KALASALINGAM UNIVERSITY
(Kalasalingam Academy of Research and Education)
(Under Section 3 of UGC Act 1956)
Anand Nagar, Krishnankoil – 626 126

B.Sc. Physics

Curriculum and Syllabi-2017
(Choice Based Credit System)

KALASALINGAM UNIVERSITY

(Kalasalingam Academy of Research and Education)
Anand Nagar, Krishnankoil – 626 126

DEPARTMENT OF PHYSICS

B.Sc. (Physics) Programme

University/ Department	VISION	MISSION
Kalasalingam University	**To be a Centre of Excellence of International repute in education and research**	**To produce technically competent, socially committed technocrats and administrators through quality education and research**
Department of Physics	To achieve excellence in education and research in the field of Physics and other related areas through knowledge creation and dissemination.	• Impart quality education and promote scientific temper • Blend theoretical knowledge with practical skills • Motivate basic/academic and applied research in technically important fields • Provide access to all sections of the society to pursue higher education • Inculcate moral values and ethics among students • Prepare students as responsible citizens • Hasten the process of creating a knowledgeable society

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Technical Proficiency

Succeed in obtaining employment appropriate to their interests, education and will become valuable physicist

PEO2: Professional Growth

Continue to develop professionally through life-long learning, higher education, research and other creative pursuits in their areas of specialization

PEO3: Management Skills

Improve leadership qualities in a technical and social response through innovative manner

PROGRAMME OUTCOMES

POs *describe what students are expected to know or be able to do by the time of graduation from the programme*.

The Program Outcomes of UG in Physics are:

At the end of the programme, the students will be able to:

1. Be able to identify, formulate and solve the complex problems in the field of theoretical physics, condensed matter physics and electronics
2. Recognize the need for and have an ability to engage in life-long learning and be able to demonstrate a knowledge of contemporary issues
3. Be able to plan, execute and report the results of a complex extended experiment or investigation, using appropriate methods to analyze data and to evaluate the level of its uncertainty
4. Be able to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
5. Be able to communicate effectively in oral and written form

DEPARTMENT OF PHYSICS

B.SC (PHYSICS) – Revised Curriculum Structure (2017 onwards) (CBCS)

Scheme of Instructions

Subject Code	Course Opted	Subjects	L	T	P	C
BAE17R112	Language Tamil	தமிழ் இலக்கிய வரலாறும் புதினமும்	3	0	0	3
PHY17R121	Core Course I	Mechanics and Properties of Matter	4	0	4	6
MAT17R141	Core Course II	Algebra And Calculus	5	1	0	6
CHY17R141/ PAE17R141	Core Course III	Fundamentals of Chemistry / A.C Circuits	4	0	4	6
BAE17R107	*AEC Course I	Communicative English	2	0	0	2
BAE17R111	Language English	Poetry, Short Stories, Fiction, Grammar, Composition And Vocabulary	3	0	0	3
PHY17R122	Core Course IV	Electricity and Magnetism	4	0	4	6
MAT17R142	Core Course V	Analytical Geometry, Vector Calculus And Fourier Series	5	1	0	6
CHY17R142/ PAE17R142	Core Course VI	Equilibrium Phenomena and Functional Organic Chemistry-I / Semiconductor diodes and applications	4	0	4	6
CHY17R103	*AEC Course II	Environmental Science	2	0	0	2
PHY17R221	Core Course VII	Thermal Physics and Statistical Mechanics	4	0	4	6
MAT17R241	Core Course VIII	Application of Differential Equation, Laplace Transform And Complex Variable.	5	1	0	6
CHY17R241/ PAE17R241	Core Course IX	Phase Equilibrium, Electrochemistry & Functional Group Organic Chemistry-II / Electronic devices and circuits	4	0	4	6
PHY17RSXX	SEC I	Skill Enhancement Course - 1	2	0	0	2
PHY17R222	Core Course X	Waves and Optics	4	0	4	6
MAT17R242	Core Course XI	Group Theory, Probability And Interpolation.	5	1	0	6
CHY17R242/ PAE17R242	Core Course XII	Transition Metal Chemistry, States of Matter & Chemical Kinetics / Linear integrated Circuits	4	0	4	6
PHY17RSXX	SEC II	Skill Enhancement Course - 2	2	0	0	2
PHY17R3XX	Discipline Specific Elective - I		4	0	4	6
PHY17R3XX	Discipline Specific Elective – II		4	0	4	6
PHY17R3XX	Discipline Specific Elective - III		4	0	4	6
PHY17RSXX	Skill Enhancement Course -3		2	0	0	2
PHY17R3XX	Discipline Specific Elective - IV		4	0	4	6
PHY17R3XX	Discipline Specific Elective - V		4	0	4	6
PHY17RSXX	Skill Enhancement Course -4		2	0	0	2
PHY17R399	Project		0	0	12	6
Total Credits						126

***AEC-Ability Enhancement Compulsory Course**

#SEC-Skill Enhancement Course

Discipline Specific Elective

Subject Code	Subjects	L	T	P	C
PHY17R301	Atomic and Nuclear Physics	**4**	**0**	**4**	**6**
PHY17R302	Relativity and Quantum Mechanics	**4**	**0**	**4**	**6**
PHY17R303	Mathematical Physics	**4**	**0**	**4**	**6**
PHY17R304	Basic electronics	**4**	**0**	**4**	**6**
PHY17R305	Solid State Physics	**4**	**0**	**4**	**6**
PHY17R306	Digital Electronics and Communication	**4**	**0**	**4**	**6**
PHY17R307	Microprocessors 8085	**4**	**0**	**4**	**6**
PHY17R308	Programming in C++ and Numerical Methods	**4**	**0**	**4**	**6**
PHY17R309	Theoretical Physics	**4**	**0**	**4**	**6**
PHY17R310	Materials Science	**4**	**0**	**4**	**6**
PHY17R311	Communication Physics	**4**	**0**	**4**	**6**
PHY17R312	Laser and Spectroscopy	**6**	**0**	**0**	**6**
PHY17R313	Non-Linear Optics	**6**	**0**	**0**	**6**
PHY17R314	Radiation Physics	**6**	**0**	**0**	**6**
PHY17R315	Elements of Nanoscience and Nanotechnology	**6**	**0**	**0**	**6**
PHY17R316	Medical Physics	**4**	**0**	**4**	**6**
PHY17R317	Elements of Modern Physics	**4**	**0**	**4**	**6**
PHY17R399	Project	**0**	**0**	**12**	**6**

Skill Enhancement Course

Subject Code	Subjects	L	T	P	C
PHY17RS01	Physics Workshop skills	**2**	**0**	**0**	**2**
PHY17RS02	Computational Physics	**2**	**0**	**0**	**2**
PHY17RS03	Electrical Circuits and Network skills	**2**	**0**	**0**	**2**
PHY17RS04	Basic Instrumentation skills	**2**	**0**	**0**	**2**
PHY17RS05	Renewable energy and energy harvesting	**2**	**0**	**0**	**2**
PHY17RS06	Electrical appliances	**2**	**0**	**0**	**2**
PHY17RS07	Astrophysics	**2**	**0**	**0**	**2**
PHY17RS08	Bio-Medical instrumentation	**2**	**0**	**0**	**2**
PHY17RS09	Programming in C				
PHY17RS10	Space Physics	**2**	**0**	**0**	**2**
PHY17RS11	Non -Destructive Testing	**2**	**0**	**0**	**2**
PHY17RS12	X-ray Diffraction and Electron Microscopy	**2**	**0**	**0**	**2**
PHY17RS13	Laser Physics	**2**	**0**	**0**	**2**
PHY17RS14	Energy Resources	**2**	**0**	**0**	**2**
PHY17RS15	Solar Energy	**2**	**0**	**0**	**2**
PHY17RS16	Technical Drawing	**2**	**0**	**0**	**2**
PHY17RS17	Radiology and Safety	**2**	**0**	**0**	**2**
PHY17RS18	Weather Forecasting	**2**	**0**	**0**	**2**

BAE17R112 தமிழ் இலக்கிய வரலாறும் புதினமும்	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Language **Course Type**: Theory			

(இளங்கலை,இளம் அறிவியல்,இளநிலை வணிகவியல்,இளநிலை வணிக நிர்வாகவியல் பட்டப்படிப்பு 2017-2018 கல்வியாண்டு முதல் ஆண்டு மாணாக்கர்களுக்கானது)

கூறு-1

தமிழ் மொழியின் பழமையும் சிறப்பும் –திராவிட மொழிக்குடும்பம்

தமிழ்நாடு-தமிழின் சிறப்புகள்

பழந்தமிழ் இலக்கண நூல்கள்-தொல்காப்பியம்,நன்னூல் முதலிய இலக்கண நூல்கள்-எழுத்து,சொல்,பொருள் அதிகாரங்கள்

கூறு-2

சங்க காலம்-மூன்று சங்கங்கள்-இலக்கியச் சான்றுகள்-கல்வெட்டுச் சான்றுகள்

இலக்கண,சங்க நூல்களின் சிறப்பு-பத்துப் பாட்டு-எட்டுத்தொகை-சங்கத் தமிழர் மாண்புகள்

கூறு-3

சங்கம் மருவிய காலம்-பதிணெண் கீழ்க்கணக்கு நூல்கள்-வகைகள்

காப்பிய இலக்கிய வரலாறு-ஐம்பெருங்காப்பயங்கள்-சிறு காப்பியங்கள்-காப்பியக்கூறுகள்

கூறு-4

புதினம்

தேடல்

கூறு-5

அடிப்படை இலக்கணம்

முதல்,சார்பு எழுத்துக்கள்,மொழி முதல்,இறுதி எழுத்துக்கள்,வல்லினம் மிகும் மிகா இடங்கள்

பாட நூல்:

1. **தமிழ் இலக்கிய வரலாறு, முனைவர் ச.வே.சுப்பிரமணியன், மணிவாசகர் பதிப்பகம், 31,சிங்கர் தெரு,பாரி முனை, சென்னை-600 108**
2. **நன்னூல்-எழுத்ததிகாரம், முனைவர் சு.அழகேசன் உரை, சுதன் பதிப்பகம், தூத்துக்குடி.**
3. **தேடல், பொன்னீலன், ஒன்பதாம் பதிப்பு, நியூபுக் ஹவுஸ் வெளியீடு, சென்னை-98**

PHY17R121 Mechanics and Properties of matter	L	T	P	Credit
	4	0	4	6

Pre-requisite: Nil **Course Category:** Program Core

Course Type: Integrated Course

Objectives

- To understand the basic concepts of mechanics and apply it to various physical problems.
- To analyze the different properties of matter

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Acquire fundamental knowledge in Newtonian mechanics of linear motion

CO2: Understand the basic concepts of rotational motion of bodies

CO3: Gain the knowledge of gravitational force between bodies including planets

CO4: Analyze the elastic and viscous properties of materials

CO5: Understand the concepts of surface tension and its implications.

Mapping of COs with Pos

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M		
CO2	H		H		
CO3	H	M		H	
CO4	H		H		H
CO5	H		H	H	L

Unit I: Motion **12 hrs**

Newton laws of motion, Friction, properties of friction, Drag force and terminal speed, Uniform circular motion. Center of mass, Newton's second law for a system of particles, Linear momentum, Collision and impulse, conservation of linear momentum, Momentum and kinetic energy in collisions, elastic and inelastic collisions in one dimension, collision in two dimensions.

Unit II: Rotation **12 hrs**

Rotational variables, Rotation with constant angular acceleration, Relating the linear and angular variables, Kinetic energy of rotation, Calculating the rotational inertia, Torque, Newton's second law for rotation, work and rotational kinetic energy, Newton's second law in angular form, conservation of angular momentum

Unit III: Gravitation **12 hrs**

Newton's law of gravitation, Gravitation and the principle of superposition, Gravitation near earth's surface, Gravitation inside earth, Gravitational field and potential due to a solid sphere and spherical shell, Determination of G by Boy's experiment-Planets and satellites: kepler's laws, satellites: orbits and energy, Compound Pendulum.

Unit IV: Elasticity and viscosity **12 hrs**

Definition, stress – strain, three modulii of elasticity– Hooke's law – definition – yield point – elastic limit – elastic fatigue – Poisson's ratio – definition – limiting values – relation between q , n , k and σ

Definition – units – dimension – stream lined motion & turbulent motion – definition – Poiseuilli's formula to determine η (without correction for pressure head) – equation of continuity – Bernoulli's theorem (Statement only), Stoke's experiment with theory (dimension method).

Unit V: Surface tension **12 hrs**

Definition – units – dimensions – surface energy definition – units – Excess pressure across a curved surface (special cases : spherical and cylindrical drop and bubble) – angle of contact – capillarity – ST determination by capillary rise - experiment to determine ST & IST by drop weight method – determination of ST of a liquid by Jaeger's method.

Experiments **30 hrs**

1. Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope.
2. To determine the Moment of Inertia of a Flywheel.
3. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
4. To determine the Elastic Constants of a Wire by Searle's method.
5. Compound pendulum – g and k.
6. Non-uniform bending – Pin and Microscope.
7. Uniform bending – Optic lever.
8. Torsion Pendulum.
9. Surface tension – Capillary rise.
10. Experiment to determine coefficient of viscosity of low viscous liquid by Stokes's method.

Text Books:

1. Principles of Physics, J.Walker, Davis Halliday, Robert Resnick, Wiley, 10th ed., 2016
2. Properties of Matter, R. Murugashan, S. Chand & Co. publication, 2016.

Reference Books:

1. Properties of Matter – Brijlal & N. Subrahmanyam – S. Chand & Co, 2002.
2. University Physics, FW Sears, MW Zemansky and HD Young13/e, Addison-Wesley 1986.
3. Mechanics Berkeley Physics course,v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Mechanics – D.S. Mathur – S. Chand & Co., - Reprint 2000

6. Advanced Practical Physics for students, B.L.Flint and H.T.Worsnop, 1971, Asia Publishing House.
7. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
8. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage LearningIndia Pvt. Ltd.
9. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.

MAT17R141 Algebra And Calculus	L	T	P	Credit
	5	1	0	6
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Theory			

Objective:

- To enable the students to acquire basic knowledge in Algebra, Calculus, and Trigonometry.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basic concepts of theory of equation and know the relation between roots and coefficients.

CO2: Learn about the nature of roots.

CO3: Know about the application of calculus.

CO4: Know the properties of definite integral and reduction formula.

CO5: Study about the Partial differentiation and Euler's theorem.

Mapping of COs with Pos

CO	PO1	PO2	PO3	PO4	PO5
CO1	H		L	L	H
CO2	H	M	L	L	L
CO3	H	L		L	L
CO4	H	L	M	L	M
CO5	H			L	L

Unit I: Relation between roots and coefficients of an equation. 15 hrs

Theory of equations – An n^{th} degree equation has exactly n roots – Relation between the roots and Coefficients-Reciprocal equations.

Unit II: Methods for finding real roots 15 hrs

Finding the roots up to two decimals by Descarte's Rule – nature of roots – Descarte's Rule of signs-Newton's and Horner's Methods.

Unit III: Radius of Curvature 15 hrs

Curvature-Radius of Curvature, Centre of curvature of Plane curves-Evolute

Unit IV: Definite integral 15 hrs

Definite integrals, Reduction formulas for sinnx, cosnx, secnx, cotnx, cosecnx, and sinmx.cosnx and simple problems.

Unit V: Partial differentiation and Euler's theorem. 15 hrs

Partial Differentiation -Homogenious functions and Euler,s Theorem

Text book:

1. Ancillary Mathematics, Paper I, S. Arumugam,New Gamma Publishing House, Reprint 2002.

Reference Book:

1. Mathematics for Engineers, S.Arumugam,A.Tangapandi Isaac, A.Somasundaram, Scitech Publications Pvt.Limited, Chennai 2008.

CHY17R141 Chemistry–I: Fundamentals of Chemistry	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Integrated Course			

Objective:

- Acquire basic knowledge about atomic structure, bonding, molecular structure, organic, stereochemistry and preparation of hydrocarbons.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: To understand the atomic structure, basics of quantum chemistry and its applications.
CO2: Gaining basic knowledge about theories of chemical bonding and molecular structure
CO3: To have a basic knowledge of organic chemistry.
CO4: Understanding the basic principles of stereochemistry
CO5: To study about the preparative methods of aliphatic hydrocarbons.

Mapping of COs with Pos

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	M	L	L
CO2	H	L	M		L
CO3	H	L	L	L	L
CO4	H	L		M	L
CO5	H			M	L

Unit-I Atomic Structure **12 hrs**

Dual behaviour of matter and radiation, de Broglie relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

Postulates of Quantum Mechanics-Time independent Schrodinger equation (derivation not required) and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Spin quantum number (*s*) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, Anomalous electronic configurations.

Unit- II Chemical Bonding and Molecular Structure **12 hrs**

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Polarizing power and polarizability.

Covalent bonding:

VB Approach: Shapes of inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs. MO treatment of homonuclear and heteronuclear diatomic molecules viz., H_2, O_2, N_2, CO, NO and NO^+. Comparison of VB and MO approaches.

Unit- III Fundamentals of Organic Chemistry **12 hrs**

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting

pK values. Aromaticity: Benzenoids and Hückel's rule.

Unit- IV Stereochemistry **12 hrs**

Conformations: Ethane, butane and cyclohexane. Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms).

Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds. Threo and erythro; D and L; *cis – trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).

Unit V Aliphatic Hydrocarbons **12 hrs**

Functional group approach for the following reactions (preparations and reactions) to be studied in context to their structure.

Alkanes: *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis and, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: *Preparation:* Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); *Reactions: cis*-addition (alk. $KMnO_4$) and *trans*-addition (bromine), Addition of HX (Markownikoff's and *anti*-Markownikoff's addition), Hydration, Ozonolysis-oxidation.

Alkynes: *Preparation:* Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* Formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.

List of Experiments for Practical **30 hrs**

Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.
6. Estimation of hydrogen peroxide.

Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing up to two extra elements).
2. Separation of organic compounds based on solubility.
3. Separation of mixtures by Chromatography: Measurement of the R_f value in each case (combination of two compounds to be given)
   i. Identification and separation of the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
   ii. Identification and separation of the sugars present in the given mixture by paper chromatography.

Text Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.

Reference Books:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry*, Orient-Longman, 1960.
2. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
3. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.

4. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
5. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.
6. Graham Solomons, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
7. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
8. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
9. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
10. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
11. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
12. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, 2010.

PAE17R141 A.C Circuits	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Integrated Course			

Objective:

- The aim of this course is to enable the students to familiar and experience with various A.C. circuits

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basic concepts of passive circuit components

CO2: Acquire and analyse the concepts of AC fundamental

CO3: Understand the AC concepts to construct resonance circuits

CO4: Determine the time constant for resonance circuits

CO5: Apply the AC concepts in tuning circuits and filters

Mapping of COs with Pos

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	M	L	L
CO2	H	L		L	M
CO3	H		L		L
CO4	H	L	L	L	
CO5	H	H		M	L

Unit I: Passive circuit elements **12 hrs**

Resistor-Resistor types-Power Rating-Variable resistors-Potentiometers and Rheostats-Resistor color code- Inductor-inductance of an inductor-Mutual inductance-variable inductors-Inductors in series and parallel without M-Reactance offered by a coil-Energy stored in inductor-Capacitors-Factors controlling capacitance-Types of capacitors-Variable capacitors-Capacitors in series and parallel- Energy stored in a capacitor.

Unit II: AC Fundamentals **12 hrs**

Introduction- definitions of cycle, time period, frequency, amplitude -Characteristics of a sine wave-Audio and Radio frequencies-Phase of an AC-Phase difference-AC through pure resistance, Inductance, capacitance.

Unit III: Resonance circuit **12 hrs**

R-L circuit-Q-factor of a coil-skin effect-R-C circuit-Coupling capacitor-R-L-C circuit-Resonance in an R-L-C circuit-Resonance curve-Main characteristic of series resonance-Bandwidth of a tuned circuit-Sharpness of resonance-tuning-Parallel resonance.

Unit IV: Time Constant **12 hrs**

Rise and Fall of current in pure resistance-Time constant of an R-L circuit-circuit conditions-Inductive kick-Time constant of an R-C circuit-Charging and Discharging of a Capacitor-Decreasing time constant-Flasher.

Unit V: Tuning circuits and Filters **12 hrs**

Tuned circuit-characteristics-Tuned transformers-Double tuned transformers-Filters, Filter definitions, Types of filter circuits-Low pass filter-High Pass filter- Band Pass filter-Band stop filter-Uses of filters.

Laboratory Experiments **30 hrs**

1. Resistors in series and parallel
2. Capacitors in series and parallel
3. Characteristics of waves using CRO
4. L-C circuit
5. R-L circuit

6. R-C circuit
7. LCR Series resonance circuit
8. LCR parallel resonance circuit
9. Low pass filter
10. High Pass filter
11. Band Pass filter

Text Book:

1. Basic Electronics, B. L. Theraja, 5th Edition, , (Reprinted in 2012), S. Chand & Company Ltd, New Delhi.

Reference Books:

1. Principles of electronics, V.K.Mehta, 6th Edition, (Reprinted in 2000), S.Chand & Company, New Delhi.
2. Electronic Devices and Circuits, S. Salivahanan and N. Suresh Kumar, II nd Edition, 2001, Tata Mc Graw Hill Publication, New Delhi.
3. Basic Electronics, B.L.Theraja, 5th Edition, , (Reprinted in 2012), S. Chand & Company Ltd, New Delhi.
4. Principles of electronics, V.K.Mehta, 6th Edition, (Reprinted in 2000), S.Chand & Company, New Delhi.

BAE17R107 Communicative English	L	T	P	Credit
	2	0	0	2

Pre-requisite: Nil **Course Category:** Ability Enhancement Course

Course Type: Theory

Unit I: Introduction **6 hrs**

Theory of Communication, Types and modes of Communication

Unit II: Language of Communication: **6 hrs**

Verbal and Non-verbal (Spoken and Written)

Personal, Social and Business

Barriers and Strategies

Intra Personal, Inter Personal and Group Communication

Unit III: Speaking Skills **6 hrs**

Monologue

Dialogue

Group Discussion

Effective Communication/ Mis- Communication

Interview

Public Speech

Unit IV: Reading and Understanding **6 hrs**

CloZe Reading

Comprehension

Summary Paraphrasing

Analysis and Interpretation

Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit V: Writing Skills **6 hrs**

Documenting

Report Writing

Making notes

Letter Writing

Text Books:

1. *Language through Literature* (forthcoming) ed. Dr. Gauri Mishra, DrRanjana Kaul, Dr Brat Biswas.
2. Fluency in English Part II Oxford University Press, 2006.
3. *Business English*, Pearson, 2008.

BAE17R111 Poetry, Short Stories, Fiction, Grammar, Composition And Vocabulary	L	T	P	Credit
	3	0	0	3
Pre-requisite: Nil	**Course Category:** Language **Course Type**: Theory			

Objective:

- The course aims to help the students achieve fluency and accuracy in English.

Course Outcomes:

Upon successful completion of this course, students will be able to

- Introduce World renowned poets to students.
- Make them understand the nuances of Short stories.
- Acquaint students with the writings of Nobel laurates.
- Excel in Grammar.

Unit I: Poetry **9 hrs**

Nissim Ezekiel – Night of the scorpion
Robert Frost – Road Not Taken
Percy Bysshe Shelley – Ode to the West Wind

Unit II: Short Stories **9 hrs**

Jesse Owens - My Greatest Olympic Prize
R.K.Narayan – An Astrologer's Day
Stephen Leacock – My Financial Career

Unit III: Fiction **9 hrs**

Ernest Hemingway – The Old man and the Sea

Unit IV: Grammar **9 hrs**

Tenses
Nouns – Countable and Uncountable
Kinds of Sentences
Articles
Prepositions

Unit V: Composition and Vocabulary **9 hrs**

Composition
Letter Writing (Formal and Informal)
Curriculum Vitae
Situational Conversation
Vocabulary

One Word Substitutes:

alimony, amateur, amnesty, anaesthesia, anarchist, anatomy, anonymous, archive, atheist, autobiography, cannibal, carcinogen, cardiologist, carnivorous, centenarian, contemporary, connoisseur, cosmopolitan, crew, detective, (21 – 40) emigrant, epitaph, extempore, fauna, feminist, fleet, flora, forgery, gymnasium, gynaecologist, herbivorous, hypocrisy, incorrigible, kleptomania, lexicographer, manuscript, mercenary, misanthrope, mortuary, novice, (41 – 60) obituary, omniscient, ophthalmologist, optimist, omnipotent, orphan, panacea, parasite, pedestrian, pessimist, philanthropy philatelist, polygamy, posthumous, post-mortem, secular, somnambulist , theology, unanimous, utopia.

Text Books:

1. Sadanand Kamalesh & Punitha, Susheela, Spoken English: A Foundation Course. Part 2 Orient Black Swan, New Delhi, 2011.
2. Taylor, Grant. English Conversational Practice, New Delhi, Tata McGraw- Hill, 1975.

PHY17R122 Electricity and Magnetism	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Core **Course Type**: Integrated Course			

Objectives:

- To provide the students a firm understanding of the basics of Electricity and Magnetism.
- To introduce the students, the application of Electricity and Magnetism and Electromagnetism

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Describe the properties of static charges.

CO2: Understand the basic concepts of thermoelectricity and their related experiments.

CO3: Design LCR circuits and AC bridges.

CO4: Understand the fundamentals of magnetism.

CO5: Apply the knowledge on electromagnetism in solving real world problems

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H		L	M	M
CO2	H	L	L	L	
CO3	H	L		L	L
CO4	H	L	H		L
CO5	H	L	H	L	L

Unit I: Electrostatics **12 hrs**

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. Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere.

Unit II: Thermoelectricity **12 hrs**

Thermoelectricity- Seebeck effect- Peltier effect-determination of Pelltier coefficient-thermodynamics of thermocouple-Thomson effect-uses of thermoelectric diagrams-Gibbs-Helmholtz equation for the emf of a reversible cell- calculation of emf of Daniel cell- emf of thermocouple using potentiometer- calibration of high range voltmeter. Carey Foster's bridge-theory- determination of temperature coefficient.

Unit III: LCR Circuits **12 hrs**

Growth and decay of currents in LR circuits-growth and decay of charge in CR circuits-determination of high resistance by leakage- growth and decay of charge in LCR circuit-condition for growth and decay to be oscillatory-expression for frequency of oscillation-series and parallel resonant circuits-theory- comparison - Power in LCR circuit-skin effect.

Unit IV: Magnetism **12 hrs**

Magnetostatics: Biot-Savart's law & 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 V: Electromagnetic induction **12 hrs**

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.

Magnetic induction on the axis of a solenoid-Moving coil ballistic galvanometer-theory-damping correction-charge sensitivity of a BG-determination of absolute capacity of a condenser.

Experiments **30 hrs**

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c)DC Current, and (d) checking electrical fuses.
2. Deflection magnetometer – m and BH – TAN C position
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
5. To study the Characteristics of a Series RC Circuit.
6. To study the a series LCR circuit and determine its (a) Resonant Frequency, (b)Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and(b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. BG – Determination of absolute capacity
10. Determination of Thermo emf- direct method – BG

Text Books:

1. Electricity and Magnetism, Brijlal and Subramaniam,
2. Electricity and Magnetism R Murugesan, S. Chand & Co. 1995

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, 1991, Oxford Univ.Press.
3. Electricity and Magnetism- Narayanamurthy and Nagarrthnam National Publishing Company
4. Electricity and Magnetism K KTiwari S Chand & Co
5. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, AsiaPublishing House.
6. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition,2011, KitabMahal, New Delhi.
7. Engineering Practical Physics, S.Panigrahi& B.Mallick,2015, CengageLearningIndiaPvt. Ltd.
8. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers

MAT17R142 Analytical Geometry, Vector Calculus and Fourier Series	L	T	P	Credit
	5	1	0	6
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Theory			

Objective:

- To enable the students to understand the concepts of Analytical geometry of three dimensions, Vector calculus, Interpolation and Fourier Series.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of Analytical geometry.
CO2: Learn about the topic co-planar lines and sphere.
CO3: Know about the topic of multiple integrals.
CO4: Understand the concepts of interpolation.
CO5: Understand the concepts of Fourier series.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L		M
CO2	H	L	M	L	L
CO3	H	L		L	L
CO4	H	L	L		L
CO5	H	L	H	L	L

Unit I: Analytical Geometry of Three Dimensions **15 hrs**

Direction cosines, direction ratios of a line- angle between two straight lines - plane - straight lines.

Unit II: Analytical Geometry of Three Dimensions **15 hrs**

Angle between a plane and a line – co-planar lines- shortest distance between lines-spere-Equations of sphere –section of a sphere by a plane-tanget plane.

Unit III: Multiple Integrals **15 hrs**

Double integration – Cartesian and polar coordinates – Change of order of integration – Change of variable between Cartesian and polar – Area as double integral – Triple integration in Cartesian, cylindrical and spherical polar coordinates – Volume as triple integral.

Unit IV: Vector Calculus **15 hrs**

Vector differential operators, Gradient, Divergence, curl and their simple properties - Directional derivatives-Soleniodal - Irrotational vectors.

Unit V: Fourier Series **15 hrs**

Fourier series-Trigonometric series-Even and odd functions- Half range Fourier series-

Text Books:

1. Ancillary Mathematics, Paper I, S. Arumugam, New Gamma Publications,2002.
2. Mathematics for Engineers, S. Arumugam, A.Thangapandi Isaac, A.Somasundaram-Scitech Publications, Pvt.Ltd, 2008.

Reference Book:

1.Allied Mathematics, Paper-III, S.Arumugam, Issac, New Gamma Publications, Pvt.Ltd, 2007.

CHY17R142 Chemistry-II: Equilibrium Phenomena and Functional Organic Chemistry-I	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Integrated Course			

Objective:

- To grasp the concepts of thermodynamics, thermochemistry, chemical equilibrium

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: To understand the laws of thermodynamics principles of thermochemistry and chemical equilibrium.

CO2: Learning the solubility and solubility product of ionic compounds

CO3: To study about the preparative methods of aromatic hydrocarbons

CO4: Explaining the preparation and some important reactions of alkyl and aryl halides

CO5: To study about the preparation and some reactions of aliphatic and aromatic carbonyl compounds, alcohols, phenols and ethers.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L		L	L
CO2	H	L	M	L	L
CO3	H	L	M	M	L
CO4	H		L		L
CO5	H	L	L	L	M

Unit I - Chemical Energetics and Chemical Equilibria **12 hrs**

Laws of Thermodynamics. Important principles and definitions of thermochemistry. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics.

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG_o, Le Chatelier's principle. Relationships between *Kp* and *Kc* for reactions involving ideal gases.

Unit II -Ionic Equilibria **12 hrs**

Types of electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, *p*H scale, common ion effect. Salt hydrolysis-Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Unit III – Aromatic Hydrocarbons **12 hrs**

Functional group approach for the following reactions (preparations and reactions) to be studied in context to their structure.

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulfonation. Friedel-Craft's reaction (alkylation and acylation).

Unit IV - Alkyl and Aryl Halides **12 hrs**

Alkyl Halides: Types of Nucleophilic Substitution (S_N1 and S_N2) reactions.

Preparation: from alkenes *and* alcohols.

Reactions: hydrolysis, nitrite and nitro formation, nitrile and isonitrile formation. Williamson's ether synthesis: Elimination versus substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent.

Unit V - Aliphatic and Aromatic Carbonyl Compounds, Alcohols, Phenols and Ethers

Aldehydes and ketones (aliphatic and aromatic): 12 hrs

(Formaldehyde, acetaldehyde, acetone and benzaldehyde) *Preparation:* from acid chlorides and from nitriles.

Reactions: Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro reaction. Benzoin condensation. Clemensen reduction and Wolff Kishner reduction.

Alcohols, Phenols and Ethers

Alcohols: *Preparation:* Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

Reactions: With sodium, HX (Lucas test), esterification, oxidation (alk. $KMnO_4$, acidic dichromate, conc. HNO_3).

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.

Reactions: Electrophilic substitution: Nitration, halogenation and sulfonation. Reimer Tiemann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

List of Experiments for Practical **30 hrs**

Physical Chemistry (*Thermochemistry*)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic Equilibria (*p*H measurements)

1. Measurement of *p*H of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using *p*H-meter.
2. Preparation of buffer solutions:
   i. Sodium acetate-acetic acid
   ii. Ammonium chloride-ammonium hydroxide
3. Measurement of the *p*H of buffer solutions and comparison of the values with theoretical values.

Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed.
   Recrystallisation, determination of melting point and calculation of quantitative yield to be done.
   (a) Bromination of Phenol/Aniline
   (b) Benzoylation of amines/phenols
   (c) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone

4 (a) Estimation of Aniline
(b) Estimation of Phenol.

Text Books:

1. Graham Solomons, T.W., Fryhle, C.B. & Snyder, S.A. *Organic Chemistry*, John Wiley & Sons (2014).
2. Mcmurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
4. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.

Reference Books:

1. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
2. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
3. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
4. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
5. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).
6. Mahan, B.H. *University Chemistry* 3rd Ed. Narosa (1998).
7. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
8. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
9. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
10. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R.Chand & Co.: New Delhi (2011).

PAE17R142 Semiconductor diodes and applications	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program Core **Course Type**: Integrated Course			

Objective:

- The aim of this course is to make the students proficient in the field of semiconductor diodes

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts, types and characteristics of semiconductors.
CO2: Understand the characteristics PN junction diode and their applications
CO3: Demonstrate the concepts of advanced diodes.
CO4: Apply the concepts of PN junction diode in designing the rectifiers and filters
CO5: Design the regulated DC power supplies

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L		M
CO2	H	L	L	L	
CO3	H		M	L	L
CO4	H	L		L	L
CO5	H	L	L		L

Unit I: Basic semiconductor physics **12 hrs**

Energy Bands in solids-valence and conduction bands-Hole formation and its movement-conductors, Semiconductors, Insulators-Types of semiconductors-Intrinsic semiconductor-Extrinsic semiconductor-Majority and minority charge carriers-Mobile charge carrier and immobile ions-Drift current in good conductors-Drift current in intrinsic semiconductors-Intrinsic conduction.

Unit II: P-N junction diode **12 hrs**

P-N Junction-Formation of depletion layer- Voltage-current characteristics-P-N Junction diode-Diode ratings -diode testing-The ideal diode-The real diode-Diode circuit with DC and AC voltage sources-Diode fabrication-Clippers and Clampers-Clippers-Some clipping circuits-Clampers-Summary of clamping circuits.

Unit III: Special Diodes **12 hrs**

Zener Diode-Voltage regulation-Zener Diode as peak Clipper-Meter protection-Tunneling Effect-Tunnel Diode-Tunnel Diode oscillator-Varactor-PIN Diode-Schottky Diode-Step recovery Diode.

Unit IV: Rectifiers and Filters **12 hrs**

Full wave rectifier-Full wave Bridge rectifier-Filters-Series inductor filter-Shunt Capacitor Filter-Effect of increasing Filter Capacitance-LC Filter-The CLC and Pi Filter-Bleeder resistor.

Unit V: DC power supplies **12 hrs**

Voltage regulation-Zener Diode Shunt regulator-Voltage dividers-Voltage multipliers-Half wave voltage doubler- Full wave voltage doubler-Voltage Tripler and Quadrapole circuits-Troubleshooting Power supplies.

List of Experiments **30 hrs**

1. V-I characteristics of diode
2. Half wave rectifier
3. Full wave rectifier
4. Bridge rectifier
5. Zener diode Characteristics
6. Zener voltage regulator
7. Schottky Diode characteristics
8. Voltage doubler
9. Voltage tripler
10. Clipper circuit
11. Clamper circuit

Text Book:

1. Basic Electronics, B.L.Theraja, 5th Edition, (Reprinted in 2012), S. Chand & Company Ltd, New Delhi.

Reference Books:

1. Principles of electronics, V.K.Mehta, 6th Edition, (Reprinted in 2000), S.Chand & Company, New Delhi.
2. Electronic Devices and Circuits, S. Salivahanan and N. Suresh Kumar, II nd Edition, 2001, Tata Mc Graw Hill Publication, New Delhi.
3. Basic Electronics, B.L.Theraja, 5th Edition, , (Reprinted in 2012), S. Chand & Company Ltd, New Delhi.
4. Principles of electronics, V.K.Mehta, 6th Edition, (Reprinted in 2000), S.Chand & Company, New Delhi.

CHY17R103 Environmental Science	L	T	P	Credit
	2	0	0	2
Pre-requisite: Nil	**Course Category:** Ability Enhancement Course **Course Type**: Theory			

Objective:

- Creating awareness among engineering students about the importance of environment, the effect of technology on the environment and ecological balance is the prime aim of the course.

Course Outcomes:

At the end of this course, the student is expected to

CO1: To Know the importance of environmental studies and methods of conservation of natural resources.

CO2: Describe the structure and function of an ecosystem and explain the values and Conservation of bio-diversity.

CO3: Explain the sources, environmental effects and control measures of various types of pollutions.

CO4: Select the appropriate methods for waste management.

CO5: Recall social issues and legal provision and describe the necessities for environmental act.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	M	L	M	M
CO2	M	M	L		L
CO3	L	L		L	L
CO4	L		L	L	L
CO5	L	L		L	

Unit-I: Natural Resources **6 hrs**

Definition, scope, and importance of environmental sciences -Need for public awareness- Natural resources: Forest resources, Water resources, Land resources, Mineral resources, and Energy resources - Role of an individual in conservation of natural resources.

Unit-II: Ecosystem and Biodiversity **6 hrs**

Concept of an ecosystem - Structure and function of an ecosystem - Food chains, food webs and ecological pyramids - Biodiversity - Definition, value of biodiversity- Hot spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III: Environmental Pollution **6 hrs**

Sources, consequences and control measures of Air pollution, Water pollution, Soil pollution, Thermal pollution and nuclear pollution. Environmental threats -, Acid rain, Climate change, Global warming (Greenhouse effect), Ozone layer depletion. Fireworks: current environmental issues.

Unit-IV: Management of Environmental Pollution **6 hrs**

Causes, effects, treatments methods and control measures of solid waste, municipal waste, biomedical waste - Waste minimization techniques - Cleaner technology-- Disaster management: floods, earthquake, cyclone, landslides and Tsunami.

Unit-V: Social Issues and the Environment **6 hrs**

Water conservation, rain water harvesting- Environmental impact assessment- Precautionary and polluters pay principle- environment protection act - air (prevention and control of pollution) act - water (prevention and control of pollution) act - Population explosion -

Family Welfare Programmes - Environment and human health - Human Rights - Women and Child Welfare.

Text Books:

1. Dhameja, S. K., Environmental Engineering and Management, S. K. Kataria and sons, New Delhi, 1st edition 2015.
2. Anubha Kaushik and Kaushik C.P., Environmental Science & Engineering" New Age international Publishers, New Delhi, 2010.

Reference Books:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., 2nd edition, 2004.
2. Erach Bharucha, Textbook for Environmental Studies, UGC, New Delhi, 2004.
3. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co. USA, 2nd edition 2004.
4. Erach Bharucha, "The Biodiversity of India", Mapin publishing Pvt. Ltd., Ahmedabad India, 2002.
5. Trivedi R.K., "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro media, 2003.
6. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
7. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
8. Sawyer C. N, McCarty P. L, and Parkin G. F., Chemistry for Environmental Engineering, McGraw-Hill, Inc., New York, 1994.

PHY17R221 Thermal Physics and Statistical Mechanics	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program core **Course Type**: Integrated Course			

Objective:

- This course aims to focus on the complete knowledge on thermodynamics and statistical mechanics

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Acquire knowledge on the fundamental laws of thermodynamics

CO2: Understand the basic principles of thermodynamic potential

CO3: Describe the basic knowledge on kinetic theory of gases

CO4: Understand the concepts on the blackbody radiation

CO5: Analyse the basic concepts on energy distribution

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L		L	L
CO2	H	L	L	M	L
CO3	H	L			
CO4	H	L	L	L	M
CO5	H		L	L	M

Unit I: Laws of Thermodynamics **12 hrs**

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 CP &CV, Work Done during Isothermal and Adiabatic Processes. Second law & Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.

Unit II: Thermodynamic Potentials **12 hrs**

Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations & applications - Joule-Thompson Effect, Clausius-Clapeyron Equation, Expression for (CP – CV), CP/CV, TdS equations.

Unit III: Kinetic Theory of Gases **12 hrs**

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

Unit IV: Theory of Radiation **12 hrs**

Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law

Unit V: Statistical Mechanics **12 hrs**

Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell Boltzmann law - distribution of velocity -Quantum statistics - Fermi-Dirac distribution law electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

List of Experiments **30 hrs**

1. Measurement of Planck's constant using black body radiation.
2. To determine Stefan's Constant.
3. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
4. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
5. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
6. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
7. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
8. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
9. To calibrate a Resistance Temperature Device (RTD) to measure temperature in a specified range using Null Method/ Off-Balance Bridge with Galvanometer based Measurement.
10. Specific heat of liquid - Newton's law of cooling.

Text Books:

1. Heat, Thermodynamics and Statistical Mechanics, Brijlal & Subramaniam, S. Chand Publication, 2012
2. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill.

Reference Books:

1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1969, Indian Press.
3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.
4. Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill.
5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears &G. L. Salinger. 1988, Narosa
6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
7. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
8. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers
9. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.
10. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal,1985, Vani Publication.

MAT17R241 Application of Differential Equation, Laplace Transform and Complex Variable	L	T	P	Credit
	5	1	0	6

Pre-requisite: Nil **Course Category:** Program core

Course Type: Theory

Course Objective:

- To enable the students to acquire basic knowledge in Differential equations and application of differential equations, Laplace Transforms and analytic functions.

Course Outcomes :

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of differential equations.

CO2: Learn about the topicapplication of differential equation.

CO3: Know about the topic of Partial differential equations.

CO4: Understand the concepts of Laplace transform.

CO5: Understand the concepts Of complex variables.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	L		M
CO2	M	L	L	L	L
CO3	M		L	L	L
CO4	M	L		M	
CO5	M		M		L

Unit I: Differential Equations **15 hrs**

Second order equations and constant coefficients- second order equations with right hand side in the forms x^n, e^{ax}, sin ax, cosax, e^{ax}sinbx, e^{ax}cosbx , $e^{ax}x^n$ –Second order equations.

Unit II: Applications Of Differential Equations **15 hrs**

Growth, decay and chemical reactions-Simple electric circuits – Planetary Motion.

Unit III: Partial Differential Equations **15 hrs**

Partial differential equations – Formation of partial differential equations – Lagrange's equation – some standard forms.

Unit IV: Laplace Transforms **15 hrs**

Laplace transform-Inverse Laplace transformation-Solution of differential equations using Laplace Transforms.

Unit V: Complex Variables **15 hrs**

Analytic function – C.R.Equations (without proof)-Bilinear Transformation- Cross Ratios.

Text Book:

1. S. Arumugam and Thangapandi, Issac, Ancillary Mathematics Paper III, New Gamma Publications, 2003.

Reference Books:

1. Narayanan & Manickavasagam Pillai, Differential Equations, S.V. Publication – Reprint, 2003.
2. P.DuraiPandian, Lakshmi Durai Pandian and D. Muhilan, Complex Analysis, Emerald publishers, 1995.

CHY17R241 Chemistry-III: Phase Equilibrium, Electrochemistry & Functional Group Organic Chemistry-II	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program core **Course Type**: Integrated Course			

Course Objective:

- To learn the basic principles of phase equilibrium, Electrochemistry and functional group organic chemistry

Course Outcomes :

Upon successful completion of this course, Students will be able to

CO1: Acquiring knowledge about the basics of phase equilibrium

CO2: To understand the basic principles of electrochemistry

CO3: Formulate the preparation and reaction of carboxylic acids and its derivatives and diazonium salts.

CO4: To study about the building blocks of proteins

CO5: Summarize the classification, properties and structure of carbohydrates.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L		L	M
CO2	M		L	L	L
CO3	M	L	L	L	
CO4	M	M	L	M	L
CO5	M	L	M		L

Unit I Phase Equilibrium **12 hrs**

Phases, components and degrees of freedom of a system. Gibbs Phase Rule. Derivation of Clausius–Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water) and two component systems involving eutectics (lead-silver, metal-organic compound system).

Unit II Electrochemistry **12 hrs**

Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell.Nernst equation and its importance. Standard Hydrogen Electrode (SHE). Standard electrode potential. Electrochemical series.

Calculation of equilibrium constant from EMF data. Concentration cells with transferenceand without transference. Liquid junction potential and salt bridge.

*p*H determination using hydrogen electrode.

Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction only).

Unit III Carboxylic acids & Diazonium Salts **12 hrs**

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Carboxylic acids (aliphatic and aromatic): *Preparation (*Acidic and Alkaline hydrolysis of esters) and *Reaction: (*Hell – Volhard - Zelinsky Reaction).

Carboxylic acid derivatives (aliphatic): *Preparation (*Acid chlorides, Anhydrides, Esters and Amides from acids) and their interconversion.

Reactions: Reformatsky Reaction, Perkin condensation.

Diazonium salts: *Preparation:* from aromatic amines. *Reactions:* conversion to benzene, phenol, dyes.

Unit IV Amino Acids, Peptides and Proteins: **12 hrs**

Preparation of Amino Acids: Strecker synthesis, using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: esterification of –COOH group, acetylation of $–NH_2$ group, complexation with Cu^{2+} ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

Determination of Primary structure of Peptides by degradation - Edman degradation. Synthesis of simple peptides by *N*-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis.

Unit V Carbohydrates: **12 hrs**

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

List of Experiments for Practical 30 hrs

Physical Chemistry

Distribution

Study of the equilibrium of one of the following reactions by the distribution method:

$I_{2(aq)} + I^-_{(aq)} \rightarrow I^{3-}_{(aq)}$

$Cu^{2+}_{(aq)} + xNH_{2(aq)} \rightarrow [Cu(NH_3)_x]^{2+}$

Phase Equilibria

1. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
2. Determination of the critical solution temperature and composition of the phenol-water system and study of the effect of impurities on it.
3. Study of the variation of mutual solubility temperature with concentration for the phenol-water system and determination of the critical solubility temperature.

Conductance

I. Determination of cell constant
II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
III. Performing the following conductometric titrations:
   i. Strong acid vs. strong base
   ii. Weak acid vs. strong base

Potentiometry

Performing the following potentiometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base
iii. Potassium dichromate vs. Mohr's salt

Organic Chemistry

I. Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.
II. 1. Separation of amino acids by paper chromatography
   2. Determination of the concentration of glycine solution by formylation method.
   3. Titration curve of glycine
   4. Action of salivary amylase on starch
   5. Effect of temperature on the action of salivary amylase on starch.
   6. Differentiation between a reducing and a nonreducing sugar.

Text Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).

3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry*, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
4. Mahan, B.H. *University Chemistry*, 3rd Ed. Narosa (1998).

Reference Books:

1. Petrucci, R.H. *General Chemistry*, 5th Ed., Macmillan Publishing Co.: New York (1985).
2. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India)
3. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Nelson, D. L. & Cox, M. M. *Lehninger's Principles of Bioch*emistry *7th Ed.*, W. H. Freeman.
6. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, W.H. Freeman, 2002.
7. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
8. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
9. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).
10. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry*, Universities Press.

PAE17R241 Electronic devices and circuits	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program core **Course Type**: Integrated Course			

Objective:

- The course aims to make the students to understand the electronic devices and to use them in designing of electronic circuits

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of 555 timer and its applications.
CO2: Understand the characteristics of Unijunction Transistor and its applications.
CO3: Apply the knowledge on transistor in advanced devices
CO4: Acquire the basic knowledge on opto-electronic devices
CO5: Demonstrate the measuring instruments

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L		M
CO2	H	L	L	M	L
CO3	H	L		L	
CO4	H		L		L
CO5	H	L	M	L	L

Unit I: 555 Timer **12 hrs**

Introduction – Description of functional diagram – Monostable operation – Missing pulse detector – Frequency divider – Astable operation – FSK generator.

Unit II: Uni Junction Transistor **12 hrs**

UJT construction – operation – equivalent circuit – characteristics – Advantages – applications – UJT relaxation oscillator – Over voltage detector.

Unit III: Thyristors **12 hrs**

Silicon Controlled Rectifier (SCR)- Thyristor ratings - Rectifier circuits using SCR - Light activated SCR (LACR) - Triac - Diac.

Unit IV: Optoelectronic Devices **12 hrs**

Introduction-Special response of Human eye-Photoconductive sensors-Photovoltaic sensors-Photo emissive sensors-Light emitters-Liquid crystal displays-Plasma display panels.

Unit V: Measuring Instruments **12 hrs**

Introduction-Cathode Ray Oscilloscope-Digital multimeter-Frequency meter-Time meter-Energy meter-Power meter.

List of experiments **30 hrs**

1. 555 Timer
2. Astable multivibrator
3. UJT Characteristics
4. UJT Relaxation Oscillator
5. Study of SCR
6. Rectifier circuit using SCR
7. Study and Characteristics of LDR
8. Study of thermistor
9. Triac and Diac Chracteristics
10. Lissajous Figures using CRO

Text Books:

1. Electronic Devices and Circuits, S. Salivahanan and N. Suresh Kumar, II nd Edition, 2001, Tata Mc Graw Hill Publication, New Delhi.
2. Electronic Instrumentation, H.S.Kalsi, 14th Reprint 2002, Tata Mc Graw Hill Publication, New Delhi.

Reference Books:

1. Principles of electronics, V.K.Mehta, 6th Edition, (Reprinted in 2000), S.Chand & Company, New Delhi.
2. Basic Electronics, B.L.Theraja, 5th Edition, (Reprinted in 2012), S. Chand & Company Ltd, New Delhi.
3. Basic Electronics, B.L.Theraja, 5th Edition, , (Reprinted in 2012), S. Chand & Company Ltd, New Delhi.
4. Principles of electronics, V.K.Mehta, 6th Edition, (Reprinted in 2000), S.Chand & Company, New Delhi.

PHY17R222 Waves and Optics	L	T	P	Credit
	4	0	4	6
Pre-requisite: Nil	**Course Category:** Program core **Course Type**: Integrated Course			

Objective:

- This course aims to expose the fundamental concepts of waves, optics and their applications

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of waves and their types.
CO2: Acquire the basic concepts on acoustics and analyze the acoustical demands of building
CO3: Describe the optical interference mechanism.
CO4: Acquire the knowledge on creating the optical diffraction phenomena
CO5: Apply the basic concepts of polarization phenomena

Mapping of COs with Pos

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	L	L	M
CO2	H	L			L
CO3	H	M	L	L	L
CO4	L	H	M	L	
CO5	H		L		L

Unit I: Wave Motion **12 hrs**

Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.

Unit II: Sound **12 hrs**

Simple harmonic motion - forced vibrations and resonance - Fourier's Theorem – Application to saw tooth wave and square wave - Intensity and loudness of sound - Decibels – Intensity levels - musical notes - musical scale. Acoustics of buildings: Reverberation and time of reverberation - Absorption coefficient - Sabine's formula - measurement of reverberation time - Acoustic aspects of halls and auditoria.

Unit III: Interference **12 hrs**

Division of amplitude and division of wavefront. Young's Double Slit experiment. Lloyd's Mirror and Fresnel's Biprism. Interference in Thin Films: parallel and wedge-shaped films. Newton's Rings: measurement of wavelength and refractive index.

Michelson's Interferometer: Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes.

Unit IV: Diffraction **12 hrs**

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

Unit V: Polarization **12 hrs**

Polarization of light waves, Production of plane polarized light by reflection, refraction and scattering, Brewster's law, Malus' law, Superposition of two linearly polarized electromagnetic waves, Nicol prism, Polaroids, Interference of polarized light, quarter and half wave plates, Production of elliptically and circularly polarized light. Optical activity, Faraday rotation.

Experiments **30 hrs**

1. To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's Experiment and to verify λ^2 – T Law.
2. To study Lissajous Figures
3. To determine the Refractive Index of the Material of a given Prism using Sodium Light.
4. To determine Dispersive Power of the Material of a given Prism using Mercury Light
5. To determine the value of Cauchy Constants of a material of a prism.
6. To determine the Resolving Power of a Prism.
7. To determine wavelength of sodium light using Fresnel Biprism.
8. To determine wavelength of sodium light using Newton's Rings.
9. To determine the wavelength of Laser light using Diffraction of Single Slit.
10. To determine wavelength of (1) Sodium & (2) spectrum of Mercury light using plane diffraction Grating
11. To study the Polarization of Light by Reflection and to determine the Polarizing Angle for air-glass interface.
12. To determine the particle size by using LASER

Text Books:

1. Principles of Optics, B.K. Mathur, Gopal Printing, , 1995.
2. Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publication

Reference Books:

1. Fundamentals of Optics, F A Jenkins and H E White, 1976, McGraw-Hill
2. University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison Wesley
3. Optics - Brijlal & Subramaniam, S. Chand Publication, 2014.
4. Optics, Ajoy Ghatak, Tata McGraw Hill, 2008
5. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers
7. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.

MAT17R242 Group Theory, Probability and Interpolation	L	T	P	Credit
	5	1	0	6
Pre-requisite: Nil	**Course Category:** Program core **Course Type**: Theory			

Objective:

- To enable the students to acquire basic knowledge in Arithmetic calculations in solving real world problems.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of set theory and functions.

CO2: Learn about group theory.

CO3: Know about the topic of probability.

CO4: Understand the concepts of interpolation**.**

CO5: Understand the concepts oftrigonometry.

Mapping of COs with Pos

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	L	L	M
CO2	H	L			L
CO3	H	L	L	L	L
CO4	L	H	M	M	
CO5	H	L		M	L

Unit I: Set Theory And Functions. **15 hrs**

Concepts of sets – Operation on sets –Cartesian product of sets-Relations and equivalence relations – Partial Order-Functions-Binary Operation.

Unit II: Group Theory **15 hrs**

Group-Equivalent Definitions of a group-Elementary properties of group-Permutation group - subgroups-Lagrange's Theorem-Cyclic groups.

Unit III: Probability **15 hrs**

Probability-Axiom of Probability-Conditional Probability –Independents events –Bayes Theorem(without Proof) and connected Problems.

Unit IV: Interpolation **15 hrs**

Numerical Methods-Interpolation, Lagrange's and Newton's methods.

Unit V: Trigonometry **15 hrs**

Trigonometry-Expansions, Hyperbolic functions, Logarithms of complex numbers.

Text Books:

1. T.K.Manicavasagam Pillai and NarayananNumerical Analysis – TKM and Narayanan, S.Vishwanathan publications and printers, New edition1994.
2. Modern Algebra-S.Arumugam and A. TangapadiIsaac,Scitech Publications Pvt.Limited,Chennai 2014.
3. Probability Statistics and Random Process.T.Veerarajan,tataMcgraw Hill Private limited .Delhi,Third Edition2009.
4. S. Arumugam, Ancillary Mathematics, Paper I, New Gamma Publishing House, Reprint 2002

Reference Book:

1. Calculas of finite differences and Numerical Analysis by R. Gupta – Malik, Krishna PrakashanMandir, Meerut.

Subject Code	Chemistry-IV: Transition Metal Chemistry,	L	T	P	C
CHY17R242	States of Matter & Chemical Kinetics	4	0	4	6
Pre-requisite: Nil		**Course Category:** Program core ***Course Type:*** *Integrated Course*			

Objective:

- To acquire the knowledge of coordination compounds, states of matter and kinetics of chemical reactions.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: To understand the properties of transition elements**.**

CO2: Understanding basic concepts of coordination chemistry.

CO3: To have a comprehensive knowledge about kinetic theories of gases.

CO4: Acquiring basic knowledge about condensed states of matter**.**

CO5: Knowing the basic concepts of chemical kinetics.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M		M	L
CO2	H	M	M	L	L
CO3	H	L	L		M
CO4	H		L	L	L
CO5	H	L	L	L	M

Unit-I Transition Elements (3d series) 12 hrs

General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states for Mn, and Cr.

Lanthanoids and actinoids: Electronic configuration, oxidation states, colour, magnetic properties, lanthanide contraction and its consequences.

Unit-II Coordination Chemistry 12 hrs

IUPAC system of nomenclature.

Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Drawbacks of VBT.

Crystal Field Theory: Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series.

Unit-III Kinetic Theory of Gases 12 hrs

Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. Van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance.

Unit IV – Condensed States of Matter 12 hrs

Liquids: Viscosity of a liquid and effect of temperature on coefficient of viscosity (qualitative treatment only).

Solids: Forms of solids. unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals (Schottky and Frenkel only). Glasses and liquid crystals.

Unit-V Chemical Kinetics **12 hrs**

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions. Half–life of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

List of Experiments for practical **30 hrs**

Inorganic Chemistry

Semi-micro qualitative analysis using H_2S of mixtures - not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Fe^{3+}, Al^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Mn^{2+}, Zn^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}

Anions : CO_3^{2-} ,S^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-,Cl^-, Br^-, I^-, NO_3^-,SO_4^{2-}, PO_4^{3-}, BO_3^{3-}, $C_2O_4^{2-}$, F^-

(Spot tests should be carried out wherever feasible)

1. Estimation of the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oximate in a given solution gravimetrically.
2. Drawing calibration curve (absorbance at λmax vs. concentration) for various concentrations of a given coloured compound (KMnO4/ CuSO4) and estimation of the concentration of the same in a given solution.
3. Determination of the composition of the Fe3+-salicylic acid complex solution by Job's method.
4. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
5. Estimation of total hardness of a given sample of water by complexometric titration.
6. Determination of concentration of Na^+ and K^+ using Flame Photometry.

Physical Chemistry

I. Viscosity measurement (use of organic solvents excluded).
   a. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
   b. Studying of the variation of viscosity of an aqueous solution with concentration of solute.

II. Chemical Kinetics

Studying of the kinetics of the following reactions.

1. Initial rate method:
   Iodide-persulphate reaction
2. Integrated rate method:
   a. Acid hydrolysis of Ethyl acetate with hydrochloric acid.
   b. Saponification of ethyl acetate.
   c. Comparison of the strengths of Acids by studying kinetics of hydrolysis of ethyl acetate

Text Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry*, R. Chand & Co.: New Delhi (2011).

Reference Books:

1. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
2. Castellan, G.W. *Physical Chemistry* 4th Ed. Narosa (2004).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning
4. India Pvt. Ltd., New Delhi (2009).
5. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
6. Cotton, F.A. & Wilkinson, G. *Basic Inorganic Chemistry*, Wiley.
7. Shriver, D.F. & Atkins, P.W. *Inorganic Chemistry*, Oxford University Press.

Subject Code	Linear integrated Circuits	L	T	P	C
PAE17R242		4	0	4	6
Pre-requisite: Nil		**Course Category:** Program core ***Course Type:*** *Integrated Course*			

Objective:

This course focuses on linear integrated circuits and their applications

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Acquire the basic knowledge on fabrication of IC chips

CO2: Understand the principles and characteristics of operational amplifier

CO3: Apply the concepts operational amplifiers in rectifiers and wave shaping circuits.

CO4: Apply the basic concepts on OPAMP in comparators and wave generators

CO5: Design the filter circuits and non-linear amplifiers

Mapping of COs with Pos

CO	PO1	PO2	PO3	PO4	PO5
CO1	H		L	L	M
CO2	H	L		M	L
CO3	H	L	L	L	
CO4	H		M	L	L
CO5	H	M	L	L	L

Unit I: Integrated Circuit fabrication **12 hrs**

Introduction-Classification-IC Chip size and circuit complexity-Fundamentals of monolithic IC technology-Basic planar processes-Silicon wafer preparation-Epitaxial growth-Oxidation-Photolithography-Diffusion-Ion implantation-Isolation techniques-Metalization-Assembly Processing and Packing-Fabrication of a typical circuit

Unit II: Operational Amplifier **12 hrs**

Introduction-Basic information of an Op-amp-The ideal operational amplifier-open loop operation of op-amp-Feedback in ideal op-amp-The inverting amplifier-The Non-inverting amplifier-Voltage Follower-Differential amplifier-Common-mode rejection ratio-DC characteristics-Input Bias current-Input offset current-Input offset voltage-total output offset voltage-Thermal drift-AC characteristics-Frequency response-Stability of an op-amp-frequency compensation-Slew rate

Unit III: Operational amplifier applications **12 hrs**

Introduction-Basic op-amp applications-Instrumentation amplifier-AC amplifier-V/I and I/V converter-Half wave rectifier-Full wave rectifier-Peak detector-Clipper-Clamper-Sample and hold circuit-Log and antilog amplifier-Differentiator-Integrator

Unit IV: Comparators and waveform generator **12 hrs**

Introduction-Comparator-Applications of comparator-Regenerative comparator (Schmitt trigger)-Square wave generator-Triangular wave generator-Sine wave generators

Unit V: Filters and non linear amplifiers **12 hrs**

Low pass filter-High Pass filter-Band Pass filter-Band Reject filter - Log and anti log amplifier – Differentiator – Integrator.

List of Experiments for practical **30 hrs**

1. Op-Amp characteristics
2. Clipper circuit
3. Clamper circuit
4. Schmidt trigger

5. Comparator
6. Square wave generator
7. Triangular wave generator
8. Adder and subtractor circuits using op-amp
9. Integrator and differentiator circuits using op-amp
10. Low pass filter
11. High Pas filter

Text Book:

1. Linear Integrated Circuits, D. Roy Choudhury and Shail B. Jain, IInd edition, 2003, New age international publishers, New Delhi

Reference Book:

1. Op-amps and Linear Integrated Circuits, Ramakant A. Gayakwad, 4th Edition, 2000, Prentice Hall, New Delhi.
2. Basic Electronics, B.L.Theraja, 5th Edition, , (Reprinted in 2012), S. Chand & Company Ltd, New Delhi.
3. Principles of electronics, V.K.Mehta, 6th Edition, (Reprinted in 2000), S.Chand & Company, New Delhi.

Subject Code	Atomic and Nuclear Physics	L	T	P	C
PHY17R301		4	0	4	6

Pre-requisite: *Nil* ***Course Category:*** Discipline Specific Elective

Course Type: *Integrated Course*

Objective:

This course aims to impart the basic concepts on atomic and nuclear models, nuclear reactors and elementary particles.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts on vector atom model.

CO2: Learn the concepts on fine structure of atomic spectral lines.

CO3: Acquire the knowledge on nucleus and nuclear models

CO4: Understand different types of nuclear reactions and nuclear reactors

CO5: Understand the designing of particle accelerators and detectors

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M		L	L
CO2	H	L	L	L	
CO3	H	L	L		L
CO4	H		M	L	L
CO5	H	L	L		

Unit 1: Vector atom model **12 hrs**

The Vector atom model-Quantum numbers associated with vector atom model-Coupling Schemes-Pauli's exclusion principle – electronic configuration of elements and periodic classification – magnetic dipole moment of electron due to orbital and spin motion – Bohr magneton-stern and Gerlach experiment.

Unit II: Fine structure of spectral lines **12 hrs**

Special terms and notations – selection rules- intensity rule and internal rule – Fine structure of sodium D lines – Alkali spectra – Fine structure in Alkali spectra – spectrum of Helium – Zeeman effect - Larmor's theorem – Debye's quantum mechanical explanation of the normal Zeeman effect – Anamolous Zeeman effect – theoretical explanation, Lande's 'g' factor and explanation of splitting of D1 and D2 lines of sodium.

Unit III: Nucleus and Nuclear models **12 hrs**

Properties of nucleus – Charge, mass, size, spin, magnetic moment, amu, quadrupole moment, mass defect - binding energy – mass – empirical formula (all factors) – Liquid drop model - magic numbers – shell model : evidence for the existence of magic numbers.

Unit IV: Nuclear reactions and reactors **12 hrs**

Nuclear fission- types of nuclear fission-Bohr Wheeler theory-chain reaction- critical size-critical mass-nuclear fusion- source of stellar energy- Carbon – nitrogen cycle- proton- proton cycle-thermonuclear reaction- controlled thermo nuclear reaction- types of nuclear reactors.

Unit V: Particle accelerators, detectors, cosmic rays **12 hrs**

Synchro-cyclotron – betatron – synchrotron – GM counter – scintillation counters – Wilson cloud chamber – Bubble chamber – Cosmic rays : introduction – discovery of cosmic rays – nature of cosmic rays – cosmic ray showers – origin of cosmic radiation.

List of Experiments for practical **30 hrs**

1. Draw the plateau using G M counter (b) Determine the mass attenuation coefficient by G M counter

2. Ionization of air through radioactivity
3. Demonstrating the tracks of α particles in a Wilson cloud chamber
4. Determination of Rydberg constant using Microsoft excels.
5. Determination of e/m using Microsoft excels.
6. Study of absorption spectra of Iodine and determination of its wavelength using grating.
7. Hartsmann's Dispersion formula
8. Study of spectra of hydrogen and deuterium (Rydberg constant and ratio of masses of electron to proton)
9. Study of alkali or alkaline earth spectra using a concave grating
10. Study of Zeeman effect for determination of Lande g-factor

Text Books:

1. Atomic and Nuclear Physics, Brijlal and Subrahmanyam, S. Chand Publications, 1999
2. Modern Physics, R. Murugesan, S. Chand Publications, 2003.

Reference Books:

1. Modern Physics, Sehgal and Chopra, Sultan Chand & Co., 2000.
2. Nuclear Physics, D. C. Tayal, Himalaya Publishing House, 3rd edition,
3. Atomic Physics, J.B.Rajam, S. Chand Publications, 2002.
4. Fundamentals of Modern Physics, Duggal and Chhabra, Shobanlan Nagin, Chand & Co., 1997.
5. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House.
6. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4thEdition, reprinted 1985, Heinemann Educational Publishers.
7. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition,2011, Kitab Mahal, New Delhi.

Subject Code	Relativity and Quantum mechanics	L	T	P	C
PHY17R302		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

This course aims to make the students to understand the basics of quantum physics and theory of Relativity

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Study the behaviour of atoms under the influence of electric and magnetic fields.

CO2: Understand and analyse the time dependent Schrodinger wave equation.

CO3: Understand and analyse the time independent Schrodinger wave equation.

CO4: Learn the basic concepts on bound states in an arbitrary potential

CO5: Understand the fundamental concepts on theory of relativity.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	M		M
CO2	H		L	L	L
CO3	H	M		L	L
CO4	H	L	M		
CO5	H	L	L	L	L

Unit I: Atoms in Electric and Magnetic Fields **12 hrs**

Electron Angular Momentum. Space Quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and Bohr Magneton.

Unit II: Time dependent Schrodinger equation **12 hrs**

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

Unit III: Time independent Schrodinger equation **12 hrs**

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

Unit IV: General discussion of bound states in an arbitrary potential **12 hrs**

Continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem – square well potential; Quantum mechanics of simple harmonic oscillator – energy levels and energy eigen functions using Frobenius method.

Unit V: Relativity **12 hrs**

Frames of reference – Galilean transformation – Lorentz transformation – Special theory of relativity –Postulates of special relativity – Time dilation – Ultimate speed of light – Doppler

effect – Expanding Universe – Length contraction – Twin paradox – Relativistic mass – Mass and energy – Energy and momentum – General theory of relativity – Gravity and light – Velocity addition – Simultaneity.

List of Experiments for practical 30 hrs

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

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

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

   Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 $(eVÅ)^{1/2}$, ħc = 1973 (eVÅ) and m = 0.511x106eV/c2.
2. Solve the s-wave radial Schrodinger equation for an atom:

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

   Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

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

   Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eVÅ)1/2, m = 0.511x106eV/c2 , and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.
3. Solve the s-wave radial Schrodinger equation for a particle of mass m:

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

   For the anharmonic oscillator potential

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

   for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c2, k = 100 MeV fm-2, b = 0, 10, 30 MeV fm-3 In these units, cħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.
4. Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule:

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

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

   $V(r) = D(e^{-2ar'} - e^{-ar'}),\ r' = \frac{r - r_0}{r}$

   Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.
   Take: m = 940x106eV/C2, D = 0.755501 eV, α = 1.44, ro = 0.131349 Å

   Laboratory based experiments:
5. Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
6. Study of Zeeman effect: with external magnetic field; Hyperfine splitting

7. To study the quantum tunnelling effect with solid state device, e.g. tunnelling current in backward diode or tunnel diode.

Text Books:

1. A Text book of Quantum Mechanics, P.M. Mathews & K. Venkatesan, McGraw Hill, 2nd Ed., 2010.
2. Quantum Mechanics, G. Aruldhas, PHI Learning of India, 2nd Ed., 2002.

Reference Books:

1. Quantum Mechanics, Robert Eisberg and Robert Resnick, Wiley, 2nd Ed., 2002.
2. Quantum Mechanics, Leonard I. Schiff, Tata McGraw Hill, 3rd Ed., 2010.
3. Quantum Mechanics, Bruce Cameron Reed, Jones and Bartlett Learning, 2008.
4. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publications.
5. Numerical Recipes in C: The Art of Scientific Computing, W.H.Press et al., 3rd Edn., 2007, Cambridge University Press.
6. Elementary Numerical Analysis, K.E.Atkinson, 3 r dEdn. , 2007, Wiley India Edition.
7. A Guide to MATLAB, B.R. Hunt, R.L. Lipsman, J.M. Rosenberg, 2014, 3rd Edn., Cambridge University Press
8. 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
9. Scilab by example: M. Affouf2012ISBN: 978-1479203444
10. Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011 S. Chand and Company, New Delhi ISBN: 978-8121939706
11. Scilab Image Processing: Lambert M. Surhone. 2010Betascript Publishing ISBN: 978- 6133459274A

Subject Code	Mathematical physics	L	T	P	C
PHY17R303		4	0	4	6

Pre-requisite: *Nil* ***Course Category:*** Discipline Specific Elective

Course Type: *Integrated Course*

Objective:

This course aims to enable the students to apply the mathematical concepts in physics

Course outcomes

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of Fourier series to solve the physical problems

CO2: Analyse the concepts of vectors towards physical problems

CO3: Understand the knowledge on beta and gamma functions

CO4: Learn the basic concepts on partial differential equation and numerical methods

CO5: Analyse the complex variables towards solving the real world problem

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L		M	L
CO2	H	L	L		L
CO3	H	L	L	L	M
CO4	H		M	L	
CO5	H	L	M		L

Unit I: Fourier series **12 hrs**

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. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions.

Unit II: Vectors **12 hrs**

Vectors. – Addition and subtraction of vectors- properties of addition of vectors- Products for two vectors- scalar or dot product – cross product- vector product expressed as a determinant, Area of the parallogram, moment of force, vector product of three vectors- scalar product of four vector and vector product of four vector, Gradient, div, curl vectors.

Unit III: Some Special Integrals **12 hrs**

Gamma function, transformation of Gamma function, Beta function, Evaluation of Beta function, A property of beta function, Transformation of beta function, Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Liouville's Extension of Dirichlet theorem.

Unit IV: Partial Differential Equations and numerical method **12 hrs**

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

Newton raphson method or successive substitution method, Rule of false position, Solution of linear system, Crout's method, iteration method, Jacobi's iteration formula, Gauss-seidal method, solution of ordinary differential equation.

Unit V: Complex Analysis **12 hrs**

Brief Revision of Complex Numbers and their Graphical Representation. Euler's formula, De Moivre's theorem, Roots of Complex Numbers. Functions of Complex Variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy’s Integral formula.

List of Experiments for practical **30 hrs**

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.

- *Highlights the use of computational methods to solve physical problems*
- *Use of computer language as a tool in solving physics problems (applications)*
- *The course will consist of lectures (both theory and practical) in the ComputerLab*
- *Evaluation done not on the programming but on the basis of formulating the problem*
- *Aim at teaching students to construct the computational problem to be solved Students can use any operating system Linux or Microsoft Windows for the following concepts*

Topics	Description with applicaions
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition.
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C++ Programming Fundamentals	Introduction to C++, constants, variables, data types, operators & Expressions, I/O statements, Control statement, *Unconditional andConditional Looping*, Arrays and strings.
Programs: using C/C++ language	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending-descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of (**π**)
Interpolation by Newton Gregory Forward and Backward difference formula, Error estimation of linear interpolation	Evaluation of trigonometric functions e.g. *sin θ, cos θ, tan θ, etc.*
Numerical differentiation (Forward and Backward difference formula) and Integration (Trapezoidal and Simpson rules)	Given Position with equidistant time data to calculate velocity and acceleration and vice-versa. Find the area of B-H Hysteresis loop

Text Books:

1. Mathematical physics, H.K.Dass, S. Chand publications, 2009.
2. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
3. Introduction to Numerical Analysis, S.S. Sastry, 5thEdn., 2012, PHI Pvt. Ltd.
4. Schaum's Outline of Programming with C^{++}. J.Hubbard, 2000, McGraw-Hill.

Reference Books:

1. 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, Earl A Coddington, 1961, PHILearning.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Essential Mathematical Methods, K.F. Riley and M.P. Hobson, 2011, CambridgeUniversity Press
6. Numerical Recipes in C^{++}: The Art of Scientific Computing, W.H. Pressetal., 3rdEdn., 2007, Cambridge University Press.
7. A first course in Numerical Methods, Uri M. Ascher and Chen Greif, 2012, PHI.
8. Elementary Numerical Analysis, K.E. Atkinson, 3$^{r\,d}$Edn ., 2007, Wiley India Edition.
9. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973,Courier Dover Pub.

Subject Code	Basic Electronics	L	T	P	C
PHY17R304		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

This course aims to give exposure to the students on basic electronic components, devices and their applications

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of semiconductor diodes

CO2: Understand the basics of characteristics transistors

CO3: Analyse the characteristics of transistor amplifiers

CO4: Design the different types of oscillators using transistors

CO5: Understand the basic concepts of Field effect Transistor and OPAMP

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	L		L
CO2	H	L	H	L	L
CO3	H	L			L
CO4	H		H	L	M
CO5	H	M	H	L	M

Unit I: Semiconductor diodes **12 hrs**

Semiconductor diode-Crystal diode as a rectifier- resistance of a crystal diode-Equivalent circuit-important terms-Half wave rectifier-efficiency-full wave bridge rectifier-efficiency-Ripple factor-comparison of rectifier-filter circuits-voltage stabilization-zener diode-equivalent circuits-zener as voltage stabilizer.

Unit II: Transistors **12 hrs**

Transistor –Naming the transistor terminals-action-symbols-transistor as an amplifier-transistor connections(CB,CE,CC)-Characteristics (CE only)-Comparison-DC load line analysis-operating points-transistor biasing and its essentials- stability factor-voltage divide bias-hybrid parameter-determination of h-parameter-equivalent circuit-performance of linear circuit in h parameter – the h-parameters of a transistor – nomenclature for transistor h-parameters.

Unit III: Transistor amplifiers **12 hrs**

Single stage transistor amplifier- transistor amplification and its graphical demonstration-practical circuits of transistor amplifier-Load line analysis-multistage amplifier-important terms-RC coupled amplifier-transformer coupled amplifier-direct coupled amplifier-comparison-performance of power amplifier-classification of power amplifier- feedback amplifier- principle of negative feedback amplifier-advantages of negative feedback-feedback circuit.

Unit IV: Oscillators and Multivibrators **12 hrs**

Oscillators-types of sinusoidal oscillations-oscillatory circuits-undamped oscillation from tank circuit-Explanation of Barkhausen criterion for self-sustained oscillations-RC Phase shift oscillator, determination of frequency - Hartley oscillator-Colpitts oscillator-wien bridge oscillator-Multivibrators-astable- monostable-bistable multivibrator.

Unit V: Field Effect Transistors and OPAMP **12 hrs**

Introduction – Types of FETs – JFET – working principle of JFET – JFET as an amplifier – output characteristics of JFET – Important terms – Expression for drain current – advantages of JFET – parameters of JFET – relation among JFET parameters.

Operational Amplifier and their Characteristics-Applications-Addition, Subtraction, Integration and differentiation.

List of Experiments for practical 30 hrs

1. Full-Wave Rectifier with capacitance filter
2. Bridge Rectifier with filter circuit
3. Zener Regulated Power supply
4. Transistor Characteristics – CE mode
5. Single-stage amplifier – discrete components
6. Hartley Oscillator
7. Colpitt's Oscillator
8. Phase shift Oscillator
9. Astable multivibrator
10. FET characteristics
11. FET amplifier
12. OP-AMP applications - Adder, Subtractor, Integrator and Differentiator

Text Books:

1. Basic Electronics: Solid State, B.L.Theraja, S.Chand & Co., 2001.
2. Principles of electronics, V.K.Mehta & Shalu Mehta, S. Chand Publications, 8th Ed., 2003.
3. A Text Book of Practical Physics by M.N.Srinivasan, S.Balasubramanian, R.Ranganathan-Sultan Chand &Sons, 2007

Reference Books:

1. A Text Book of applied electronics, R.S. Sheda, S.Chand & Co., 2003.
2. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, Tata Mc-Graw Hill, 2003.
3. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, PHI Learning Pvt. Ltd., 2000.
4. A. P. Malvino, Electronic Principals, Glencoe, 1993.
5. A Text Book of Practical Physics by Indu Prakash and Ramakrishna, Kitab Mahal Agencies
6. Practical Physics : S.R. Govinda Rajan, T. Murugaiyan S. Sundara Rajan, Rochouse & Sons

Subject Code	Solid State Physics	L	T	P	C
PHY17R305		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

The aim of this course is to expose knowledge on the structural, electrical, magnetic and dielectric properties of materials

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the structural behaviours of materials.

CO2: Understand the fundamental concepts of elementary lattice dynamics

CO3: Learn the concepts of semiconducting and magnetic properties of solids

CO4: Understand and analyse the dielectric properties of materials

CO5: Get the basic theoretical knowledge on superconducting materials.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M		L	M
CO2	H	M	L	L	L
CO3	H		L	L	L
CO4	H	L	M	L	
CO5	H		L		L

Unit I: Crystal Physics **12 hrs**

Lattice Points and Space Lattice; The Basis and Crystal Structure; Unit Cell and Primitive Cell; Crystal systems; Crystal Symmetry; Translation Symmetry elements; Space groups; The Bravais Space group; Metallic Crystal Structures; Diamond, Zinc Blende, Sodium Chloride, Caesium Chloride Structures; Direction, Plane and Miller indices; Imperfections in crystals (qualitatively); Reciprocal Lattice

Unit II: Elementary Lattice Dynamics **12 hrs**

Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Specific Heat; Classical Theory (Dulong and Petit's Law); Einstein theory and Debye's theories of specific heat of solids; T^3 law.

Unit III: Semiconducting and Magnetic Properties of solids **12 hrs**

Band Gaps, Conductors, Semiconductors and insulators; P and N type Semiconductors; Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.

Magnetic permeability; magnetisation; Electric current in atoms-Bohr Magneton; Electron Spin and Magnetic Moment; Diamagnetism; Paramagnetism; Weiss theory of Paramagnetism; Quantum Theory of Paramagnetism; Hund rules; Quantum theory of Ferromagnetism; Ferromagnetic Domains; Antiferromagnetism.

Unit IV: Dielectric Properties of Materials **12 hrs**

Polarisation; Various Polarisation mechanism in dielectrics: electronic, ionic, orientation and space charge polarization; Langevin's Theory of Polarisation in Polar Dielectrics; Internal field or Local field; Clausius-Mosotti relation; Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation; Ferro electricity; Effects of Dielectrics.

Unit V: Advanced solid state material **12 hrs**

Mechanism of Superconductor; Critical Current; Flux Exclusion: Meissner Effect; Thermal properties; The Energy Gap; Isotope Effect; mechanical Effects; The penetration Depth; Type

I and Type II Superconductors; London Equation and Penetration depth; BCS Theory.

List of Experiments for practical 30 hrs

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

Text Books:

1. Solid State Physics, S.O. Pillai, 6th Ed., 2012, New age International Publishers.
2. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
3. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Reference Books:

1. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
2. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
3. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi.
6. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

Subject Code	Digital electronics and communication	L	T	P	C
PHY17R306		4	0	4	6

Pre-requisite: *Nil* ***Course Category:*** Discipline Specific Elective

Course Type: *Integrated Course*

Objective:

This course aims to provide the knowledge on the principles and design of digital circuits and to impart the concepts on analog communication and fiber optic communication

Course outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the binary number systems.

CO2: Apply the basics binary arithmetic and solve the problems.

CO3: Design the registers and counters using digital logic circuits

CO4: Design the circuits on amplitude, frequency modulation and their demodulation.

CO5: Understand the basic principles and types of optical fibers and design the optical receiver circuit.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	L	M
CO2	H			L	L
CO3	H	L	L		L
CO4	H	L	M	H	
CO5	H	L	L		L

Unit I: Number Systems **12 hrs**

Binary number system; Basic gates; Boolean algebra; NOR gates; NAND gates; Boolean laws and theorems; Sum of products method; Truth table to karnaugh map; Pairs, Quads, and Octets; Karnaugh simplifications; Product of Sums method; Product of sums simplification; Binary to Decimal conversion; Decimal to Binary conversion; Octal numbers; Hexadecimal numbers.

Unit II: Binary arithmetic and Flip-flops **12 hrs**

One's complement; two's complement representation; two's complement arithmetic; Arithmetic building blocks; The Adder; Subtractor; RS Flip-Flops; Gated Flip-Flops; Edge-Triggered JK Flip-Flops; JK Master-slave Flip-Flops.

Unit III: Registers and combination circuits **12 hrs**

Types of Registers; Serial in-Serial out; Serial in-Parallel out; Asynchronous counters; Synchronous counters; Variable-resistor Networks; Binary ladders; A/D converter; D/A converter.

Unit IV: Analog communication **12 hrs**

Carrier and signal; Need for modulation; Mathematical Analysis of a Modulated Carrier Wave; Power relations in an AM wave; Block diagram of AM transmitter; Frequency Modulation; Mathematical Expression for FM wave; Demodulation; Essentials of AM detection; Diode Detector for AM signals; FM Detection; Superheterodyne AM receiver; FM receiver; Comparison between AM and FM.

Unit V: Fiber Optic Communication **12 hrs**

Introduction; Principles of light transmission in a fiber; Propagation within a fibre; Numerical Aperture; Acceptance angle; Fibre Index profile; Step Index fibre; Graded Index fibre; Photo-detectors; Optical receiver circuit; Losses in fibers; Connectors and Splices.

List of Experiments for practical **30 hrs**

1. Logic gates using discrete components
2. NAND, NOR as universal gates
3. Half adder and Full adder – Using NAND/NOR gates.
4. Half subtractor and full subtractor
5. Verification of De Morgan's theorems
6. RS, T Flip flops using NAND gates only
7. Shift Register
8. Simplification of Boolean expression using Karnaugh map.
9. Amplitude Modulation and demodulation
10. Frequency modulation

Text Books:

1. Digital Electronics and Applications, Malvino & Leach, McGraw Hill, 1975.
2. Electionic Communication – Dennis Roddy and John Coolen, PHI, 4th Edition, 1995.
3. A Text Book of Practical Physics by M.N.Srinivasan, S.Balasubramanian, R.Ranganathan-Sultan Chand &Sons, 2007
4. A Text Book of Practical Physics by Indu Prakash and Ramakrishna, Kitab Mahal Agencies

Reference Books:

1. Basic Electronics: Solid State, B.L.Theraja, S.Chand Co., 2001.
2. Electronic Communication systems, Kennedy & Davis 4th Edn.,TMH, 1993
3. Electronic Communication systems, Gothman
4. Digital Electronics, Subrata Ghoshal, Cengage Learning, 2012.
5. Practical Physics : S.R. Govinda Rajan, T. Murugaiyan S. Sundara Rajan, Rochouse & Sons

Subject Code	Microprocessors 8085	L	T	P	C
PHY17R307		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

The aim of this course is to give thorough understandings of the functioning of the microprocessor 8085 and also provide them with basic skills in developing assembly language programs.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the designing of the microprocessor architecture μP 8085

CO2: Get the basic knowledge on address bus, data bus, Opcodes and operands

CO3: Learn the different types of addressing modes and the instruction sets of μP 8085

CO4: Write the assembly language programmes using μP 8085

CO5: Apply the knowledge of μP 8085 in implementing interrupts.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H		M	M	M
CO2	H	L	M	L	L
CO3	H	L	L		L
CO4	H		L	L	
CO5	H	M	L	L	L

Unit I: Introduction to microprocessors **12 hrs**

Introduction- evolution of microprocessors – evolution of digital computers- CPU- memory- input device – output device – semiconductor memory –RAM, i RAM, ROM, EPROM, Non-volatile RAM-Microprocessor architecture 8085 and its operations.

Unit II: Buses and Opcodes **12 hrs**

ALU- timing and control unit – registers – data and address bus – pin configuration – Intel 8085 instructions – Opcodes and operands – instruction word size.

Unit III: Addressing modes and 8085 instructions **12 hrs**

Introduction – instruction and data formats – addressing modes – direct addressing mode – register, register indirect, immediate, implicit addressing modes –status flags – symbols and abbreviations – 8085 instructions – data transfer group – arithmetic group – logical, branching groups – stack, I/O and machine control group.

Unit IV: Programming with 8085 **12 hrs**

Introduction – assembly language – stacks – subroutines – simple examples – addition of two 8-bit numbers (sum 8-bit) –8-bit subtraction – addition of two 8-bit numbers (sum 16-bit) – 8 – bit decimal subtraction – 1's complement of 8-bit number – 2's complement of 8-bit number – to find square from look-up table – to find largest of two numbers – to find largest number in a data array.

Unit V: Implementation of Interrupts **12 hrs**

Interrupt - Implementing interrupts - Multiple interrupt - 8085 - trap - Problems on implementing 8085 interrupt - DMA - Memory interfaces - Ram & Rom - I/O interface - Direct I/O - Memory mapped I/O.

List of Experiments for practical **30 hrs**

Write and execute the following programmes

1. Addition of two 8-bit numbers (Sum 8 Bit)
2. Addition of two 8-bit numbers (Sum 16 Bit)
3. 1's complement of 8-bit number
4. 2's complement of 8-bit number
5. Find the largest number in the data array
6. Ascending order
7. Descending order
8. Square and rectangular W/f generator using microprocessor 8085
9. DC motor control using microprocessor 8085
10. Stepper motor control using microprocessor 8085
11. LCD module Display using microprocessor 8085
12. A/D Convertor using microprocessor 8085

Text Books:

1. Fundamentals of microprocessors and microcomputers, B.Ram, Dhanpat rai publications, 5th Ed., 2000.

Reference Books:

1. R.S. Gaonkar, 'Microprocessor Architecture, Programming and Applications with 8085/8080A', Wiley East em limited, 1990.
2. A. Mathur, 'Introduction to Microprocessor' Third Edition, Tata McGraw-Hill Publishing Co. Ltd., 1993
3. J.P. Hayes, Computer Architecture and organization, 3rd Ed., McGraw-Hill, Singapore,1985.

Subject Code	Programming in C++ and Numerical Methods	L	T	P	C
PHY17R308		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

The aim of this course is to enable the students to write programmes using C++ and to apply them to solve problems in numerical methods.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the basic concepts of C++

CO2: Learn the role of functions, arrays, pointers and programming structures of C++

CO3: Learn and apply the basic concepts of object oriented programming

CO4: Understand the different types of inheritance and overloading

CO5: Apply the concepts of C++ in solving problems in numerical methods.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H		L	L	M
CO2	H	L	L		
CO3	H			M	L
CO4	H	L	L	L	M
CO5	H	L	M		H

Unit I: C++ Basics **12 hrs**

Identifiers and key words; String numeric and character constants; Operators; Type conversion; Declaration of variables; Types of statements; Keyboard and screen I/O; Predefined manipulators; Input and output stream flags; Control statements: Conditional expressions, loop statements and breaking control statements.

Unit II: Functions, program structures, arrays and pointers **12 hrs**

Defining a function; 'Return' statement; Types of functions; Actual and formal arguments; Local and global variables; Default arguments; Multifunction program; Recursive function; Array notation, declaration and initialization; Processing with array; Arrays and functions; Multidimensional arrays; Character array; Pointer operator; Address operator; Pointer expressions; Pointer arithmetic; Pointers and functions; Pointers and arrays; Pointers and strings; Arrays of pointers; Pointers to pointers.

Unit III: Classes and objects **12 hrs**

Declaration of Class; Member functions; Object of a class; Accessing a member of a class; Array of class objects; Pointers and classes; Unions and classes; Nested class; Copy constructors; Default constructors; Destructors; Inline member functions; Static data member; Static member functions; Friend functions; Dynamic memory allocations; 'this' pointer.

Unit IV: Inheritance and overloading **12 hrs**

Single inheritance; Direct and indirect base classes; Public, private and protected inheritance; Array of class objects and single inheritance; Multiple inheritance; Container classes; Member access control; Summary Inheritance Access Specifier; Function overloading with various data types and arguments; Scoping rules and special features of function overloading; Overloading assignment, arithmetic, comparison and Unary operators.

Unit V: C++ programming in numerical methods **12 hrs**

Bi-Section method; Newton-Raphson method; Trapezoidal rule; Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ method; Tyler series method; Euler method for first order equation;

List of Experiments for practical **30 hrs**

Write and execute a C++ program for following

1. Trapezoidal rule
2. Simpson's 1/3rd and 3/8th rule
3. Bisection method
4. IV order Ruge-kutta method
5. Newtons Raphson method
6. Quadratic equation
7. Stright line equation
8. Add two Complex variables
9. Sorting of the given numbers
10. Find the largest number from the given list
11. Sine and cosine Series
12. Exponential series

Text Books:

1. Programming with C++, D. Ravichandran, Tata Mc Graw Hill Pub. Company Ltd., New Delhi, 2001.
2. Numerical methods with C++ programming, RM. Somasundaram and RM. Chandrasekaran, Prentice Hall India, 2005

Reference Books:

1. Object Oriented Programming with C++, E. Balagurusamy, TMH , 2nd Edition
2. V.Rajaraman, Computer Oriented Numerical Methods, TMH, 1998
3. Sankara Rao K, Numerical Methods for Scientisits and Engineers, 3rd Ed., Printice Hall of India Private Ltd, New Delhi, 2007.
4. Veerarajan T and Ramachandran T, Numerical methods with programming in 'C' 2nd Ed., Tata McGraw-Hill Publishing. Co. Ltd., 2007.
5. C language and numerical methods, C. Xavier, New Age International Pub. (2003 reprint)
6. Computer Oriented Numerical Methods – V.Rajaraman – TMH – 1998 reprint

Subject Code	Theoretical Physics	L	T	P	C
PHY17R309		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

This course aims to give exposure in key concepts on classical and quantum mechanics

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Learn the fundamentals of Lagrangian formulation

CO2: Understand the Hamilton's formulation

CO3: Analyse the dual nature of matter

CO4: Understand the basic concepts of quantum mechanics

CO5: Apply the basic concepts of quantum mechanics in solving quantum mechanical problems.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M		M	L
CO2	H	L	L	L	L
CO3	H	M	L	M	L
CO4	H	L	L	L	
CO5	H	L	L	M	L

Unit I: Fundamental Principles and Lagrangian Formulation 12 hrs

Mechanics of a particle and system of particles – Conservation laws – Constraints - Generalized coordinates – Principle of virtual work-D' Alembert's principle and Lagrange's equation – Hamilton's principle –Lagrange's equation of motion – conservation theorems and symmetry properties –Atwood's machine – Simple pendulum.

Unit II: Hamilton's Formulation 12 hrs

Hamilton's canonical equations of motion – Hamilton's equations from variational principle –Principle of least action – Phase space – Generalized momentum – Cyclic co-ordinates Conservation theorem for generalized momentum – Conservation theorem for energy

Unit III: Dual Nature of Matter 12 hrs

De Broglie concept of matter waves – De Broglie wavelength – Wave velocity and group velocity for the De Broglie waves – Experimental study of matter waves – Davison and Germer experiment – G.P. Thomon's experiment for verifying De Broglie relation – Heisenberg's uncertainty Principle – Electron microscope – Gamma ray microscope.

Unit IV: Basics of Quantum Mechanics 12 hrs

Basic postulates of wave Mechanics – Development of Schrodinger wave equation – Time independent and dependent forms of equations – Properties of wave function – Orthogonal and normalized wave function Eigen function and eigen values – Expectation values and Ehrenfest's theorem.

Unit V: Exactly Solvable Quantum Systems 12 hrs

Linear harmonic oscillator- Three dimensional harmonic oscillator (Spherically Symmetric case) – Particle in a box –Rectangular barrier potential –Rigid rotator – Hydrogen atom.

List of Experiments for practical **30 hrs**

Use programming language like C++ based on Quantum Mechanics

1. Jacobi's method for finding Eigen values and eigenvectors of the symmetric matrix.
2. Solve the one-particle Schrodinger equation for a potential specified in function potential ( ).
3. Calculate the wave function at fixed energy eigenvalue.
4. Particles in a box
5. Solve the s-wave radial Schrodinger equation for an atom:

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

   Where m is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential

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

   Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wavefunction. Take e = 3.795 (eVÅ)1/2, m = 0.511x106eV/c2 , and a = 3 Å, 5 Å, 7 Å. In these units ħc = 1973 (eVÅ). The ground state energy is expected to be above -12 eV in all three cases.
6. Solve the s-wave radial Schrodinger equation for a particle of mass m:

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

   For the anharmonic oscillator potential

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

   for the ground state energy (in MeV) of the particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose m = 940 MeV/c2, k = 100 MeV fm-2, b = 0, 10, 30 MeV fm-3 In these units, cħ = 197.3 MeV fm. The ground state energy I expected to lie between 90 and 110 MeV for all three cases.
7. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:

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

   Here, m is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wavefunctions. Remember that the ground state energy of the hydrogen atom is ≈ -13.6 eV. Take e = 3.795 $(\text{eVÅ})^{1/2}$, ħc = 1973 (eVÅ) and m = 0.511x106eV/c2.

Text Books:

1. S.L.Gupta., V. Kumar and H.V.Sharma, Pragathi Prakasan, *Classical Mechanics* Educational Publisher, Meerut, 25th edition, 2011.
2. Murughesan, R., *Modern Physics*, S.Chand & Co., New Delhi, 2006.
3. Schaum's Outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publications.

Reference Books:

1. Arthur Beiser, *Concept of Modern Physics*: McGraw Hill Ed. V (1999).
2. H.Goldstein, *Classical Mechanics*, Narosa Book distributors, New Delhi 1980.
3. N.C.Rana and P.S.Joag, *Classical Mechanics*, Tata Mc Graw Hill, New Delhi, 1991.
4. P M. Mathews and K. Venkatesan, *A Text Book of Quantum Mechanics* ,Tata McGrawHill, New Delhi, 1987.
5. Elementary Numerical Analysis, K.E.Atkinson, 3 r dEdn. , 2007, Wiley India Edition.

Subject Code	Materials Science	L	T	P	C
PHY17R310		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

The aim of this course is to make students to understand the characteristics of different types of materials and their applications

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the internal atomic arrangement of atoms in crystals

CO2: Acquire the knowledge on the properties and applications of Nanomaterials

CO3: Learn the basic characteristics and applications of advanced materials

CO4: Analyse the different mechanical behaviour of materials

CO5: Understand the different techniques to characterize the materials.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M		M	L
CO2	H	M	M	L	L
CO3	H	L	L		L
CO4	H		L	L	L
CO5	H	L	L	L	L

Unit I: Crystal Structure **12 hrs**

Types of crystals-space lattice-basis- unit cell and lattice parameters – Bravais lattices-Lattice planes and Miller indices-inter planar spacing in a cubic lattice cubic lattice-SC – BCC – FCC- Sodium chloride and Diamond crystal structure – Bonding of solids (Ionic , Covalent , Metallic , Hydrogen and Van der Waal).

Unit II: Nano Materials **12 hrs**

Nanoscience and nanotechnology – Nanomaterials- Properties of nanomaterials (size dependent) -synthesis of nanomaterials- Fullurenes-Application of nanomaterials – Carbon nanotubes- Fabrication and structure of carbon nano tubes - Properties of carbon nanotubes (Mechanical and Electrical) - Applications of CNT’s.

Unit III: Advanced Materials **12 hrs**

Metallic glass and its applications — Fiber reinforced metals – SAW Materials and its applications – Biomaterials – Ceramic-Nuclear engineering materials-Nanophase materials - SMART materials- Conducting polymers- Optical materials - Fiber optic materials and their applications.

Unit IV: Mechanical Behaviour of Materials **12 hrs**

Different mechanical properties of engineering materials – creep – Fracture technological properties – factors affecting mechanical properties of material-Heat treatment-cold and hot working-types of mechanical tests- metal forming process deformation of metals-Deformation of crystals and polycrystalline materials.

Unit V: Materials Characterization **12 hrs**

Structural Analysis: X-ray diffraction methods - Powder method – Scherrer formula for estimation of Crystallite size. Morphology: Scanning electron microscopy (SEM), Transmission Electron Microscopy (TEM) - Atomic force microscopy - Instrumentation and

result analysis. Thermal Analytical Techniques: Principles, methodology and use of differential thermal analysis and thermo gravimetric analysis

List of Experiments for practical 30 hrs

1. Analysis of powder X-ray spectrum for BCC structure
2. Analysis of X-ray spectrum for FCC structure
3. Analysis of Scherer's formula for a given X-ray spectrum
4. Ferroelectric curie temperature measurement
5. Computer simulations for Brilloun zones for high symmetry cases
6. To measure the Dielectric Constant of a dielectric Materials with frequency
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. Computer simulations for Fermi surfaces for high symmetry cases
9. To measure the resistivity of a semiconductor (Ge) crystal with temperature by fourprobe method (from room temperature to 150° C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.

Text Books:

1. M.N. Avadhanulu, *Material science*, S.Chand & Company, New Delhi, 2014.
2. M.Arumugam, *Material science*, Anuradha puplishers, 1990.
3. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers

Reference Books:

1. V. Raghavan, *Material Science and Engineering* , Printice Hall India.,2004.
2. V. Rajendran, *Material Science*, Tata McGraw Hill Ltd, New Delhi,2001.
3. Introduction to Solid State Physics, C. Kittel, 8th Ed., 2004.
4. H. Willard, L. Merritt, J. Dean, Wadsworth Publishing Company, 7th Ed., 1988.
5. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal, New Delhi.
6. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.

Subject Code	Communication Physics	L	T	P	C
PHY17R311		4	0	4	6

Pre-requisite: *Nil* ***Course Category****:* Discipline Specific Elective

Course Type: *Integrated Course*

Objective:

This course aims to disseminate knowledge to the students on various communication systems

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the transmission and reception modes in radio communication

CO2: Learn the basics of fibre optic communication systems

CO3: Understand the communication mechanisms of RADAR

CO4: Learn the concepts and components of satellite communication systems

CO5: Understand the basic concepts of mobile communication systems.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L		L	L
CO2	H		L		L
CO3	H	L		M	
CO4	H	L	L	L	L
CO5	H		L	L	

Unit I: Radio transmission and reception **12 hrs**

Transmitter-modulation-need for modulation- types of modulation amplitude, frequency and phase modulation- modulation factor-sideband frequencies in AM wave-limitations of amplitude modulation – frequency modulation-block diagram of AM and FM Transmitter. Receiver- demodulation-AM & FM radio receivers-super heterodyne radio receiver.

Unit II: Fiber Optic Communication **12 hrs**

Introduction –structure of optical fibre –total internal reflection in optical fibre – principal and propagation of light in optical fibre - acceptance angle – numerical aperture – types of optical fibers based on material – number of modes – refractive index profile - fiber optical communication system (block diagram) - fiber optic sensors – Temperature sensor – fiber optic endoscope.

Unit III: Radar Communication **12 hrs**

Basic radar system -Radar range –Antenna scanning – Pulsed radar system – Plan position indicator- Tracking radar- Moving target indicator- Doppler effect-MTI Principle- CW Doppler Radar- Frequency modulator CW Radar.

Unit IV: Satellite Communication **12 hrs**

Introduction – history of satellites – satellite communication system – satellite orbits – classification of satellites – types of satellites – basic components of satellite communication – constructional features of satellites- multiple access – communication package – antenna-power source – satellite foot points- satellite communication in India.

Unit V: Mobile Communication **12 hrs**

GSM – mobile services- concept of cell – system architecture – radio interface – logical channels and frame hierarchy – protocols – localization and calling – Handover- facsimile (FAX) – application – VSAT (very small aperture terminals) – Modem – IPTV (internet protocol television) – Wi-Fi - 3G (Basic ideas only).

List of Experiments for practical **30 hrs**

1. Amplitude Modulation and Demodulation
2. Frequency Modulation
3. Pulse Amplitude Modulation
4. Pre-emphasis and De-emphasis
5. Pulse width modulation
6. Measurement of propagation or attenuation loss in optical fiber.
7. Measurement of the Numerical Aperture (NA) of the fiber.
8. Performance analysis of Half wave dipole antenna
9. Performance analysis of Loop antenna
10. Performance analysis of Yagi-Uda antenna

Text Books:

1. Anokh Singh and Chopra A.K., *Principles of communication Engineering*, S. Chand & Company PVT. Ltd., 2013.
2. Metha V.K., *Principles of Electronics,* S. Chand & Company Ltd., 2013

Reference Books:

1. Metha V.K., *Principles of Electronics,* S. Chand & Company Ltd., 2013.
2. Mani I. P., *A text book of Engineering Physics*, Dhanam Publications, Chennai- 42, 2014.
3. Poornima Thangam I, *Satellite communication,* Charulatha Publications, 2012.
4. Dennis Roddy and John Coolen, *Electronic Communication*, PHI, 1990.
5. William C.Y. lee, *Cellular telecommunication* (second edition), Tata Mcgraw hill, 1991.
6. Anokh Singh and Chopra A.K., *Principles of communication Engineering*, S. Chand & Company PVT. Ltd., 2013.

Subject Code	Laser and Spectroscopy	L	T	P	C
PHY17R312		6	0	0	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Theory Course*			

Objective:

1. To expose the students on the fundamentals of spectroscopy
2. To provide the student with knowledge of the wide range applications of spectroscopy

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Gain basic knowledge on the principles of spectroscopy.
CO2: Apply the basis of spectroscopic techniques in modern research
CO3: Gain the knowledge on structural information of the materials
CO4: Get knowledge about instrumentation techniques in spectroscopy
CO5: Acquire the detailed knowledge in atomic spectra

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H		M		
CO2	H		L		
CO3	H	M	M		
CO4	H	L	H		
CO5	H				L

Unit-I: Laser Physics **18 Hour**

Einstein's A and B coefficients, Laser pumping, spontaneous and induced emissions, conditions for laser action, population inversion, 3 and 4 Level Systems with Example (He-Ne). – Solid laser – Nd YAG Laser –CO2 Laser - resonators – vibrational modes of resonators, number of modes per unit volume – open resonators, control resonators, Q factor, losses in the cavity, threshold condition, quantum yield. Hologram construction and reconstruction process - General ideas of optical fiber cable-Types of OFC- Applications

Unit-II: Infrared spectroscopy **18 Hour**

Vibrating diatomic molecule – energy of diatomic molecule, harmonic and anharmonic oscillator, vibrating rotator – co- vibrating rotator spectrum, interaction of rotations and vibrations – vibrations of polyatomic molecules – fundamental vibrations and their symmetry – overtones and combination frequencies. Analysis by IR techniques. Techniques and instrumentation – Outline, single and double beam arrangement.

Unit-III: Raman Spectroscopy **18 Hour**

Theory of Raman effect, Pure rotational Raman spectra – linear, symmetric top, spherical top, asymmetric top molecules. Pure vibrational Raman spectra – Raman activity of vibration rule of mutual exclusion, overtones and combination vibrational spectra, nature of light polarized, vibration of spherical top molecules and other type of molecules. Structural determinations from Raman and IR spectroscopy, techniques and instrumentation.

Unit-IV: NMR spectroscopy And Atomic spectra **18 Hour**

Basic theory of NMR, ESR and NQR- Techniques and instrumentation – Applications- Spectra of hydrogen, deuteron and alkali atoms, spectral terms, doublet fine structure, screening constants for alkali spectra for s, p. d, and f states, selection rules. Singlet and triplet fine structure in alkaline earth spectra, L-S and J-J couplings. Weak spectra: continuous X-ray spectrum and its dependence on voltage, Duane and Haunt's law. Characteristics X-rays, Moseley's law, doublet structure and screening parameters in X-ray spectra, X-ray absorption spectra.

Unit-V: Molecular spectra **18 Hour**

Discrete set of electronic energies of molecules, quantisation of vibrational and rotational energies, determination of internuclear distance, pure rotation and rotation- vibration spectra, Dissociation limit for the ground and other electronic states, transition rules for pure vibration and electronic vibration spectra-Sample spectra analysis.

Text Books

1. Fundamentals of molecular spectroscopy C.N.Banwell, Tata McGraw Hill Publishing Co. Ltd., 3 rd Edition, 1972.
2. Lasers and non-linear optics, B. B. Laud, New Age International (P) Ltd., IIIrd Edn., 2011.

References

1. Vibrational spectroscopy D N Sathyanarayana New Age International (2004)
2. Introduction to Atomic Spectra, H E White, 1934, Mc-Graw Hill.
3. Molecular structure and spectroscopy, G. Aruldhas, 2nd Edn., 2007, PHI, Delhi

Subject Code	**Non-Linear Optics**	**L**	**T**	**P**	**C**
PHY17R313		**6**	**0**	**0**	**6**
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Theory Course*			

Objective:

This paper deals with physics of non-linearity and their applications.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Get the basic ideas on information in light.
CO2: Get the basic ideas on the electromagnetic phenomena
CO3: Acquire the knowledge on photophysical phenomena
CO4: Find out the applications in non linear optics
CO5: Get the ideas on Fiber optics

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H		L		
CO3	H		L		
CO4	H		L		
CO5	H	L			L

Unit-I: Information in Light **18 Hour**

Semiconductors for optoelectronics - Optoelectronic semiconductor devices - Bright light from cool solids - Seeing The Light- The human eye - Color vision - Color blindness - Polarization sensitivity - Speed of response - Optical illusions - Contemporary Optics- Waveguides - Optical fibres - Optical amplification - Conveying sound by light - The long and the short of optical communication.

Unit-II: Fundamental Tools **18 Hour**

Electromagnetic Phenomena - Gauss' Law - Gauss Law For Magnetic Fields - Faraday's Law - Ampere's Law - Maxwell's Adjustment To Ampere's Law - Polarization of Materials - Plane Wave Solutions To The Wave Equation - Complex Plane Waves - Real And Complex Indices of Refraction - The Lorentz Model of Dielectrics - Poynting's Theorem - Irradiance of A Plane Wave - Energy Density of Electric And Magnetic Fields.

Unit-III: Photophysical Phenomena **18 Hour**

Optical Propagation in Media - Diffraction and Dispersion effects - Wave Propagation in Homogeneous Linear Isotropic Media - Anisotropic media - The Origin and Modeling of Optical Nonlinearity - A Simple Physical Model for Optical Nonlinearity - Physical Effects of Nonlinear Polarization - Mathematical Modeling of Optical Nonlinearities - An Alternative Approach For Reflection And Refraction:-Refraction at an Interface - The Fresnel Coefficients' - Reflectance - Transmittance - Double-Interface Problem Solved Using Fresnel Coefficients' - Beyond Critical Angle: Tunneling of Evanescent Waves - Multiple Interfaces - Multilayer Coatings.

Unit-IV: Physics of Non-Linearities **18 Hour**

The Physics of Second Harmonic Generation - SHG in Crystals - Frequency Doubling and Mixing - Optical Parametric Generation Amplification - Oscillation - Mathematical Formulation - Phase Matching in Anisotropic Crystal – Nonlinear Transverse Effects in Second Harmonic Generation - Self-Refraction of Optical/Gaussian Beams - Optical Bistability phenomena - Optical Phase conjugation effects.

Unit-V: Optical Communication Today **18 Hour**

Components - Fabrication And Materials - Light Sources – Coupling- Micro Components Tapers - Splices/Connectors - Characteristics of optical fibers - Diameter Control And Measurement - Attenuation - NLO Properties In Media - Fiber-Optic Solitons - Magnetic Solitons - Optical Shocks And Self-Steepening Of Pulses - Two-Wave Mixing In Photorefractive Materials - Four-Wave Mixing And Phase Conjugation In Photorefractive Materials - Self-Phase Conjugation And Edge Enhancement - Non-Linearities In Nematic Liquid Crystals - Photonic Bandgap Structures

Text Books

1. Richard L Sutherland, *Handbook of Nonlinear Optics, 2nd Edition (Revised and Expanded),* Marcel Dekker, Inc, 2003.
2. Newell, Alan C., and Jerome V. Moloney, *Nonlinear optics,* Addison-Wesley, 1992.

References

1. Justin Peatross and Michael Ware, *Physics of Light and Optics,* 2013.
2. David A. Boas, Constantinos Pitris and Nimmi Ramanujam, *Handbook of Biomedical Optics,* CRC Press, Taylor and Francis Group, 2011.
3. David Greene, *Light and Dark* Institute of Physics Publishing Ltd, 2003.

Goure P and Verrier I, *Optical Fibre Devices Series in Optics and Optoelectronics,*Institute of Physics Publishing Ltd, 2002

Subject Code	Radiation Physics	L	T	P	C
PHY17R314		6	0	0	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Theory Course*			

Objective:

This paper deals with the detailed theoretical and experimental concepts on radiation physics.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Gain knowledge on the concepts of radiation

CO2: Get the basic ideas on the x-rays

CO3: A Acquire the knowledge on radiation therapy

CO4: Get the knowledge on instrumentation techniques in radiation therapy

CO5: Gain the knowledge on clinical radiation therapy

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H				L
CO3	H				
CO4	H		M	L	L
CO5	H	L			L

Unit-I: Structure Of Matter, Nuclear Transformation And X-Rays 18 Hour

Elementary particles - Electromagnetic radiation-wave model and quantum model. Nuclear Transformation - Nuclear transformation-radioactivity - Decay constant – Activity - Radioactive series - Radioactive equilibrium -Activation of nuclides.X-Rays-Production of X-rays - X-ray tube - X-ray circuit - voltage rectification - Physics of X-ray production - X-ray energy spectra - Operating characteristics.

Unit-II: Clinical Radiation Generators 18 Hour

Kilo-voltage units- Grenz-ray therapy - Contact therapy - Superficial therapy - Orthovoltage therapy or deep therapy - Super voltage therapy - Resonant transformer units - Megavoltage therapy - Van de graff generator - Linear accelerator - Betatron - Cyclotron - Microtron - Machines using radionuclides-Cobalt-60 unit - Heavy particle beams.

Unit-III: Ionizing Radiation, Quality of X-Ray Beams, Measurement of Absorbed Dose

Ionizing Radiation - Interaction of ionizing radiation-Ionization - Photon beam description - Photon beam attenuation - Attenuation coefficient - Energy transfer - energy absorption coefficient - Interaction of photons with matter - Coherent scattering - The Roentgen - Free air ionization chamber - String electrometer - Ion collection-Saturation and collection efficiency - Measurement of exposure. Quality of X-Ray Beams- Half value layer and its measurement - Peak voltage-Direct indirect measurement - Effective energy. measurement of Absorbed Dose- Radiation absorbed dose - Relation between Kerma - Exposure - Absorbed dose.

Unit-IV: Classical Radiation Therapy 18 Hour

Dose distribution and scatter analysis-Phantoms - Depth dose distribution - percentage depth dose-Dependence on beam quality and depth - Tissue air ratio (TAR)-relationship between TAR and percent depth dose- Dose calculation parameters- Collimator Scatter Factor - Phantom Scatter Factor - Tissue-Phantom and Tissue-Maximum Ratios - Scatter-Maximum Ratio- Practical Applications - Accelerator Calculations- SSD Technique - Cobalt 60 Calculations. Treatment planning-Acquisition of Patient Data- Internal Structures- Computed Tomography - Magnetic Resonance Imaging-Ultrasound. Skin Dose. Electron beam therapy -

Brachytherapy.

Unit-V: Modern Radiation Therapy, Dosimetry and Radiation Protection 18 Hour

Modern Radiation Therapy-Image-Guided Radiation Therapy - Proton Beam Therapy. Dosimetry-Dosimeter - Film badge dosimeter - Pocket dosimeter. Radiation Protection-Radiation Protection - Dose Equivalent - Effective Dose Equivalent - Background Radiation - Low-Level Radiation Effects - Effective Dose-Equivalent Limits- Occupational and Public Dose Limits.

Text Books

1. Meredith W.J. and J.B. Massey, *Fundamental Physics of Radiology*, A. John Wright and Sons Ltd.,3rd Edition, 1983.
2. William.R.Hendee, Geoffery.S.Ibbott and Eric.G.Hendee, *Radiation Therapy Physics*, A.John Wiley and Sons.,Inc, 3rd Edition, 2005.

References

1. Smith F.A., *A Primer in Applied Radiation Physics*, World scientific publishing Co., 2000.
2. Podgarsak E.B., *Radiation Physics for Medical Physicists*, Springer, 2006.
3. Evans R. D., *Atomic Nucleus*, Textbook Publications, 2003.

Fiaz.M.Khan, *The Physics of Radiation Therapy*, Lippincott Williams and Wilkins, 4th Edition, 2010.

Subject Code	**Elements of Nano science and Nanotechnology**	**L**	**T**	**P**	**C**
PHY17R315		**6**	**0**	**0**	**6**
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Theory Course*			

Objective:

1. This paper deals with the basic principles of nanostructures.
2. Methods of synthesis of nanomaterials

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Gain knowledge on the nanomaterials and nanotechnology.
CO2: Describe the type of nanomaterials
CO3: Get the basic ideas on the Electrical transport in nanostructure
CO4: Acquire the knowledge on basic characterization techniques.
CO5: Able to synthesis new nanomaterials

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H	L	L		
CO3	H		L		
CO4	H	L	M	H	
CO5	H	L		M	L

Unit-I: Introduction to Nanostructures 18 Hour

Introduction to nano-sized materials and structures, Definitions of nanomaterials, Brief history of Nanomaterials and challenges in Nanotechnology, Properties of Nanomaterials: Effect of reduction of dimensions, quantum size effects, Mechanical, Thermal, Optical and Magnetic properties of nanomaterials and their applications.

Unit-II: Electrical transport in nanostructure **18 Hour**

Electrical conduction in metals, The free electron model. Conduction in insulators/ionic crystals - Electron transport in semiconductors - Various conduction mechanisms in 3D (bulk), 2D(thin film) and low dimensional systems: Thermionic emission, field enhanced thermionic emission (Schottky effect), Field assisted thermionic emission from traps (Poole-Frenkel effect), Arrhenius type activated conduction, Variable range, Hopping conduction, Polaron conduction.

Unit-III: Introductory Quantum Mechanics for Nanoscience **18 Hour**

Size effects in small systems, Quatum behaviour of nanometric world: Applications of Schrödinger equation – infinite potential well, potential step, potential box; trapped particle in 3D (nanodot), electron trapped in 2D plane (nanosheet), electrons moving in 1D (nanowire, nanorod, nanobelt), Excitons, Quantum confinement effect in nanomaterials.

Unit-IV: Methods of Synthesis of Nanomaterials **18 Hour**

Bottom-up and Top-down approaches - Mechanical method: High Energy Ball Milling, Methods based on evaporation (Physical Vapour Deposition), Chemical Vapour Deposition, Chemical Methods: Colloidal Method and Sol-gel Method Special Nanomaterials: Carbon Nanotubes (CNT), Types –Single walled, multiwalled CNT, Structures and properties of CNTs, Synthesis of carbon nanotubes

Unit-V: Analytical (Characterization) Technique **18 Hour**

Microscopy: SEM. TEM, X-ray diffraction, UV-Visible spectrometer, FTIR and AAS, Electrical characterization, Vibrating Sample Magnetometer.

Text books

1. Introduction to Nanoscience & Nanotechnology by K. K. Chattopadhyay and A. N. Banerjee, Publisher: PHI Learning and Private Limited, 2009.
2. Nanotechnology, Rakesh Rathi, S Chand & Company, New Delhi, 2010.
3. Nanotechnology: Principles and Practices by Sulbha K Kulkarni, Capital Publishing Co. New Delhi, 2014.

References

1. Nanoparticle Technology Handbook – M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama (Eds.), Elsevier 2007
2. Encyclopaedia of Materials Characterization, Surfaces, Interfaces, Thin Films, Eds. Brundle, Evans and Wilson, Butterworth – Heinmann, 1992
3. Springer Handbook of nanotechnology, Bharat Bhushan (Ed.), Springer-Verlag, Berlin, 2004
4. A Handbook on Nanophysics, John D, Miller, Dominant Publishers and Distributors, Delhi, 1993.
5. Introduction to Nanotechnology, Charles P Poole Jr. and Frank J Owens, Wiley Students Edition, 2007.
6. Nano-and micro materials, K Ohno et. al, Springer International Edition 2009, New Delhi

Subject Code	Medical Physics	L	T	P	C
PHY17R316		4	0	4	6
Pre-requisite: *Nil*		***Course Category:*** Discipline Specific Elective ***Course Type:*** *Integrated Course*			

Objective:

This paper deals with the basic concepts of medical physics.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the physics of body.

CO2: Understand the acoustic, optical and electrical systems of a body.

CO3: Gain the knowledge on diagnostic and therapeutic systems

CO4: Acquire the knowledge on radiation physics.

CO5: Gain the knowledge on radiation oncology physics

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H	L	L		
CO3	H		L		
CO4	H	L	M	H	
CO5	H	L		M	L

Unit-I: PHYSICS OF THE BODY-I **12 Hour**

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 **12 Hour**

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 **12 Hour**

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

Unit-IV: Radiation Physics **12 Hour**

Radiation units exposure, absorbed dose, units: rad, gray, relative biological effectiveness, effective dose, inverse square law. Interaction of radiation with matter Compton & photoelectric effect, Rem & Sievert, linear attenuation coefficient. **Radiation Detectors**: Thimble chamber, condenser chambers, Geiger Muller counter, Scintillation counters and Solid State detectors, ionization chamber, Dosimeters, survey methods, area monitors, TLD, Semiconductor detectors

Unit-V: Radiation Oncology Physics **12 Hour**

External Beam Therapy (Basic Idea):

Telecobalt, Conformal Radiation Therapy (CRT), 3DCRT, IMRT, Image Guided Radiotherapy, EPID, Rapid Arc, Proton Therapy, Gamma Knife, Cyber Knife. Contact Beam Therapy (Basic Idea): Brachytherapy-LDR and HDR, Intra Operative Brachytherapy. Radiotherapy, kilo voltage machines, deep therapy machines, Telecobalt machines ,Medical linear accelerator. Basics of Teletherapy units, deep x-ray, Telecobalt units, medical linear accelerator, Radiation protection, external beam characteristics, dose maximum and build up – bolus, percentage depth dose, tissue maximum ratio and tissue phantom ratio, Planned target Volume and Gross Tumour Volume.

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.
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

Text books

- Medical Physics, J.R. Cameron and J.G. Skofronick, Wiley (1978)
- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
- Christensen’s Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
- Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003)

References

- Basic Radiological Physics Dr. K. Thayalan - Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi (2003)
- Christensen’s Physics of Diagnostic Radiology: Curry, Dowdey and Murry - Lippincot Williams and Wilkins (1990)
- Physics of Radiation Therapy: F M Khan - Williams and Wilkins, Third edition (2003)

Subject Code	Elements Of Modern Physics	L	T	P	C
PHY17R317		4	0	4	6

Pre-requisite: *Nil* ***Course Category:*** Discipline Specific Elective

Course Type: *Integrated Course*

Objective:

This paper deals with the basic concepts of medical physics.

Course Outcomes:

Upon successful completion of this course, Students will be able to

CO1: Understand the Basic concepts of quantum mechanics.

CO2: Understand the concepts of wave particle duality

CO3: Gain the knowledge on wave functions

CO4: Acquire the knowledge on quantum mechanical problems.

CO5: Gain the knowledge on radioactivity

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H	L	L		
CO3	H				
CO4	H	M	M	H	
CO5	H	L		M	M

Unit-I: **12 Hour**

Planck's quantum, Planck's constant and light as a collection of photons; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson Germer experiment.

Problems with Rutherford model- instability of atoms and observation of discrete atomic spectra; Bohr's quantization rule and atomic stability; calculation of energy levels for hydrogen like atoms and their spectra.

Unit-II: **12 Hour**

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle- impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle.

Unit-III: **12 Hour**

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

Unit-IV: **12 Hour**

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

Unit-V: **12 Hour**

Radioactivity: stability of nucleus; Law of radioactive decay; Mean life & half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

Fission and fusion - mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with

Uranium 235; Fusion and thermonuclear reactions.

Experiments

1. To determine value of Boltzmann constant using V-I characteristic of PN diode.
2. To determine work function of material of filament of directly heated vacuum diode
3. To determine value of Planck's constant using LEDs of at least 4 different colours.
4. To determine the ionization potential of mercury.
5. To determine the wavelength of H-alpha emission line of Hydrogen atom.
6. To determine the absorption lines in the rotational spectrum of Iodine vapour.
7. To study the diffraction patterns of single and double slits using laser source and measure its intensity variation using Photosensor and compare with incoherent source – Na light.
8. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light
9. To determine the value of e/m by magnetic focusing.
10. To setup the Millikan oil drop apparatus and determine the charge of an electron

Text books

Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill

- Modern Physics, John R. Taylor, Chris D. Zafiratos, Michael A.Dubson,2009, PHI Learning
- Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill

References

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

Subject Code	Physics Workshop skills	L	T	P	C
PHY17RS01		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective:

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

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the different types of units, conversions, and measuring different physical parameters.

CO2: Get experience in workshop practices, like manufacturing methods, materials etc.

CO3: Assemble electronic circuits and operate electronic instruments like oscilloscope.

CO4: Understand mechanisms of gear systems, wheel, lever etc.

CO5: Understand and apply simple machines, break systems, pulleys etc.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M		M	M
CO2	H	L	L	L	L
CO3	H	L		L	L
CO4	H	M	L		L
CO5	H	M	L	L	

Unit I: Introduction **6 hrs**

Measuring units. conversion to SI and CGS. Familiarization with meterscale, 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.

Unit II: Mechanical Skill **6 hrs**

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: Electrical and Electronic Skill **6 hrs**

Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C, diode) and ICs on PCB. Operation of oscilloscope.

Unit IV: Introduction to prime movers **6 hrs**

Mechanism, gear system, wheel, Fixing of gears with motor axel. Lever mechanism, Lifting of heavy weight using lever.

Unit V: Simple machine **6 hrs**

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

Text Books:

1. A text book in Electrical Technology - B L Theraja – S. Chand and Company.
2. New Engineering Technology, Lawrence Smyth/Liam Hennessy, The Educational Company of Ireland [ISBN: 0861674480]

Reference Books:

1. Performance and design of AC machines – M.G. Say, ELBS Edn.
2. Mechanical workshop practice, K.C. John, 2010, PHI Learning Pvt. Ltd.
3. Workshop Processes, Practices and Materials, Bruce J Black 2005, 3rd Edn., Editor Newnes [ISBN: 0750660732]

Subject Code	Computational Physics	L	T	P	C
PHY17RS02		2	0	0	2

Pre-requisite: Nil **Course Category:** Skill Enhancement Course

Course Type: *Theory*

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.

- Highlights the use of computational methods to solve physical problems
- Use of computer language as a tool in solving physics problems (applications)
- Course will consist of hands on training on the Problem solving on Computers.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the fundamentals of programming languages and parameters.

CO2: Understand and use different programming statements.

CO3: Understand and use different loop control structures in programming

CO4: Understand and apply different functions in programming

CO5: Apply the knowledge of program techniques to develop C-programs for solving simple problems in Physics.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	M		M
CO2	H			L	L
CO3	H		L	M	
CO4	H	L		L	
CO5	H	L	L	M	L

Unit I: C Language Fundamentals **6 hrs**

Constants, Variables, Keywords, rules for constructing integer constants, real constants, character constants. Types of C variables and rules for constructing variable names. Declaration instruction, arithmetic instruction, Integer and float conversion, type conversions in assignments, hierarchy of operation and associativity of operators.

Unit II: Decision Structure **6 hrs**

if statement, if-else, nested if-else. The logical operator: the if-else clause, the not operator, conditional operator, Switch statement.

Unit III: Loop Control Structure **6 hrs**

while loop, for loop, nesting of loop, multiple initializations in the for loop. The break statement, the continue statement and the do-while loop.

Unit IV: Functions **6 hrs**

Function, Passing values between function, Scope rule of functions, Calling convention. Advanced features of functions: return type of function, call by value and call by reference. Introduction to pointers.

Unit V: Programmes **6 hrs**

Simple pendulum, Bar pendulum, Project motion, surface tension, Nuclear decay, Wave motion, specific heat, Ohms law, Boolean laws, Kepler's Laws. Solution of linear equation. Use of spread sheets for plotting graphs.

Text Book:

1. Let Us C- Yashwant Kanetkar (8th edition) BPB Publishers

Reference Books:

1. An Introductory Course in Computational Physics-Richard Fitzpatrick.
2. Computational Physics-Nicholas Giordano & Hisao Nakanishi.
3. Introduction to computational Physics-Tao Pang.

Subject Code	Electrical Circuits and Network skills	L	T	P	C
PHY17RS03		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective:

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

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the fundamentals of electricity and electric circuits.

CO2: Understand different network theorems and apply them to solve physical problems.

CO3: Understand electrical measuring instruments and apply them for electrical measurements.

CO4: Understand the fundamentals of alternating currents and their applications

CO5: Understand the working of electrical appliances and apply this for use and servicing of such instruments.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	M	L	L
CO2	H	L	L	L	M
CO3	H		L	L	L
CO4	H	M	L		
CO5	H	L		M	L

Unit I: Basic Electricity Principles **6 hrs**

Electric Current, Electric Potential-Resistance-Unit of Resistance-Law of Resistance-Units of Resistivity-Conductance and Conductivity-Effect of Temperature on Resistance-Temperature Coefficient of Resistance-Ohm's Law-Resistance in Series-Voltage Divider Rule-Resistance in Parallel-Types of Resistors-Nonlinear Resistors-Varistor-Equivalent Resistance-Duality between Series and Parallel Circuits-Relative Potential.

Unit II: DC Network Theorems **6 hrs**

Electric Circuits and Network Theorems-Kirchhoff's Laws-Determination of Voltage Sign-Assumed Direction of Current-Current Source-Superposition Theorem- Thevenin Theorem-Reciprocity Theorem-Delta/Star Transformation-Star-Delta Transformation-Norton' s Theorem .

Unit III: Electrical Instruments and Measurements **6 hrs**

Moving-iron Ammeters and Voltmeters - Attraction Type-Repulsion Type-Sources of Error. Advantages and Disadvantages-Moving-coil Instruments-Permanent Magnet Type Instruments-Advantages and Disadvantages-Extension of Range-Voltmeter Sensitivity-Multi-range Voltmeter-Electrodynamic or Dynamometer Type - Ballistic Galvanometer-Potentiometer-Standardising the Potentiometer-Calibration of Ammeters-Calibration of Voltmeters

Unit IV: A.C. Fundamentals **6 hrs**

AC circuit analysis: Sinusoidal voltage and current, Definition of instantaneous, peak, peak to peak, root mean square and average values. Voltage-current relationship in resistor, inductor and capacitor. Phasor, complex impedance, power in AC circuits: instantaneous power, average power, reactive power, power factor, Resonance in series and parallel RLC circuits, frequency response of series and parallel RLC circuits

Unit V: Electrical Appliances **6 hrs**

AC and DC - Single phase and three phase connections - House wiring - overloading - earthing - short circuiting - Fuses - colour code for insulation wires - Inverter - UPS -

generator and motor - circuit breaker. Electrical switches.

Text Book:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.

Reference Books:

2. Performance and design of AC machines - M G Say ELBS Edn.
3. A text book of Electrical Technology - A K Theraja

Subject Code	**Basic Instrumentation skills**	**L**	**T**	**P**	**C**
PHY17RS04		**2**	**0**	**0**	**2**
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective:

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

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basic parameters of instruments like accuracy, precision, sensitivity etc.

CO2: Understand the working of different measuring instruments.

CO3: Understand the basics of Cathode Ray Oscilloscopes and their applications.

CO4: Understand the basics of analytical instruments and their applications.

CO5: Understand the basics and working of LCR bridge and their applications.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	M	L	M
CO2	H	L	L	L	L
CO3	H		L		M
CO4	H	L		L	
CO5	H	L		L	L

Unit I: Basics of Measurement **6 hrs**

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, Block diagram and working of a digital multimeter.

Unit II: Electronic Voltmeter **6 hrs**

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

Unit III: Cathode Ray Oscilloscope **6 hrs**

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

Unit IV: Signal Generators and Analysis Instruments **6 hrs**

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 **6 hrs**

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.

Text Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.

Reference Books:

1. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
2. Electronic Devices and circuits, S. Salivahanan & N. S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
3. Electronic circuits: Handbook of design and applications, U.Tietze, Ch.Schenk, 2008, Springer
4. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Subject Code	Renewable Energy and Energy Harvesting	L	T	P	C
PHY17RS05		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective:

The aim of this course is not just to impart theoretical knowledge to the students but to provide them with exposure and hands-on learning wherever possible

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basics of fossil fuels, renewable energy, their sources and applications.

CO2: Understand the importance and difference methods of harvesting solar energy, and their applications.

CO3: Understand the fundamentals of wind energy, their applications, and methods of taping wind energy.

CO4: Understand the importance of ocean energy, methods of taping them and use in daily life.

CO5: Apply the modern energy harvesting techniques in daily life.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L	L	L
CO2	H	L			
CO3	H	L		L	M
CO4	H		L	M	L
CO5	H	L		L	L

Unit I: Fossil fuels and Alternate Sources of energy **6 hrs**

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, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

Unit II: Solar energy **6 hrs**

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

Unit III: Wind Energy and Hydro energy **6 hrs**

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies

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

Unit IV: Ocean Energy **6 hrs**

Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. Geothermal Energy: Geothermal Resources, Geothermal Technologies.

Unit V: Modern energy harvesting techniques **6 hrs**

Piezoelectric Energy harvesting: Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modeling piezoelectric generators, Piezoelectric energy harvesting applications,

Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications. Carbon captured technologies, cell, batteries, power consumption.

Text Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd.

Reference Books:

4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, Oxford
5. University Press, in association with The Open University.
6. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009

Subject Code	Electrical appliances	L	T	P	C
PHY17RS06		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objectives: To make the student competent enough in installing, operating and servicing different electrical appliances.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the basic theories and applications of heat and different techniques of heating.

CO2: Understand and perform welding using different types welding equipments.

CO3: Understand the principles and applications of transformers.

CO4: Understand different types of transformers and their applications.

CO5: Understand the working of different hope appliances, installation and servicing

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	L		
CO2	H	L	M	L	L
CO3	H		M		L
CO4	H	M		L	
CO5	H	L		L	L

Unit I: Heating and Welding **6 hrs**

Electric heating - Modes of transfer of heat - Methods of electric heating - resistance heating - Induction heating - High frequency eddy current heating - Dielectric heating.

Unit II: Heating and Welding **6 hrs**

Resistance welding - Electric arc welding - DC and Ac welding equipment - Energy storage welding - Occupational hazards due to chemical reactions - Industrial heating and welding.

Unit III: Principles of transformers **6 hrs**

Principle of operation - Constructional details - Core type, Shell type - classification of transformers - EMF equation - Voltage Ratio - Current ratio - Transformer on no-load – Auto transformer - Principle - Applications.

Unit IV: Applications of transformers **6 hrs**

Three phase Transformer - Connections - Star - Star, Star - delta, Delta-star – Parallel operation of transformers - Load sharing - Cooling of transformers - Protective devices and accessories - Loses in transformer.

Unit V: Domestic appliances **6 hrs**

Theory and principle of operation of fans - Wet grinder - Water heater – Electric iron - Refrigerator - Microwave oven.

Text Books:

1. A text book in Electrical Technology, B.L. Teraja, S. Chand & Co., New Delhi
2. A text book in Electrical Technology, A.K. Teraja, S. Chand & Co., New Delhi

Reference Books:

1. A text book in Electric power, P.L. Soni, P.V. Gupta & V.S. Bhatnagar
2. Utilisation of Electrical Energy, E.O. Taylor, Orient Longman.
3. Art & Science of Utilisation of Electrical Energy, H. Partas, M/s. Dhanpat Raji & Sons, New Delhi.
4. A Course in Electrical Power, J.B. Gupta, M/s. B.D. Jaataris & Sons.

Subject Code	Astrophysics	L	T	P	C
PHY17RS07		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective: To give the student an introduction to the different physical phenomena happening in the Universe, formation of celestial objects, and their activities.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand the different planets, their composition and their surroundings.

CO2: Understand the formation of objects like Comets, Meteors, etc.

CO3: Understand the properties of Sun, activities in Sun and their planets.

CO4: Understand the formation of stars and their life.

CO5: Understand the origin of the universe and different properties.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	ML	L	L	
CO2	H	L	L	L	L
CO3	H		L		L
CO4	H	L	L	H	L
CO5	H	L		M	

Unit I: Universe **6 hrs**

Planets - interior planets - exterior planets - crust, mantle and core of the earth - different - region of earth's atmosphere - rotation of the earth - Magnetosphere - Van Allen belts - Aurora**.**

Unit II: Comets, Meteors, Asteroids **6 hrs**

Composition and structure of comets - periodic comets - salient features of asteroids, Meteors and its use.

Unit III: Sun **6 hrs**

Structure of photosphere, chromosphere, corona - sunspots - solar flares - solar prominences - solar piages - satellites of planets - structure, phases and their features of moon.

Unit IV: Stars **6 hrs**

Constellations - Binary stars - their origin and types star clusters – Globular clusters - types of variable stars - types of galaxies.

Unit V: Origin of Universe **6 hrs**

Big bang theory - pulsating theory - steady state theory - composition of universe expansion.

Text Books:

1. K.D. Abyankar, Astrophysics of the solar system, University press, India

Reference Books :

1. Baidyanath Basu, An introduction to Astrophysics, Prentice Hall of India, New Delhi.

2. Prof. P. Devadas, The fascinating Astronomy, Published by Devadas Telescopies, 2, Charkrapani Road, Guindy, Chennai

Subject Code	Bio - Medical Instrumentation	L	T	P	C
PHY17RS08		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective: To make the student familiar with different instruments in medical field, their working and their applications.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand and operate cardiographic instruments.

CO2: Understand the principles of artificial organs, and their applications.

CO3: Understand the principles and working of biomedical instruments, and use them appropriately.

CO4: Understand the effects of exposure to radiation, and apply this for the use safety instruments.

CO5: Operate hazard monitoring instruments, analyse them and take necessary safety measures.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L	H	M
CO2	H	L		L	L
CO3	H		L	M	
CO4	H	L	L		L
CO5	H	L	M	L	L

Unit I: Cardiographic instruments **6 hrs**

Electro - Cardiography (ECG) - Electromyography (EMG) - Electro - Encephelograph (EEG) - Phonocardiography.

Unit II: Artificial organs **6 hrs**

Pacemakers - Introduction - External and Internal pacemakers - Artificial heart valves - (Principle - block diagram and operation).

Unit III: Bio-medical instrumentation **6 hrs**

Anesthesia machine - Recording fetal heart movements and blood circulation using Doppler ultrasonic method - Laser based Doppler blood flow meter - Blood cell counter - B.P. measurement - Direct and indirect method - Haemocytometer - counting of RBCs and WBCs.

Unit IV: Radiation Safety instrumentation **6 hrs**

Radiation safety instrumentation - Effects of radiation exposure – Radiation monitoring instruments - Pocket dosimeter - pocket type radiation alarm**.**

Unit V: Hazards Effect **6 hrs**

Area monitoring instruments - physiological effects due to current passage - micro shock and macro shock - Electrical Accidents in hospital - Micro shock hazards - macro shock hazards**.**

Text Book:

1. Bio-medical Instrumentation - Dr. M. Arumugam - Anuradha Agencies.

Reference Books:

1. Bio instrumentation - John G. Webster, editor - John Wiley & Sons, Inc

2. Biological Instrumentation and methodology, P.K. Bajpai.

Subject Code	Programming in C	L	T	P	C
PHY17RS09		2	0	0	2

Pre-requisite: Nil **Course Category:** Skill Enhancement Course

Course Type: *Theory*

Objective: To make the student familiar in programming in C.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Understand basics of c programming.

CO2: Understand the Array and functions.

CO3: Understand the concepts of structures

CO4: Gain the knowledge of pointers

CO5: Gain the knowledge on file operations

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L	H	M
CO2	H	L		L	L
CO3	H		L	M	
CO4	H	L	L		L
CO5	H	L	M	L	L

UNIT-I

History of C - Characteristics of C - C Program Structure - Data Types - Variables and Constants - Operators - Conditional Statements - Looping and Iteration

UNIT-II

Single Dimensional Array - Multi Dimensional Array - Types of functions - Functions and Arrays - String Functions - Recursive Functions

UNIT-III

Basics, Structures and functions - Arrays of structures - Pointers to structures - Self referential structures - Typedef - Union - Bitfields - Enum Data Types

UNIT-IV

Pointers introduction - declaration - passing function to pointers - pointers with arrays - dynamic memory allocation.

UNIT V

File management and Console input and output – Functions for file management - Standard I/O, Formatted output - Formatted input - File access - Error handling

Text Books

1. E. Balagurusamy , Programming in Ansi C , 6th Edition, TMG - India 2012.

References

1. Herbert Schildt, The Complete Reference C, 4th Edition, Tata Mc - Graw Hill, 2000.

2. Byron C Gottfried, Programming with C, Schaums' outline series 2nd Edition, Tata Mc - Graw Hill, 2006

Subject Code	Space Physics	L	T	P	C
PHY17RS10		2	0	0	2

Pre-requisite: Nil **Course Category:** Skill Enhancement Course

Course Type: *Theory*

Objective: This paper deals with the detailed concepts on space science.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Know about the earth's atmosphere.

CO2: Get the basic ideas on the interplanetary medium

CO3: Acquire the knowledge on planets

CO4: Carry out the research work on space physics

CO5: Acquire the knowledge on sun atmosphere

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H				M
CO3	H				M
CO4	H		L		M
CO5	H				M

Unit-I: The Earth's Upper Atmosphere 6 Hours

Variations of atmospheric densities and temperature. Formation and structure of Ionosphere. Studies of ionosphere by ground based and space techniques. The radiation belts. Auroras. Lyman glow of the night sky. The geo-corona and airglow studies.

Unit-II: Sun **6 Hours**

Structure of solar atmosphere. Solar convection and differential rotation. Large scale and small scale magnetic fields. Solar granulation and super granulation. Sunspots. Solar flares.

Unit III Interplanetary Medium **6 Hours**

Xray and g-ray studies of sun. Solar X-ray and radio bursts. Solar wind. Interaction with planetary atmosphere. Structure of bow shocks. Magnetosphere. Ring Current. Radiation belts and interplanetary magnetic field.

Unit - IV Moon **6 Hours**

Origin of Moon. Solar and Lunar eclipses. Lunar ranging experiments. Studies of lunar surface from various space missions and their results. Satellites of other planets of the solar system.

Unit - V Planets 6 Hours

Infrared spectroscopy of planetary atmospheres. Principal results of the Mariner, Venera and Viking Space Missions to Mars and Venus. Voyager space mission studies of outer planets and their satellites and rings. Comparative studies of planetary atmospheres. Planetary ionospheres. Extra-solar system planets.

Text Books

1. Sun, Earth and radio: An Introduction to the Ionosphere and Magnetosphere, J.A.Ratcliffe, 1970, Littlehampton Book Services Ltd

2. An Intoduction to Planetary Physics: The Terrestrial Plants, Kaula. W.M, 1969, John Wiley & Sons Inc.

3. Harold Zirin: Astrophysics of the Sun, 1988, Cambridge University Press

References

1. W.N.Hess and G.Mead(Ed): Introduction to Space Science, 1965, Gorden and Breach,

2. V.Bumba and Kleczek, Basic Mechanism of Solar Activity, 1976.

3. W. J. Kaufmann, Exploration of the Solar System, Mac Millan, 1978, New york.

Subject Code	Non -Destructive Testing	L	T	P	C
PHY17RS11		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective: This paper deals with the detailed concepts on space science.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Get the basic ideas on testing of materials

CO2: Get the knowledge on radiography

CO3: Acquire information on ultrasonic testing

CO4: Identify and rectify the defects in materials

CO5: Acquire the knowledge on acoustic emission testing

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H				M
CO3	H				M
CO4	H		L		M
CO5	H				M

Unit – I:

Visual Examination & Liquid Penetrant Testing Basic principles- The eye- Unaided visual inspection- Optical aids used for visual inspection- Application – Liquid penetrant testing - Physical principles procedure – Penetrant testing materials - Testing methods – Applications and limitations.

Unit – II:

Magnetic Particle Testing and Eddy Current Testing Principle of MPT – Magnetizing techniques- Procedure-EquipmentLimitations- Eddy Current Testing principles- Instrumentation Techniques Applications - Limitations

Unit – III:

Radiography Basic principle – X ray source-production of gamma ray sourcesProperties of X rays and gamma rays- Attenuation in specimen effect of radiation on film – radiographic imaging –Inspection techniques – Applications - Limitations – Safety in industrial radiography- Neutron radiography.

Unit – IV:

Ultrasonic Testing Basic properties of sound beam- Ultrasonic transducers- Inspection methods- Techniques for normal beam inspection - Techniques for angle beam inspection – Flaw characterization techniques , detection equipment Modes of display- Immersion testing- Applications – Advantages-Limitations.

Unit – V:

Acoustic Emission Testing Principles of Acoustic Emission Testing - Techniques- Instrumentation sensitivity- Applications standards- Structural integrity assessment- Acoustic emission technique for leak detection.

Text Books

1. Practical Non- Destructive testing by Dr.BaldevRaj, T.Jayakumar and M.Thavasimuthu, Narosa Publications, New Delhi, 2008.
2. Non-Destructive Testing Techniques, Ravi Prakash, New Age International, 2010.

References

1. Barry Hull & Vernun John, Nondestructive testing, Springer, 1988.
2. Non-destructive Testing,1st ed., Hull B.,2012, Springer Verlag, 2012.

Subject Code	X-ray Diffraction and Electron Microscopy	L	T	P	C
PHY17RS12		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective: This paper deals with the detailed theoretical and experimental concepts on X-ray diffraction and microscopic techniques.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Gain knowledge on the X-ray diffraction.

CO2: Get the basic ideas on the optical microscopy

CO3: Acquire the knowledge on other spectroscopic techniques

CO4: Understand the detailed structural information using X-ray diffraction

CO5: Identify symmetric nature of materials through X-ray diffraction

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				
CO2	H				M
CO3	H				M
CO4	H		L		M
CO5	H				M

External and internal symmetry

Symmetry with respect to a line, point and plane, 32 point groups, super-group, sub-group, screw axis, glide plane, effect of screw axis and glide plane on structure factor, centro-symmetry in structures and its effect on X-ray and electron diffraction, introduction to space group, reading of the space group tables

Stereographic projections

Basic concept, standard projections (100, 111, 110), pole figures, measurement of pole figures by X-ray diffraction, applications of stereographic projections

X-ray diffraction

Generation of X-rays, characteristic X-ray spectrum, Bragg's Law, Laue method, rotating crystal method, powder method, Principle, equipment and applications, X-ray diffractometer instrumentation and its effect on peak profiles, filters, counters/detectors, applications of X-ray diffractions

Optical microscopy (OM)

Reflected/transmitted light microscopy, theoretical and practical resolution of an optical microscope, numerical aperture, principles of image formation, microscope construction and working, effective/empty magnification, different light sources.

Microscopic Techniques

Mechanics of SEM, Block diagram of SEM, its working and construction, Principles of transmission electron microscopy, construction, ray-diagram, working, sample preparation, contrast mechanisms.

Text Books

1. Cullity B D., Stock S R "Elements of X-ray Diffraction", Prentice Hall, Inc 2001.

2. L. Yang, Materials Characterization: Introduction to microscopic and spectroscopic, Wiley, 2013.

3. Goodhew, Humphreys and Beanland, Electron Microscopy and Analysis, 3rd edn., CRC Press, 2000.

References

1. D. Brandon and W. Kaplan, Micro structural characterization of materials, Wiley & Sons, 2008
2. DeGraf and McHenry, Structure of Materials, Cambridge University Press, 2012.
3. Schwartz A.J., Electron backscattered diffraction in materials science, Springer, 2009.
4. Instrumental Methods of Analysis, Hobart H. Willard, 1988.

Subject Code	**Laser Physics**	**L**	**T**	**P**	**C**
PHY17RS13		**2**	**0**	**0**	**2**
Pre-requisite: Nil	**Course Category:** Skill Enhancement Course ***Course Type:*** *Theory*				

Objective: This paper deals with the fundamental concepts of laser

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Know about the fundamentals of laser

CO2: Get the basic ideas on the production of laser

CO3: Understand the classification of laser

CO4: Acquire the knowledge on applications of laser in various fields

CO5: Carry out the research work on laser

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	H				**L**
CO2	H				**L**
CO3	H		L		
CO4	H				**L**
CO5	H		M		**L**

Fundamentals of LASER

Spontaneous emission – stimulated emission – meta stable state – Population inversion – pumping – Laser Characteristics

Production of LASER

Helium – Neon Laser – Ruby Laser – CO2 Laser – Semiconductor Laser

Industrial Applications of LASER

Laser cutting – welding – drilling – Hologram – Recording and reconstruction of hologram

Lasers in Medicine:

Lasers in Surgery – Lasers in ophthalmology – Lasers in cancertreatment

Lasers in Communication

Optic fibre communication- Total internal reflection – Block diagram of fibre optic communication system – Advantages of fibre optic communication

Text Books

1. Laser fundamentals – William T. Silfvast Cambridge University Press – Published in South Asia by foundation books, 23, Ansari Road, New Delhi , 2008
2. An introduction to LASERS – N. Avadhanulu, S. Chand & Company, 2001.

References

1. LASER Theory and Application – K. Thyagarajan and A.K. Ghatak, Mac millan, India Ltd., 1981.
2. Lasers and non-linear optics, B. B. Laud, New Age International (P) Ltd., IIIrd Edn., 2011

Subject Code	Energy Resources	L	T	P	C
PHY17RS14		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective: This paper deals with the detailed theoretical and experimental concepts on energy resources.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Gain knowledge on the conventional energy resources.

CO2: Know about the importance of conventional energy sources

CO3: Get the basic ideas on the solar energy

CO4: Acquire the knowledge on fundamentals in biomass energy

CO5: Know about the other forms of energy resources

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				**L**
CO2	**H**	**M**			**L**
CO3	**H**	**M**	**L**	**L**	
CO4	**H**		**L**		
CO5	**H**				**L**

Unit-I: Conventional Energy Sources

Worlds reserve - commercial energy sources and their availability – various forms of energy – renewable and conventional energy system – comparison – Coal, oil and natural gas – applications – Merits and Demerits

Unit-II: Solar Energy

Renewable energy sources – solar energy – nature and solar radiation – components – solar heaters – crop dryers – solar cookers – water desalination (block diagram) Photovoltaic generation – merits and demerits

Unit-III: Biomass energy fundamentals

Biomass energy – classification – photosynthesis – Biomass conversion process

Unit-IV: Biomass Utilization

Gobar gas plants – wood gasification – advantages & disadvantages of biomass as energy source

Unit-V: Other forms of energy sources

Geothermal energy – wind energy – Ocean thermal energy conversion – energy from waves and tides (basic ideas)

Text Book

1.G.D.Rai, Non- Conventional Energy Sources, Kanna Publishers, IVth Edn., 15th Reprint, 2005.

References

1."Renewable energy sources and emerging Technologies", by D.P. Kothari, K.C. Singal & Rakesh Ranjan, Prentice Hall of India pvt. Ltd., New Delhi. 2008.

2. "Renewable Energy sources and their environmental impact" – S.A. Abbasi and Nasema Abbasi PHI Learning Pvt. Ltd., New Delhi, 2008

Subject Code	Solar Energy	L	T	P	C
PHY17RS15		2	0	0	2

Pre-requisite: Nil **Course Category:** Skill Enhancement Course

Course Type: *Theory*

Objective: This paper deals with the detailed experimental concepts on solar energy related applications.

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Gain knowledge on the basics of solar energy.

CO2: Get the basic ideas on the solar collectors

CO3: Acquire the knowledge on fuel cells

CO4: Carry out research work in solar energy related resources

CO5: Get the fundamental knowledge on photovoltaic solar cells

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				**L**
CO2	**H**				**L**
CO3	**H**				
CO4	**H**	**L**			
CO5	**H**	**L**	**M**	**M**	**L**

Unit-I: Solar Energy:

Solar constant, solar radiation at the Earth's surface, solar energy collectors: physical principle of the conversion of solar radiation in to heat. Types of collectors: Parabolic collectors, Mirror strip reflector, Fresnel lens collector, Compound parabolic concentrators (CPC).

Unit-II: Solar PV fundamentals

Semiconductor – Properties – Energy levels – P-N junction - Homo and hetro junctions – P-N junction - Equilibrium condition - Non equilibrium condition – Basic Silicon Solar cell - Crystalline and multicrystalline – Dark and illumination characteristics – Efficiency limits – Variation of efficiency with band gap and temperature – Beyond single junction Efficiency Limit - Efficiency measurements - GaAs Solar cells

Unit-III: Application of Solar Energy

Solar Water Heating, Heating and Cooling of Buildings, Thermo electric conversion, Power generation, PV cells, Solar distillation, Pumping, Cooking, Hydrogen production

Unit-IV: Solar Thermal Energy

Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

Unit-V: Fuel Cells

Design and principle of operation, Classification, Types, Advantages and disadvantages, Conversion efficiency, Types of electrodes, work output and EMF of Fuel Cells, Applications of Fuel Cells.

Text Books

1. G.D.Rai, Non- Conventional Energy Sources, Kanna Publishers, IVth Edn., 15th Reprint, 2005.
2. G.D. Rai, Solar Energy Utilization, Khanna Pub., Vth Edn., 1995.

References

1. Solar Energy – S.P.Sukhatme, 1996, II nd edition Tata McGraw-Hill.
2. Fundamentals of Renewable Energy Systems - D. Mukherjee and S. Chakrabarti, 2007, New Age International Publishers.

Non Conventional Energy Resources, D.S. Chauhan, 2010, New Age International Publishers.

Subject Code	Technical Drawing	**L**	**T**	**P**	**C**
PHY17RS16		**2**	**0**	**0**	**2**
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective: This paper deals with the detailed experimental concepts on technical drawing

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Gain knowledge on the basics of drawing techniques.

CO2: Get the basic ideas on the projection.

CO3: Acquire the knowledge on object projections

CO4: Understand the basics of CAD drawing

CO5: Acquire the knowledge on 3D modelling and Auto CAD

Mapping of COs with POs

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**H**				**L**
CO2	**H**				**L**
CO3	**H**				
CO4	**H**	**L**			
CO5	**H**	**L**	**M**	**M**	**L**

Unit-I:

Introduction: Drafting Instruments and their uses. lettering: construction and uses of various scales: dimensioning as per I.S.I. 696-1972. Engineering Curves: Parabola: hyperbola: ellipse: cycloids, involute: spiral: helix and loci of points of simple moving mechanism.2D geometrical construction. Representation of 3D objects. Principles of projections.

Unit-II:

Projections: Straight lines, planes and solids. Development of surfaces of right and oblique solids. Section of solids

Unit-III:

Object Projections: Orthographic projection. Interpenetration and intersection of solids. Isometric and oblique parallel projection of solids

Unit-IV:

Introduction to CAD and Auto CAD, precision drawing and drawing aids, Geometric shapes, Demonstrating CAD- specific skills (graphical user interface. Create, retrieve, edit, and use symbol libraries. Use inquiry commands to extract drawing data).

Unit-V:

Control entity properties. Demonstrating basic skills to produce 2-D and 3-Ddrawings. 3D modeling with Auto CAD (surfaces and solids), 3D modeling with sketch up, annotating in Auto CAD with text and hatching, layers, templates & design center, advanced plotting (layouts, viewports), office standards, dimensioning, internet and collaboration, Blocks, Drafting symbols, attributes, extracting data. Basic printing, editing tools, Plot/Print drawing to appropriate scale.

Reference Books:

- K. Venugopal, and V. Raja Prabhu. Engineering Graphic, New Age International
- AutoCAD 2014 & AutoCAD 2014/Donnie Gladfelter/Sybex/ISBN:978-1-118-57510-9
- Architectural Design with Sketchup/Alexander Schreyer/John Wiley & Sons/ISBN: 978-1-118-12309-6

Subject Code	Radiology and Safety	**L**	**T**	**P**	**C**
PHY17RS17		**2**	**0**	**0**	**2**
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course ***Course Type:*** *Theory*			

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

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Gain knowledge on the basics of atomic and nuclear physics.

CO2: Get the basic ideas on the interaction with matter.

CO3: Acquire the knowledge on the radiation detection and monitoring devices

CO4: Understand the basics of radiation safety management.

CO5: Apply the nuclear techniques.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				**L**
CO2	**H**				**L**
CO3	**H**				
CO4	**H**	**L**			
CO5	**H**	**L**	**M**	**M**	**L**

Unit-I:

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

Unit-II:

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

Unit-III:

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

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

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.

Unit-V:

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

Reference Books:

- K. Venugopal, and V. Raja Prabhu. Engineering Graphic, New Age International
- AutoCAD 2014 & AutoCAD 2014/Donnie Gladfelter/Sybex/ISBN:978-1-118-57510-9
- Architectural Design with Sketchup/Alexander Schreyer/John Wiley & Sons/ISBN: 978-1-118-12309-6

Subject Code	Weather Forecasting	L	T	P	C
PHY17RS18		2	0	0	2
Pre-requisite: Nil		**Course Category:** Skill Enhancement Course			
		Course Type: *Theory*			

Objective: The aim of this course is not just to impart theoretical knowledge to the students but to enable them to develop an awareness and understanding regarding the causes and effects of different weather phenomenon and basic forecasting techniques

Course Outcomes:

Upon successful completion of this course, students will be able to

CO1: Gain knowledge on the basics of atomic and nuclear physics.

CO2: Get the basic ideas on the interaction with matter.

CO3: Acquire the knowledge on the radiation detection and monitoring devices

CO4: Understand the basics of radiation safety management.

CO5: Apply the nuclear techniques.

Mapping of COs with POs

CO	PO1	PO2	PO3	PO4	PO5
CO1	**H**				**L**
CO2	**H**				**L**
CO3	**H**				
CO4	**H**	**L**			
CO5	**H**	**L**	**M**	**M**	**L**

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

Reference Books:

1. Aviation Meteorology, I.C. Joshi, 3rd edition 2014, Himalayan Books
2. The weather Observers Hand book, Stephen Burt, 2012, Cambridge University Press.
3. Meteorology, S.R. Ghadekar, 2001, Agromet Publishers, Nagpur.

4. Text Book of Agrometeorology, S.R. Ghadekar, 2005, Agromet Publishers, Nagpur.
5. Why the weather, Charls Franklin Brooks, 1924, Chpraman & Hall, London.
6. Atmosphere and Ocean, John G. Harvey, 1995, The Artemis Press

Subject Code	PROJECT	L	T	P	C
PHY17R399		0	0	12	6

Course Objective: To develop the students' knowledge towards solving, analysing and/or exploring the real time difficult problems.

Course Outcomes: At the end of the course, students should be able to:

CO1: Demonstrate the fundamental physics concepts
CO2: Undertake the problem identification, formulation and solution
CO3: Demonstrate knowledge of contemporary issues in their chosen field of research.
CO4: Design the new solution/product

This course will be conducted largely as an individual or small group project under the direct supervision of a member of academic staff. The specific project topic undertaken will reflect the common interests and expertise of the student(s) and supervisor. The following few fields are listed below.

- Electronic circuit design
- Electronic instrumentation
- Development of Electronic devices
- Communication devices
- Computer simulation towards physics problems
- Materials synthesis
- Materials characterization
- Theoretical Physics
- Materials Science
- Thin Film
- Energy Physics
- Astrophysics
- Nuclear and Particle Physics
- Biophysics
- Medical physics
- Atmospheric Physics

Those who want to select the project fields which are not listed above, they are also permitted to do the project on their own interest with the permission of supervisor and department.