management and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Case studies.

UNIT V**SOCIAL ISSUES AND THE ENVIRONMENT**

Concept of sustainability and sustainable development. Water conservation - Rain water harvesting, watershed management. Climate change, global warming, ozone layer depletion, acid rain and its impacts on human communities and agriculture. Environment Laws (Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, Forest Conservation Act). International agreements (Montreal and Kyoto protocols). Resettlement and rehabilitation of project affected persons. Disaster management (floods, earthquake, cyclones and landslides). Environmental Movements (Chipko, Silent valley, Bishnois of Rajasthan). Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Human population growth: Impacts on environment, human health and welfare.

SUGGESTED READINGS

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**19PHU301 THERMAL PHYSICS & STATISTICAL MECHANICS****4H-4C**

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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, Third law of thermodynamics.

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).

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, Bose-Einstein distribution law.

SUGGESTED READINGS

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

19PHU302 PHYSICS OF ELECTRONIC DEVICES AND CIRCUITS 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0**Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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.

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).

UNIT- IV

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-V

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

Timer IC: IC 555 Pin diagram and its application as Astable and Monostable Multivibrator using IC 555. Multivibrators: Astable, Bistable and Monostable Multivibrators using transistors.

SUGGESTED READINGS

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/> <https://www.docsity.com/en/basic-power-supply-basic-electrical-engineering-handouts/77821/>
11. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-334-power-electronics-spring-2007/lecture-notes/>
12. https://www.electronics-notes.com/articles/analogue_circuits/power-supply-electronics/power-supply-overview.php

SEMESTER – III

19PHU303A RENEWABLE ENERGY AND ENERGY HARVESTING 3H - 3C

Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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.

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

UNIT - IV

Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources. Piezoelectric Energy harvesting: Introduction.

UNIT - V

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications, Geothermal Energy: Geothermal Resources, Geothermal Technologies. Environmental issues and Renewable sources of energy, sustainability.

SUGGESTED READINGS

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 Assessment 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

19PHU303B

PHYSICS WORKSHOP SKILL

3H - 3C

Instruction Hours / week: L: 3 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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. Smoothing of cutting edge of sheet using file. Drilling of holes of different diameter in metal sheet and wooden block. Use of bench vice and tools for fitting. Make funnel using metal sheet.

UNIT -IV

Electrical and Electronic Skill: Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, 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 READINGS

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]
6. <https://www.electronics-notes.com/articles/test-methods/oscilloscope/scope-basics.php>
7. <https://www.ibiblio.org/kuphaldt/socratic/output/scope1.pdf>
8. <https://ocw.mit.edu/courses/mechanical-engineering/2-996-biomedical-devices-design-laboratory-fall-2007/lecture-notes/lecture02.pdf>
9. <https://www.iitk.ac.in/ee/data/pcb/pcb-lab.pdf>

SEMESTER – III

19PHU304

CHEMISTRY – I

4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40

External: 60

Total: 100

End Semester Exam: 3 Hours

Course Objectives

The student should know

- The molecular orbital theory, preparation and properties of inorganic compounds.
- Theory of covalent bond, polar effects and stereochemistry of organic compounds.
- To know about the important industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
- To get interest on elements of photochemistry, chemical kinetics and chromatography.
- To gain knowledge about the dyes, chemotherapy and vitamins.
- Correlate the chemistry with physics concepts and their applications.

Course Outcome

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

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 industrial chemicals like silicones, fuel gases and fertilizers and their impact on environment.
4. Elements of photochemistry, chemical kinetics and chromatography.
5. Know about the dyes, chemotherapy and vitamins.
6. Understand the concept of chemical bondings and their applications.

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. Peroxides 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-Grothuss-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, bathochromic 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 penicillins and Chloromycetin. **Vitamins:** Diseases caused by the deficiency of vitamins A, B₁, B₂, C and D-sources of these vitamins.

Suggested Readings

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.
6. <http://chemocare.com/chemotherapy/health-wellness/vitamins-and-cancer.aspx>
7. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3389405/>

SEMESTER – III

**19PHU311 THERMAL PHYSICS AND STATISTICAL MECHANICS 4H - 2C
PRACTICAL**

Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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 practicals.
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 conductance 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 7 Experiments

1. To determine the coefficient of thermal conductivity of a bad conductor by Lee's disc method.
2. Verification of Newton's law of cooling.
3. Determination of thermal conductivity of rubber.
4. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
5. Cooling Curve of a metallic body.
6. To determine the temperature co-efficient of resistance of the given thermistor using post-office box.
7. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system

8. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge
9. Coefficient of thermal conductivity of copper by Searle's method
10. Thermal conductivity of copper by angstrom method.
11. To determine the specific heat capacity of liquid by Joule's Calorimetre.

SUGGESTED READINGS

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**19PHU312 PHYSICS OF ELECTRONIC DEVICES AND CIRCUITS****4H - 2C****PRACTICAL****Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****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 outlines some ways of thinking about analog circuits that hopefully will help to develop intuition.
6. Design, fabricate and test small electronic circuit.

Any 5 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 design an Amplitude Modulator using Transistor.
7. To design an Astable multivibrator of given specifications using IC 555.
8. To study the zero-crossing detector and comparator
9. To design a digital to analog converter (DAC) of given specifications.
10. To study the analog to digital convertor (ADC) IC.
11. To investigate the use of an op-amp as a Differentiator and Integrator.

SUGGESTED READINGS

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
19PHU313A RENEWABLE ENERGY AND ENERGY HARVESTING 3H-1C
PRACTICAL

Instruction Hours / week: L: 0 T: 0 P: 3 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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. Solar cell characteristics
2. Solar Water heater.
3. Solar distillation unit.
4. Analysis of wind velocity
5. Analysis of solar radiation for a day
6. Study of solar distiller.
7. Study of box type solar cooker.
8. Determination of instantaneous thermal efficiency of parabolic collector.
9. Efficiency and fill factor of solar cells.

SUGGESTED READINGS

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**19PHU313B****PHYSICS WORKSHOP SKILL PRACTICAL****3H - 1C****Instruction Hours / week: L: 0 T: 0 P: 3****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 foundry tools.
6. Construct the circuit of regulated power supply. Timer circuit, Electronic switch using transistor and relay.

Any 4 Experiments

1. Screw gauge, 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. Smoothing 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 READINGS

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**19PHU314****CHEMISTRY PRACTICAL – I****4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****Course Objective**

- To make the student able to identify the elements and the functional groups present in an organic compound.
- To calculate percent composition given a molecular formula and molecular formula given the percent composition.
- To experience to find name of the salts, acids, bases and covalent compounds and provide formulas for these given a molecular formula.
- To identify weak and strong acids and bases and insoluble compounds using dissociation and solubility rules.
- Molarity i.e. moles per litre or decimeter is widely used unit of concentration.

Course Outcome

On successful completion of the course the students should have

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 whether 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 READINGS

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.

19PHU401	SEMESTER IV WAVE AND OPTICS	4H - 4C
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Instruction Hours / week: L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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

WAVE OPTICS: Huygen's wave theory of light - Huygen's principle - construction Huygen's wave front - Laws of reflection and refraction using spherical wave for at a plane surface (derivation of image distance = object distance using Huygen's construction, derivation of Snells law).

UNIT II

INTERFERENCE: Coherent sources and their production; Conditions for observing interference constructive and destructive interference - Coherent sources by division of wave front Biprism-theory and working, experiment to determine wavelength; Effect of thin film in the path of one of the beams; Calculation of thickness of the Coherent sources by division of amplitude: Interference at thin films - reflected and transmitted light, Colours of thin films; Theory of air wedge; Theory of Newton's rings - Determination of Refractive index of a liquid.

Unit - III

Diffraction - Fresnel diffraction Concept of Fresnel's half period zones; Theory of rectilinear propagation; Fresnel diffraction, Construction and working of Zone plate; Comparison of Zone plate with lens; Cylindrical Wavefront (Half period strips – qualitative), Theory of diffraction at a straightedge - Fraunhofer diffraction Theory of single slit diffraction; Theory of grating - normal and oblique incidence - Experimental determination of wavelength; Discussion of Dispersive power; Resolving power, Rayleigh's criterion; Expression for resolving power of grating and telescope; Comparison of prism and grating spectra.

UNIT IV

Polarization Review of plane polarized light and method of production; Double refraction at crystals; Huygens' explanation of double refraction; Theory of retarding plates - Quarter wave plates and Half wave plates; Theory of superposition of two plane polarized waves with perpendicular vibrations, Production and detection of linearly , elliptically and circularly polarized light; Optical activity - Fresnel's explanation, Laurent's half shade polarimeter.

UNIT-V

Fiber Optics: Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle –derivations, types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram)

SUGGESTED READINGS

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.clearitmedical.com/2019/05/physics-notes-wave-optics.html>
7. <https://nucleoniitjeekota.com/topic-notes.php?topic=Wave%20Optics>.

SEMESTER – IV

19PHU402

NUCLEAR AND PARTICLE PHYSICS

4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0

Marks: Internal: 40

External: 60

Total: 100

End Semester Exam: 3 Hours

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 excited 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: 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 -IV

Nuclear Reactors: 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- 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 READINGS

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**19PHU403A****BASIC INSTRUMENTATION SKILL****3H - 3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 READINGS

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
9. <https://www.electrical4u.com/electronic-dc-voltmeter/>
10. <https://electricalacademia.com/instrumentation-and-measurements/electronic-voltmeter-working-block-diagram/>

SEMESTER IV			
19PHU403B	RADIATION SAFETY		3H - 3C
Instruction Hours / week: L: 3 T: 0 P: 0		Marks: Internal: 40	External: 60 Total: 100
End Semester Exam: 3 Hours			

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 safety.
4. Gain knowledge of new concept in the field of radiation.
5. They are able to understand the Interaction of Radiation with matter.
6. Discuss the advantages to the utilization of a rotating anode.
7. 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 - Bethe-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, Thermoluminescent 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 READINGS

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
2. G.F. Knoll, Radiation detection and measurements
3. Thermoluminescence 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. Lowenthal 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**19PHU404****CHEMISTRY – II****4H - 4C****Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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.
- Learned how to think critically and analyze chemical problems.
- To use of modern computing resources involving chemical applications.
- To get knowledge of chemical principles appropriate to a physics program.
- General familiarity with the following areas in chemistry: analytical, biochemistry, inorganic, organic and physical.

Course Outcome (COs)

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
2. The industrial importance of EDTA, haemoglobin and chlorophyll.
3. Understand the concept of aromaticity and preparation of aromatic compounds including heterocyclic compounds.
4. Understand the preparation, classifications and properties of amino acids, proteins and carbohydrates.
5. Understand the concepts of first and second laws of thermodynamics.
6. Understand the fundamentals of electrochemistry.

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 READINGS:

1. Veeraiyan, V., & Vasudevan, A.N.S. (2012). Text Book of Allied Chemistry (II Edition). Chennai: Highmount Publishing House.
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 – IV**19PHU411****WAVE AND OPTICS PRACTICAL****4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Determine the specific rotation of sugar using polarimeter.
2. Spectrometer – Determination of refractive index of the prism
3. Spectrometer – Determination of wavelength of spectral lines of mercury
4. Spectrometer – Determine the dispersive power of the material of the given prism
5. Spectrometer – To draw the i-d curve for a given prism and hence to calculate the refractive index of the material.
6. Spectrometer – Determination of wavelength of spectral lines of Na atoms by using grating
7. To determine wavelength of sodium light using Newton's Rings.
8. To determine the wavelength of Laser light using Diffraction grating.
9. Determine the thickness of the given wire using air wedge method
10. Determination of refractive index of water using liquid lens
11. Determination of the angle of the prism using spectrometer

SUGGESTED READINGS

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**19PHU412 NUCLEAR AND PARTICLE PHYSICS PRACTICAL 4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****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 6 Experiments

1. Viscosity of liquid – Mayer's oscillating disc method.
2. ' e/m ' by Magnetron method.
3. ' e/m ' by Thomson method
4. G.M.Counter-Absorption co-efficient and inverse square law.
5. Fabry-perot interferometer - Determination of λ
6. Measurement of counts of radiation by radioactive source using GM counter
7. B – H Curve using Oscilloscope.
8. To calibrate Babinet Compensator.

SUGGESTED READINGS

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**19PHU413A****BASIC INSTRUMENTATION SKILL PRACTICAL****3H - 1C****Instruction Hours / week: L: 0 T: 0 P: 3****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Calibration of a low range voltmeter-potentiometer.
2. Full wave rectifier
3. Calibration of an ammeter-potentiometer
4. Half wave rectifier
5. Measurement of unknown frequency using lissajous figures by CRO.
6. Measurement of risetime and falltime using CRO.
7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges

Laboratory Exercises:

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

Open Ended Experiments:

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

SUGGESTED READINGS

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**19PHU413B****RADIATION SAFETY PRACTICAL****3H - 1C****Instruction Hours / week: L: 0 T: 0 P: 3****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Study of characteristics of GM tube and determination of operating voltage and plateau length using background radiation as source (without commercial source).
3. Study of counting statistics using background radiation using GM counter.
4. Study of radiation in various materials (e.g. KSO₄ etc.). Investigation of possible radiation in different routine materials by operating GM at operating voltage.
5. Study of absorption of beta particles in Aluminum using GM counter.
6. Detection of α particles using reference source & determining its half life using spark counter
7. Gamma spectrum of Gas Light mantle (Source of Thorium)

SUGGESTED READINGS

1. W.E. Burcham and M. Jobes – Nuclear and Particle Physics – Longman (1995)
2. G.F.Knoll, Radiation detection and measurements
3. Thermoluminescence Dosimetry, Mcknlly, A.F., Bristol, Adam Hilger (Medical Physics Handbook 5)
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 IV

19PHU414

CHEMISTRY PRACTICAL– II

4H - 2C

Instruction Hours / week: L: 0 T: 0 P: 4

Marks: Internal: 40

External:

60

Total: 100

End Semester Exam: 3 Hours

Course Objective

- The basic analytical and technical skills to work al and technical skills to work effectively in the various fields of chemistry.
- 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
- To perform accurate quantitative measurements with an understanding of the theory and use of contemporary chemical instrumentation,interpret experimental results, perform calculations on these results and draw reasonable, accurate conclusions.

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

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.

SUGGESTED READINGS:

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 – V	
19PHU501	MATHEMATICAL PHYSICS - I	4H – 4C

Instruction Hours / week: L: 4 T: 0 P: 0 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

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 - BASIC OF C LANGUAGE

Introduction, Data types, Operators and Expressions, Conditional Statements, Input and output Statements (Programs)

UNIT II - 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.

UNIT III - SPECIAL FUNCTIONS

Definition – The Beta function – Gamma function – Evaluation of Beta function – Other forms of Beta function – Evaluation of Gamma function – Other forms of Gamma function - Relation between Beta and Gamma functions – Problems.

UNIT IV- MATRICES

Introduction – special types of Matrices – Transpose of a Matrix – The Conjugate of a Matrix – Conjugate Transpose of a Matrix – Symmetric and Anti symmetric – Hermitian and skew Hermitian – Orthogonal and Unitary Matrices – Properties – Characteristics equation – Roots and characteristics vector – Diagonalization of matrices – Cayley – Hamilton theorem – Problems.

UNIT V - VECTOR CALCULUS

Operator – Divergence – Second derivative of Vector functions or fields – The Laplacian Operator – Curl of a Vector – Line Integral – Line Integral of a Vector field around an infinitesimal rectangle – Curl of Conservative field – Surface Integral – Volume Integral (without problem) – Gauss's Divergence theorem and its proof in the simple problems – Stoke's and its proof with simple problems.

SUGGESTED READINGS

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>
11. <https://mathworld.wolfram.com/GammaFunction.html>

SEMESTER V**19PHU502****ELECTROMAGNETIC WAVE PROPAGATION****4H - 4C****Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Use electromagnetic wave theory and principles in a wide range of applications.
3. Solve such problems in simple geometries using separation of variables and the method of images.
4. Define and derive expressions for the energy both for the electrostatic and magnetostatic fields.
5. Gain confidence in their ability to apply mathematical methods to understand electromagnetic problems to real-life situations.
6. Solve simple electrostatic boundary problems.
7. Describe simple models for electromagnetic interaction with media
8. Choose adequate models and solution methods for specific problems.

UNIT- I

Maxwell Equations: Maxwell's equation - Review of Maxwell's equations. Displacement Current. Electromagnetic scalar and vector potential, Gauge Transformation: Lorenz and Coulomb gauge – Poynting theorem and vector.

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.

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.

UNIT -IV

Propagation of Electromagnetic Waves: Electromagnetic waves in Free space - Isotropic dielectric - Anisotropic dielectric – Conducting media - Ionized gases. Fresnel's Formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection.

UNIT -V

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

SUGGESTED READINGS

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, William 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 V**19PHU503A****ELEMENTS OF MODERN PHYSICS****4H - 4C****Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability.

UNIT-II

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle and its applications (Uncertainty relations involving Canonical pair of variables); Derivation from Wave Packets impossibility of a particle following a trajectory.

UNIT- III

Wave amplitude and wave functions. linear superposition principle as a consequence; Schrodinger equation 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.

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 READINGS

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			
19PHU503B	MEDICAL PHYSICS	4H – 4C	
Instruction Hours / week: L: 4 T: 0 P: 0		Marks: Internal: 40	External: 60 Total: 100
End Semester Exam: 3 Hours			

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, Bremsstrahlung, 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 READINGS

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**19PHU504A****COMPUTATIONAL SKILL****3H - 3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60 Total: 100****End Semester Exam: 3 Hours****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 READINGS

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**19PHU504B****WEATHER FORECASTING****3H - 3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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. Understand the various components that go into forecasting the weather
2. Produce rudimentary weather forecasts based on weather maps
3. Gain knowledge on Ecosystems and climate interactions
4. Know the effects of climate change on life cycles
5. Understand the concept of Biodiversity, Weather vs climate
6. Acquire knowledge on greenhouse effect, Treaty rights
7. Understand the traditional ecological knowledge and climate change and related 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 READINGS

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**19PHU511****MATHEMATICAL PHYSICS - I PRACTICAL****4H – 2C**

Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

Course Objective

- The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.
- To apply calculus of variations to diverse problems in physics including isoperimetric problems.
- To find solutions to integral equations using different methods.
- To know the method of contour integration to evaluate definite integrals of varying complexity.
- To familiar with the method of Green's function to solve linear differential equations with inhomogeneous term.
- To understand the concept of linear vector space.

Course Outcome

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

1. Understand variation principle and apply it to calculate the physical variables.
2. Acquire basic concept of Hamiltonian, Hamilton's principle and Hamiltonian equation of motion, Poisson and Lagrange brackets.
3. Learn elementary group theory, i.e., definition and properties of groups, subgroups, Homomorphism, isomorphism, normal and conjugate groups, representation of groups, Reducible and Irreducible groups.
4. Learn the theory of probability, Random variables and probability distributions, Expectation values and variance. Various examples of probability distributions used in physics.
5. Gain the knowledge on Cartesian Tensors and its applications .
6. Understand the concept of Matrices and their problems associated with physical concepts.

ANY 8 EXPERIMENTS

1. Evaluate the Beta and Gamma function using C program.
2. Write the C Program to Print Square of Each Element of 2D Matrix.
3. Calculate the addition and subtraction of 2 matrices.
4. Write the C Program to Add two Complex Numbers.
5. Write C functions to add and multiply two complex numbers.

6. Program to find Transpose of Given Square Matrix.
7. Evaluate Subtraction of two matrices in C.
8. Write the C Program to perform complex number multiplication.
9. Write the C program to calculate sum of Upper Triangular Elements.
10. Write the C Program to Check whether entered matrix is magic square or not?
11. Find Inverse of a 3 X 3 Matrix using C program.
12. Write C Program to Compute Cross Product of Two Vectors.
13. Write a C Program Friend & Operator: Vector.
14. Write a C Program to Check Prime Number.
15. Check if a Number is Positive or Negative Using if...else.
16. Write a C Program to find the Factorial of a Number.

SUGGESTED READINGS

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

SEMESTER – V**19PHU512 ELECTROMAGNETIC WAVE PROPAGATION PRACTICAL 4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****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 determine the specific rotation of sugar solution using Polarimeter.
2. To analyze elliptically polarized Light by using a Babinet's compensator.
3. Determination of wavelength of the monochromatic source using Young's double slit method.
4. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
5. To verify the Stefan's law of radiation and to determine Stefan's constant.
6. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
7. To verify the law of Malus for plane polarized light.
8. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
9. Charging and discharging of a capacitor
10. Verification of Faraday's law of electromagnetism
11. Determination of Planck's constant

SUGGESTED READINGS

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 V**19PHU513A****ELEMENTS OF MODERN PHYSICS PRACTICAL 4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****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 the Planck's constant using LEDs of at least 4 different colours.
4. I-V characteristics of LED
5. I-V characteristics of photocell
6. Plank's constant using color filters.
7. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.
8. To setup the Millikan oil drop apparatus and determine the charge of an electron.
9. To show the tunneling effect in tunnel diode using I-V characteristics.

10. To determine the wavelength of laser source using diffraction of single slit.
11. To determine the wavelength of laser source using diffraction of double slits.
12. To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

SUGGESTED READINGS

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**19PHU513B****MEDICAL PHYSICS PRACTICAL****4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 6 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 READINGS

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**19PHU514A****COMPUTATIONAL SKILL PRACTICAL****3H - 1C****Instruction Hours / week: L: 0 T: 0 P: 3****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 READINGS

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**19PHU514B****WEATHER FORECASTING PRACTICAL****3H-1C****Instruction Hours / week: L: 0 T: 0 P: 3****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 READINGS:

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 – VI**19PHU601****MATHEMATICAL PHYSICS -II****4H – 4C****Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objective**

- The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.
- To apply calculus of variations to diverse problems in physics including isoperimetric problems.
- To find solutions to integral equations using different methods.
- To know the method of contour integration to evaluate definite integrals of varying complexity.
- To familiar with the method of Laplace equations to solve linear differential equations with inhomogeneous term.
- To understand the concept of group theory.

Course Outcome

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

1. Know the method of contour integration to evaluate definite integrals of varying complexity.
2. Have gained ability to apply group theory to physics problems, which is a pre-requisite for deeper understanding of crystallography, particle physics, quantum mechanics and energy bands in solids.
3. Apply calculus of variations to diverse problems in physics including isoperimetric problems.
4. Know another interesting aspect is the use of Legendre polynomials in solving physics problems.
5. Become familiar with the method of Laplace equations to solve linear differential equations with inhomogeneous term.
6. Find solutions to integral equations using different methods.

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- LAPLACE TRANSFORMS

Laplace transforms: Linearity property, first and second translation property of LT – Derivatives of Laplace transforms – Laplace transform of integrals – Initial and Final value theorems; Methods for finding LT: direct and series expansion method, Method of

differential equation; Inverse Laplace transforms: Linearity property, first and second translation property, Convolution property.

UNIT III- SPECIAL DIFFERENTIAL EQUATION

Legendre's differential equation: Legendre polynomials – Generating functions – Recurrence Formulae–Rodrigue's formula–orthogonality of Legendre's polynomial; Bessel's differential equation: Bessel's polynomial –generating functions–Recurrence Formulae–orthogonal properties of Bessel's polynomials; Hermite differential equation– Hermite polynomials – generating functions – recurrence relation.

UNIT IV- GROUP THEORY

Definition of Group - Subgroup, invariant group, abelian group, orthogonal and unitary groups -Homomorphism, isomorphism - Reducible and irreducible representations - Generators of Continuous groups.

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 READINGS

1. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, and F.E. Harris, 1970, Elsevier.
3. Modern Mathematical Methods for Physicists and Engineers, C.D. Cantrell, 2011, Cambridge University Press
4. Introduction to Matrices and Linear Transformations, D.T. Finkbeiner, 1978, Dover Pub.
5. Linear Algebra, W. Cheney, E.W.Cheney & D.R.Kincaid, 2012, Jones & Bartlett Learning
6. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
7. Mathematical Methods for Physics & Engineers, K.F.Riley, M.P.Hobson, S.J.Bence, 3rd Ed., 2006, Cambridge University Press.
8. <https://kconrad.math.uconn.edu/math216/whygroups.html>
9. <https://www.intechopen.com/books/symmetry-group-theory-and-mathematical-treatment-in-chemistry/group-theory-from-a-mathematical-viewpoint>
10. <https://medium.com/cantors-paradise/an-invitation-to-group-theory-c81e21ab739a>
11. <https://lpsa.swarthmore.edu/LaplaceXform/FwdLaplace/LaplaceProps.html>
12. <https://mathworld.wolfram.com/LaplacesEquationSphericalCoordinates.html>
13. http://personal.rhul.ac.uk/uhap/027/ph2130/ph2130_files/lapeq.pdf

SEMESTER VI**19PHU602****SOLID STATE PHYSICS****4H - 4C****Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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.
- Apply the concept of band theory to explain the behavior of conductors.

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. 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 Sellmeier relations. Langevin-Debye equation. Complex Dielectric Constant.

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 READINGS

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
- Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
3. Solid State Physics, Neil W. Ashcroft and N. David Mermin, 1976, Cengage Learning
4. Solid State Physics, Rita John, 2014, McGraw Hill
5. Solid State Physics, M.A. Wahab, 2011, Narosa Publications.
6. <http://www.physics.udel.edu/~bnikolic/teaching/phys624/lectures.html>
7. <https://www.youtube.com/watch?v=RImqF8z91fU>.
8. <https://courses.lumenlearning.com/boundless-chemistry/chapter/band-theory-of-electrical-conductivity/>

SEMESTER VI**19PHU603A****NANO MATERIALS AND APPLICATIONS****4H - 4C****Instruction Hours / week: L: 4 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 increasingly 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, 1D nanostructures 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 heterostructures and nanostructures.

UNIT – V

APPLICATIONS: Applications of nanoparticles in quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Types of CNT and CNT based transistors. Nanomaterial Devices: Quantum dots heterostructure lasers, optical switching and optical data storage. Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

SUGGESTED READINGS

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
9. <https://nptel.ac.in/courses/118/104/118104008/>

SEMESTER VI			
19PHU603B	BIOLOGICAL PHYSICS	4H - 4C	
Instruction Hours / week: L: 4 T: 0 P: 0		Marks: Internal: 40	External: 60 Total: 100
End Semester Exam: 3 Hours			

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 chooses 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 concept 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 READINGS

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**19PHU611****MATHEMATICAL PHYSICS PRACTICAL – II****4H – 2C****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objective**

- The emphasis of the course is on applications in solving problems of interest to physicists. Students are to be examined on the basis of problems, seen and unseen.
- To apply calculus of variations to diverse problems in physics including isoperimetric problems.
- To find solutions to integral equations using different methods.
- To know the method of contour integration to evaluate definite integrals of varying complexity.
- To familiar with the method of Laplace equations to solve linear differential equations with inhomogeneous term.
- To understand the concept of group theory.

Course Outcome

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

1. Understand variation principle and apply it to calculate the physical variables.
2. Acquire basic concept of Hamiltonian, Hamilton's principle and Hamiltonian equation of motion, Poisson and Lagrange brackets.
3. Learn elementary group theory, i.e., definition and properties of groups, subgroups, Homomorphism, isomorphism, normal and conjugate groups, representation of groups, Reducible and Irreducible groups.
4. Learn the theory of probability, Random variables and probability distributions, Expectation values and variance. Various examples of probability distributions used in physics.
5. Gain the knowledge on Cartesian Tensors and its applications .
6. Understand the concept of Matrices and their problems associated with physical concepts.

ANY 8 EXPERIMENTS

1. Write the C⁺⁺ Program Gauss-Jordan method.
2. Write the C⁺⁺ Program Gauss elimination method.
3. Write the C⁺⁺ Program Gauss-Seidel method.
4. Write the C⁺⁺ Program Bisection method.
5. Write the C⁺⁺ Program Runge Kutta method.
6. Write the C⁺⁺ Program Euler's method.
7. Write the C⁺⁺ Program Newton-Raphson method.
8. Write the C⁺⁺ Program Inverse of a matrix.

9. Write the C⁺⁺ ProgramRegulaFalsi method.
10. Write the C⁺⁺ ProgramSimpson's 1/3 rule.
11. Write the C⁺⁺ ProgramTrapezoidal rule.
12. Write the C⁺⁺ ProgramHorner's method.
13. Write the C⁺⁺ Programto Illustrate Trigonometric function.
14. Write the C⁺⁺ Program for heat equation.
15. Write the C⁺⁺ Programto Compute Discrete Fourier Transform Using the Fast Fourier Transform Approach.

SUGGESTED READINGS

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

SEMESTER – VI**19PHU612****SOLID STATE PHYSICS PRACTICAL****4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 susceptibility 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 - Quinck's Tube Method – Ferromagnetic solution
2. Measurement of susceptibility - Quinck's Tube Method – Paramagnetic solution
3. Measurement of susceptibility – Guoy's tube method – Ferromagnetic solution
4. Measurement of susceptibility – Guoy's tube method – Paramagnetic solution
5. Determination of Dielectric constant – Four probe method
6. Study of Hall effect
7. Study seeback's effect
8. To determine the refractive index of a dielectric layer using SPR technique.
9. To study the PE Hysteresis loop of a Ferroelectric Crystal.
10. To draw the BH curve of iron using a Solenoid and determine the energy loss from Hysteresis.
11. To measure the resistivity of a semiconductor (Ge) crystal with temperature (up to 150°C) by four-probe method and to determine its band gap.
12. To determine the Hall coefficient of a semiconductor sample.

SUGGESTED READINGS

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 VI**19PHU613A NANO MATERIALS AND APPLICATIONS PRACTICAL 4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4 Marks: Internal: 40 External: 60 Total: 100****End Semester Exam: 3 Hours****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 society.
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. Analysis of XRD spectra of a sample
3. Synthesis of iron oxide nanoparticles by chemical route.
4. Analysis of FTIR spectra of a sample
5. Analysis of UV- VIS of a sample
6. Synthesis of metal nanoparticles by green synthesis method.
7. Prepare a thin film of semiconductor.
8. Analysis of Photo Luminescence of a sample
9. Analysis of Zeta- potential of a sample
10. Intensity ratio analysis of Raman Spectra

SUGGESTED READINGS

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**19PHU613B****BIOLOGICAL PHYSICS PRACTICAL****4H - 2C****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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 chooses 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 concept of life of molecules.

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 colored 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 READINGS

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 Vatsala Piramal, Dominant Publisher and Distributors, New Delhi-110002
5. Textbook of Biophysics - by R.N. Roy 6. Photosynthesis - by Hall and Rao.

SEMESTER VI**19PHU691****PROJECT****6H - 4C****Instruction Hours / week: L: 6 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****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.