BACHELOR OF SCIENCE

IN

PHYSICS (Honours)

CURRICULUM AND SYLLABUS

(For Students admitted from academic year 2018 – 2019 onwards)

UNDER CHOICE BASED CREDIT SYSTEM

Sri Ramasamy Memorial University, Sikkim

5th Mile, Tadong, Gangtok, Sikkim 737102

B.Sc. Physics (Honours)
(For students admitted from the academic year 2018–2019 onwards)

CURRICULUM AND SYLLABUS

Objectives:

1. To help the students to acquire a comprehensive knowledge and sound understanding of fundamentals of Physics.
2. To develop practical, analytical and mathematical skills of Physics.
3. To prepare students to acquire a range of general skills, to solve problems, to evaluate information, to use computers productively, to communicate with society effectively and learn independently.
4. To enable them to acquire a job efficiently in diverse fields such as Science and Engineering, Education, Banking, Public Services, Business etc.,

Eligibility:

The candidates seeking admission to the B.Sc. Degree program shall be required to have passed (10+2) (Higher Secondary) examination or any other equivalent examination of any authority, recognized by this University, with Physics, Chemistry and Mathematics.

Duration:

3 Years (6 Semesters)

SCHEME AND SYLLABUS FORCHOICE BASED CREDIT SYSTEM

FOR B.Sc. PHYSICS (Honours)

	Core course	**Ability Enhancement Compulsory Course**	**Skill Enhancement Course**	**Discipline Specific Elective**	**Generic Elective**
SEM I	1. Properties of Matter & Acoustics 2. Classical Mechanics & Relativity theory	English-I LSRW	Environmental Studies		Allied: Mathematics-I
SEM II	1. Electricity & Magnetism 2. Mathematical Physics	English-II communication	Computer Skills		Allied: Mathematics-II
SEM III	1. Heat & Thermodynamics 2. Astrophysics		Basic Instrumentation Skills		1. Allied 3: Chemistry-I 2. Elements of Earth Science
SEM IV	1. Quantum Mechanics 2. Modern Optics		Materials Characterization |Techniques		Allied 4: Chemistry-II
SEM V	1. Solid State Physics 2. Statistical Mechanics 3. Atomic Physics and Spectroscopy 4. Analog and Digital Electronics				1. Radiation Physics 2. Solar Technology
SEM VI	1. Elements of Nano science & Nanotechnology 2. Nuclear Physics 3. Microprocessors 4. Core based project				1. Nonlinear Optics 2. Semiconductor device

Course Category	Course Code	Course Name	L	T	P	C
		SEMESTER-I				
Language	LAE1811	English – I LSRW	2	1	0	3
Core	PHY1812	Properties of Matter & Acoustics	4	0	0	4
Core	PHY1813	Classical Mechanics & Relativity theory	4	1	0	5
C -Practical	PHY1814	General Physics Laboratory - I	0	0	6	3
Allied	MAA1815	Mathematics – I	4	1	0	5
*SWAYAM	EVS1817	Environmental Studies (Internal Evaluation)	0	0	0	0
		Total				**20**
		SEMESTER-II	**L**	**T**	**P**	**C**
Language	LAE1821	English – II Communication Skills	2	1	0	3
Core	PHY1822	Electricity & Magnetism	4	0	0	4
Core	PHY1823	Mathematical Physics	4	0	0	4
Core - P	PHY1824	Electricity & Magnetism Practical	0	0	4	2
Allied	MAA1825	Mathematics – II	4	0	0	4
*Supportive	CA1826	Computer Skills (Internal Evaluation)	2	0	4	4
		Total				**21**
		SEMESTER-III	**L**	**T**	**P**	**C**
Core	PHY1831	Heat & Thermodynamics	4	0	0	4
Core	PHY1832	Astrophysics	4	0	0	4
Core-P	PHY1833	Thermal Physics Practical	0	0	4	2
Allied	CHM1812	Allied Chemistry - I	4	0	0	4
A-P	CHM1834	Allied Chemistry Practical	0	0	4	2
Core based Elective-I	PHY18C1	Elements of Earth Science	3	0	0	3
Skilled Based Elective-I	PHY18S1	Basic Instrumentational Skills	0	1	2	2
		Total				**21**
		SEMESTER-IV	**L**	**T**	**P**	**C**
Core	PHY1841	Quantum Mechanics	4	0	0	4
Core	PHY1842	Modern Optics	4	0	0	4
Core-P	PHY1843	Advanced Optics Laboratory	0	0	4	2
Allied	CHM1823	Allied Chemistry - II	4	0	0	4
E-P	CHM1844	Allied Chemistry – II Practical	0	0	4	2
Skilled based Elective-II	PHY18S2	Materials Characterization Techniques	0	1	2	2
*Supportive	CA1841	Computer programming (Matlab/Python)	3	0	4	5
		Total				**23**

		SEMESTER-V	**L**	**T**	**P**	**C**
Core	PHY1851	Solid State Physics	4	0	0	4
Core	PHY1852	Statistical Mechanics	4	0	0	4
Core	PHY1853	Atomic Physics and Spectroscopy	4	0	0	4
Core	PHY1854	Analog and Digital Electronics	4	0	0	4
Core-P	PHY1855	General Physics Laboratory -II	0	0	4	2
Core-P	PHY1856	Analog and Digital Electronics Laboratory	0	0	4	2
Core based Elective-II	PHY18C2/PHY18C3	Radiation Physics/Solar Technology	3	0	0	3
		Total				**23**
		SEMESTER-VI	**L**	**T**	**P**	**C**
Core	PHY1861	Elements of Nanoscience & Nanotechnology	4	0	0	4
Core	PHY1862	Nuclear Physics	4	0	0	4
Core	PHY1863	Microprocessors	4	0	0	4
Core-P	PHY1864	Microprocessors Laboratory	0	0	4	2
Core based Elective-III	PHY18C4/C5	Nonlinear Optics/Semiconductor Device	3	0	0	3
Core based Project	PHY1865	Project	0	0	8	4
		Total				**21**

Legend:

L – Number of lecture hours per week
T –Number of tutorial hours per week
P –Number of practical hours per
C–Number of credits for the course
*Internal Evaluation Only

Allied Courses (offered to other departments)

COURSE CODE	COURSE TITLE	L	T	P	TOTAL L+T+P	C
PHY18A1	Allied Physics - I	4	0	0	4	4
PHY18A2	Allied Physics Laboratory - I	0	0	4	4	2
PHY18A3	Allied Physics - II	4	0	0	4	4
PHY18A4	Allied Physics Laboratory - II	0	0	4	4	2

SEMESTER I

LAE1811	English – I LSRW	2	1	0	3

UNIT I: Listening Skills

Introduction to Communication- LSRW
Active Listening
Reasons for poor Listening
Types of Listening
Barriers to Listening
Traits of a good Listener
Activity: Listening to the news and making notes, listening to announcements, listening to speeches, listening to instructions and summarizing them, listening to and differentiating pronunciations.

UNIT II: Speaking Skills

Importance of Speaking Skills
Effective Speaking- Confidence, Clarity and Fluency
Types of Speaking- Task Oriented- Interpersonal – Formal and Semi
Formal Persuasive Speaking and Public Speaking
Barriers to Speaking
Guidelines for conducting a Group Discussion
Guidelines for conducting a Meeting
Activity: Peer Introduction, JAM, Public speech, Role play, Product description, debate, GD, panel discussion, Conducting Meeting

UNIT III- Reading Skills

Introduction to Reading skills
Thesis, Evidence, Evaluation
Topic sentence and its role
Types of reading- Intensive- Extensive-Skimming -
Scanning Reading and its purposes
Reading for pleasure
Reading for critical interpretation
Reading for note making and summarizing
Activity: Reading articles and short stories and verbally summarizing them, reading newspapers and magazines and highlighting the content, reading comprehensions, reading reviews, reading and interpreting the content, identifying the thesis- evidence- evaluation, reading novels (Abridged version)

UNIT IV- Writing Skills

Introduction and Importance of Writing
Writing a Sentence
Writing a Paragraph- Topic Sentence, illustration
Characteristics of Writing- Clarity- Accuracy- Correctness-
Descriptiveness Language- Appropriateness- Conciseness -Flow
Business Writing – Basic principles of Business Communication
Letter writing- Thank you and follow-up letter, complaint letter, inquiry letter, invitation letter, letter to the editor
Writing memo, notice, agenda and minutes of the meeting
Report writing
Interpretation of data (flow charts, figures and pictures)
Essay and Article Writing
Poster Making
Activity- Writing a paragraph, Writing different kinds of letters, framing notices and memos and agendas, jotting down minutes of the meeting, reporting an event or the work done, interpreting various pictures, figures and data.

UNIT V- Basic Grammar

Tense and Articles, Prepositions, Direct and Indirect Speech, Active and Passive Voice.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
PHY1812	PROPERTIES OF MATTER AND ACOUSTICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES	
1.	To understand the different kinds of moduli via experimental methods.
2.	To understand the surface tension i.e. boundary property and viscosity.
3.	To understand the wave phenomena, in general and sound wave in particular.
4.	To understand ultrasonic and acoustics.

UNIT I - ELASTICITY AND MODULI

Elasticity - Three types of elastic moduli and relation among them - Poisson's ratio and Poisson‟s ratio for rubber band- Bending of beams - Expression for bending moment - Depression of the loaded end of a Cantilever - Uniform - Non uniform bending - Theory - Experiment pin and microscope method - Work done in uniform bending – Koenig‟s method – Non-uniform bending - Theory - Expression for couple per unit twist - Determination of rigidity modulus - Static torsion method with scale and telescope – Rigidity modulus by torsion pendulum with mass.

UNIT II - FLUID MOTION

Viscosity - Coefficient of critical velocity – Poiseulli‟s formula for coefficient of viscosity and its correction - Determination of coefficient of viscosity by capillary flow method - comparison of viscosities Oswald's viscometer - Viscosity of a highly viscous liquid - Stoke's method for the Coefficient of a highly viscous liquid - Variations of viscosity with temperature and pressure - Viscosity of gases - Mayer's formula for the rate of flow of a gas through a capillary tube - Rankine's method for the determination of viscosity of a gas.

UNIT III – SURFACE TENSION

Surface tension and Osmosis - Surface energy - Angle of contact and its determination - Excess of pressure inside curved surface - Formation of drops - Experimental study of variation of Surface tension with temperature - Drop weight method of determining surface tension and interfacial surface tension - Angle of contact of mercury - Quincke's method - Surface tension and vapour pressure osmosis - Experimental determination of osmotic pressure - Laws of osmosis pressure - Osmotic and vapour pressure of a solution.

UNIT IV - SOUND

Sound - Definition of free, damped and forced vibrations – Theory of forced vibrations -Resonance - Sharpness of resonance - Fourier's theorem - Application for Saw-tooth wave and square wave - Sonometer - Determination of A.C. frequency using sonometer - Determination of frequency using Melde's apparatus.

UNIT V - ULTRASOUND AND ACOUSTICS

Ultrasonics - Production - Piezo electric method – Magnetostriction method - detection - Properties - Applications. Acoustics : Intensity Level, Loudness - Acoustics of buildings - Reveberation - Reverberation time - Derivation of Sabine's formula - determination of absorption coefficient - Optimum reverberation time - Factors affecting Acoustics of buildings - Sources of noises and its control - Sound level meter.

TEXT BOOKS

1. Brijlal and Subramaniam N., *Properties of Matter*, Revised Edition, S.Chand and Company, 2005.
2. Murugesan R., *Properties of Matter and Acoustics*, Revised Edition, S.Chand and Company, 2005.

REFERENCES

1. Landau L. D., Pitaevskii L P, Kosevich A M and Lifshitz E M, *Theory of Elasticity*, Revised Edition, Butterworth-Heinemann, 2014.
2. Landau L. D., Pitaevskii L P, Kosevich A M and Lifshitz E M, *Fluid Mechanics*, Revised Edition, Butterworth-Heinemann, 2014.
3. Saighal R. L, *A Text Book of Sound* , 5th Edition, S. Chand and Company, 2010.
4. Mathur D. S, *Elements of Properties of Matter*, 3rd Edition, S. Chand and Company, 2005.
5. Satyaprakash and Akash Saluja, *Oscillations and Waves*, Pragati Prakashan, 2002.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
PHY1813	CLASSICAL MECHANICS AND RELATIVITY	4	1	0	5	5

INSTRUCTIONAL OBJECTIVES	
1.	To understand the general principles of Classical Mechanics and Relativity.
2.	To comprehend the mathematical formulation involved.
3.	To apply the concepts in solving problems.
4.	To emphasize the significance of classical mechanics in real time situations.

UNIT I - MECHANICS OF SYSTEM OF PARTICLES

Mechanics of a single particle - Mechanics of system of particles- Conservation of linear momentum-Conservation of Angular momentum - Mechanical energy for a particle and a system of particles-Centre of mass and equation of motion - Constrained motion-Types of constraints-Forces of constraints - Principle of Virtual work - D‟Alembert‟s principle.

UNITII - LAGRANGE AND HAMILTON FORMALISM

Degrees of freedom and generalized coordinates- Transformation equations-Generalized Displacement-Generalized velocity- Generalized acceleration-Generalized momentum-Generalized Force - Generalized Potential-Hamilton‟s Variational principle- Lagrange‟s equation of motion from Hamilton‟s principle-Linear Harmonic Oscillator-Simple pendulum-Atwood‟s machine.

UNIT III - CENTRAL FORCE

Definition and properties of central force-Two body central force problem-Stability of orbits-Condition for closure-Reduction to the equivalent one body problem-Equations of motion and First integrals-Actual geometry of orbits and orbital elements-Kepler‟s problem: Inverse square law of force-The motion in time in Kepler‟s problem-Orbits of artificial satellites.

UNIT IV - THEORY OF RELATIVITY

Frame of reference- Limitation of Newton‟s law of motion- Inertial frame of reference-Galilean transformation- Frame of reference with linear acceleration-Classical relativity-Galilean invariance-Transformation equation for a frame of reference inclined to an inertial frame and rotating frame of reference-Non-inertial frames-Accelerated Frame of reference -Rotating frame of reference -Effect of centrifugal and coriolis forces due to earth‟s rotation- Fundamental frame of reference-Michelson-Morley‟s experiment-Concept of Einstein‟s relativity.

UNIT V - APPLICATIONS OF THEORY OF RELATIVITY

Special theory of relativity- Lorentz co-ordinate and physical significance of Lorentz invariance- Length contraction- Time dilation- Twin paradox- Velocity addition theorem-Variation of mass with velocity- Mass energy equivalence-Transformation of relativistic momentum and energy-Relation between relativistic momentum and energy, Mass, velocity, momentum and energy of zero rest mass

TEXT BOOKS

1. Rana N. C.and Joag P.S., *Classical Mechanics*, 1st Edition, McGraw Hill, 2011.
2. Herbert Goldstein, Charles P. Poole and John L. Safko, *Classical Mechanics*, 3rd Edition, Pearson, 2011.

REFERENCES

1. John R. Taylor*, Classical Mechanics*, 1st Edition, University Science Books, 2005.
2. David Morin, *Introduction to Classical Mechanics*, 1st Edition, Cambridge University Press, 2008.
3. Harald J. W. Muller-Kirsten, *Classical Mechanics and Relativity*, 1st Edition, World Scientific Publishing Ltd, 2008.
4. Dieter Strauch, *Classical Mechanics-An Introduction*, 5th Edition, Springer, 2009.
5. Frank H. Berkshire, T. W. B. Kibble and Tom W. B. Kibble, *ClassicalMechanics*, 5thEdition, World Scientific Publishing Company, 2004.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+ P	C
PHY1814	PHYSICS PRACTICAL I	0	0	5	5	3

INSTRUCTIONAL OBJECTIVES

1. To gain knowledge in the scientific methods and learn the
2. Process of measuring different Physical variables.
3. To enable the student to explore the field of properties of matter.
4. To make the student understand the basic concepts in acoustics.
5. To allow the student to have a deep knowledge of the fundamentals of optics.

LIST OF EXPERIMENTS

1. Determination of Young's modulus of the material of the beam – Uniform Bending (Pin and Microscope).

2. Determination of Young's modulus of the material of the beam – Non uniform bending (Pin and Microscope).

3. Determination of Young's modulus of the material of the beam – Non Uniform Bending (Scale and Telescope).

4. Determination of Young's modulus of the material of the beam – Uniform Bending (Scale and Telescope).

5. Determination of rigidity modulus using Torsional Pendulum – Without masses.

6. Determination of elastic constants of a wire by Searle's method.

7. Determination of rigidity modulus using static torsion method.

8. Determination of surface of the liquid–Capillary raise method.

9. Determination of coefficient of viscosity of liquid–Poiseuille's flow method.

10. Determination of AC frequency main using Sonometer.

11. Generation of Lissajous figure using Signal Generator.

12. Determination of acceleration due to gravity–Compound bar pendulum.

TEXT BOOKS

1. Shukla R. K. and Anchal Srivastava, *Practical Physics*, New Age International (P) Ltd, Publishers, 2006.
2. Arora C. L., *B.Sc Practical Physics,* S. Chand and Company Ltd, 2007.

REFERENCES

1. Squires G. L., *Practical Physics*, 4th Edition, Cambridge University Press, 2001.
2. Halliday D., Resnick R. and Walker J., *Fundamentals of Physics*, 6th Edition, John Wiley and Sons, 2001.
3. Jenkins F.A. and White H.E., *Fundamentals of Optics*, 4th Edition, McGraw-Hill Book Company, 2007.
4. Geeta Sanon, *B. Sc., Practical Physics*, 1st Edition, S. Chand and Company, 2007.
5. Benenson, Walter, and Horst Stöcker, *Handbook of Physics*,Springer, 2002.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
MAA1815	Mathematics I	4	1	0	5	5

INSTRUCTIONAL OBJECTIVES	
1.	To apply basic concepts for clear understanding of mathematical principles like set theory,
2.	To help students learn solving equations, deal with matrices and apply calculus for solving practical problems.

UNIT I: SETS, RELATIONS AND FUNCTIONS

Sets- representation of sets- Types of sets- Operation on sets-De morgan's law- Venn diagram. Relation- Types of relation- Equivalence relation-Function- types of functions-Composite of two functions- graph of linear, trigonometric and exponential and logarithmic functions.

UNIT II: THEORY OF EQUATIONS

Polynomial equations- Irrational roots- Complex roots-(up to third order equations only) - Approximation of roots of a polynomial equation by Newton's methods, secant method.

UNIT III: MATRICES

Symmetric- Skew symmetric- Hermitian- Skew Hermitian- Orthogonal-Unitary matrices – Cayley Hamilton Theorem –Eigen values– Eigen vectors (for 2*2 matrix only)– Solving the equations using Cramer's rule-computing rank of matrices by reducing them to echelon's form-Rank and consistency of linear equation.

UNIT IV: DIFFERENTIATION

Geometrical interpretation of continuous function-Definition of derivatives sum product and quotient rule-Interpretation of derivatives-derivatives as slope of tangent-Rolls theorem – intermediate value theorem-Simple problems on differentiation – Maxima and minima of functions of single variable – Radius of curvature (Cartesian co-ordinate) – Partial differentiation.

UNIT V: INTEGRATION

Simple problems only-integration by substitution-partial fraction-product rule- integration of simple functions- definite integral –application of definite integral in evaluating area under a curve-double integral

TEXT BOOKS

1. Shanti Narayan, P.K. Mittal, A Textbook of Matrices,2004, S Chand & Co Ltd
2. N.P. Bali, Manish Goyal, A Textbook of Engineering Mathematics, 2014, Laxmi Publication Private limited

REFERENCES

1. Thomas and Finney, Calculus, Eleventh edition, Pearson Publication

Subject Code	Subject Title	L	T	P	Total of L+T+P	C
EVS1817	ENVIRONMENTAL STUDIES	0	0	0	0	0

UNIT – I: INTRODUCTION TO NATURAL RESOURCES/ENERGY

Natural Resources – Definition – Scope and Importance – Need for Public Awareness – Renewable and Non–renewable Resources: Natural resources and associated problems. Forest resources and over–exploitation – Water resources and over–utilization – Mineralresource extraction and its effects – Food resources – food problems and Modern agriculture – Energy resources and its future.

UNIT – II: ECOSYSTEMS

Concept of an ecosystem–structure and function of an ecosystem–producers, consumers and decomposers– ecological succession– food chains(any 2 Examples)– food webs(any 2 Examples)–ecological pyramids.

UNIT – III: ENVIRONMENTAL POLLUTION /DISASTER MANAGEMENT

Definition–causes, effects and control measures of: Air, Water and Soil pollution– e–waste management– Disaster management: Natural and man made– food/earthquake/cyclone, tsunami and landslides.

UNIT – IV: SOCIAL ISSUES AND THE ENVIRONMENT

Sustainable development– Climate change: global warming, acid rain, ozone layer depletion and nuclear radiation– Environment Protection Act (any 2) air, water, wildlife and forest.

UNIT – V: HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – Population explosion—Family Welfare Programme – Environment and human health – Human rights – Value education – HIV/AIDS – Women and Child Welfare – Role of Information Technology in environment and human health.

FIELD WORK

Students will visit any one of the following place of interest and submit a written report by the end of the semester:

1. Visit to a hospital/industry/canteen for solid waste management
2. Visit to a chemical industry to study about the practices followed there for waste disposal
3. Visit to Vandalur zoo for study of animal conservation/plants– flora and fauna
4. Study of simple ecosystems–lake/hill slopes
5. Naming the trees in the campus at SRM
6. Study of common plants, insects, birds in the neighbourhood
7. Study of common diseases and their prevention
8. Optional: Street plays and rally for awareness of obesity/diabetes/ vitamin D deficiency/health issues/ waste management/ solid waste management/ no plastics/ energy consumption/wild life protection.

REFERENCES

1. Bharucha Erach, (2013), Textbook of Environmental Studies for Undergraduate Courses (Second edition). Telangana, India: Orient BlackSwan.
2. Basu Mahua, Savarimuthu Xavier, (2017), SJ Fundamentals of Environmental Studies. Cambridge, United Kingdom: Cambridge University Press.
3. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.

E–BOOK

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380013, India, Email:mapin@icenet.net (R)

SEMESTER II

COURSE CODE	COURSE TITLE	L	T	P	C
LAE1821	English – II Communication Skill	2	1	0	3

UNIT I -Understanding Communication

Introduction to Communication

Definition

Communication process

Methods of Communication- Internal and External

communication Networks of communication- Vertical-

horizontal- diagonal

Barriers of Communication- Linguistic, Psychological, Interpersonal, cultural, physical and organizational

(R.C Sharma and Krishna Mohan, *Business Correspondence*, pages 34-43)

UNIT II - Technology- based Communication Aids

Telephone and voicemails

Facsimile Machines

Internet and computers

Emails

Conferencing

Instant Messaging

Groupware

NETTIQUETTE

Positive and Negative Impact of Technology enabled communication

Effectiveness in Technology based communication

UNIT III - Verbal and Non-Verbal Communication

Verbal Communication

Conversation- importance- essentials- conversation management- non-verbal cues in conversation- Oral Presentation Skills--- Technical aids in Visual Communication
(Shirley Taylor, V. Chandra, *Communication for Business – A practical Approach* 4th ed, page nos 378-397)

Team Presentation

Non- verbal Communication

Definition and Significance
Significance of Non-verbal Signals in organizations
Types of Nonverbal communication- Kinesics- Paralinguistic- Proxemics and Chronemics

UNIT IV- Interviews
Introduction- Objectives of Interviews
Types of interviews
Job Interviews- cover letter- Resume Writing- Preparation for interview- Interviewing Process- Mock Interview
Medium of Interview- Telephonic interview- web interview

(Meenakshi Raman, Sangeeta Sharma, *Technical Communication-Principles and practices,* pg no 180-203)

UNIT V - Cross Cultural Communication
Introduction
Concept of Cross- Cultural Communication
Ethnocentrism
Cultural Variables and Communication Sensitivity
Variables of National Culture
Cross- Cultural Communication Strategies
Potential Hot Spots in Cross- Cultural Communication

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
PHY1821	**ELECTRICITY AND MAGNETISM**	**4**	**0**	**0**	**4**	**4**
INSTRUCTIONAL OBJECTIVES						
1.	To understand the general concepts in Electrostatics.					
2.	To apply the Physics concepts in solving problems.					
3.	To educate scientifically the principles in Magnetism.					
4.	To emphasize the significance of Electromagnetic theory.					

UNIT I - ELECTROSTATICS AND DIELECTRICS

Electrostatic potential - Electric potential as line integral of electric field - Relation between electric potential and electric field in vector form - Gauss‟s Law and its applications – Gauss Divergence Theorem and differential form of Gauss‟s Law - Poisson‟s and Laplace‟s equations - Capacitance - Capacitance of a spherical andcylindrical capacitor - energy of a charged capacitor - Energy density - Loss of energy due to sharing of charges - Kelvin‟s attracted disc electrometer - The quadrant electrometer - Polarization in linear dielectric - Field inside a dielectric sphere in uniform electric field - Clausius-Mossoti Relation.

UNIT II - CURRENT ELECTRICITY AND THERMO ELECTRICITY

Current and current density - Equation of continuity – Ohm‟s law and electrical conductivity - Drude - Lawrence theory of electrical conduction - Kirchhoff‟s Laws - Carey Foster bridge - Theory - Determination of temperature coefficient of resistance - Calibration of ammeter and voltmeter using a potentiometer - Seebeck, Peltier and Thomson effects - Laws of thermoelectric circuits - Peltier coefficient - Thomson coefficient - Application of thermodynamics to a thermocouple and expressions for Peltier and Thomson coefficients - Thermoelectric diagram and uses.

UNIT III - CHEMICAL EFFECTS AND MAGNETIC EFFECTS OF ELECTRIC CURRENT

Electrical conductivity of an electrolyte – Arhenius Theory of Electrolytic Dissociation - Faraday‟s laws of electrolysis - Determination of specific conductivity of an electrolyte (Kohlrausch bridge) - Gibbs Helmholtz equation for the emf of a reversible cell - calculation ofemf of a Daniel Cell - Ampere‟s circuital law (both in integral and differential form) and its application to simple systems viz., current carrying loop - solenoid – toroid - Biot-Savart‟s law and its application to simple systems viz., long straight wire carrying steady current - Circular loop carrying steady current - Solenoid - Helmholtz Galvanometer - Theory of moving coil Ballistic Galvanometer - Damping correction.

UNIT IV - ELECTROMAGNETIC INDUCTION AND TRANSIENT CURRENTS Faraday‟s laws - Lenz‟s laws – Integral and differential forms of Faraday‟s law– Mutual and Self Inductance - Determination of self-inductance by Anderson‟s bridge method and absolute mutual inductance by BG-Ruhmkorff‟s induction coil - Growth and decay of current in a circuit containing resistance and inductance - Growth and decay of charge in a circuit containing resistance and capacitor - Measurement of high resistance by leakage - Growth and decay of charge in a LCR circuit - Condition for the discharge to be oscillatory - Frequency of oscillation.

UNIT V - MAGNETIC PROPERTIES OF MATERIALS AND MAXWELL'S EQUATIONS

Susceptibility - permeability - Intensity of magnetization and the relation $B=\mu_0(H+I)$-Properties of dia, para and ferromagnetic materials - Langevin‟s theory of diamagnetism and paramagnetism - Weiss theory of ferromagnetism-antiferrimagnetism and ferrimagnetism - Maxwell‟s equations - Displacement current- Maxwell‟s equations in material media, plane electromagnetic waves in free space- Poynting vector-Hertz experiment for production of electromagnetic waves

TEXT BOOKS

1. Griffth D.J, *Introduction to Electrodynamics,* 4th Edition, Prentice Hall of India, 2012.
2. Murugeshan R., *Electricity and Magnetism*, 7th Edition, S. Chand and Company, 2008.

REFERENCES

1. Laud B.B, *Electromagnetics*. 2nd Edition, New Age International Publication, 2005.
2. Navina Wadhani, *Electricity and Magnetism*, Prentice Hall of India, 2012.
3. Tiwari A.K., *Electricity and Magnetism*, S.Chand and Company, 2007.
4. Halliday-Resnick and Walker, *Fundamentals of Physics – Electricity andMagnetism*, Wiley India Pvt Ltd , 2011.
5. Edward M Purcell, *Electricity and Magnetism,* Berkeley Physics Course, Volume 2, 2nd Edition, 2011.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1822	MATHEMATICAL PHYSICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To enable students to use mathematical concepts required in physics
2	To enhance problem solving skills
3	To develop knowledge in mathematical physics and its application
4	To enable students to formulate, interpret and draw inferences from mathematical solutions

UNIT–I: MATRICES AND LINEAR ALGEBRA

System of Linear Simultaneous Equations and Matrix Multiplication - Formal definition of Vector space with examples - Linear Independence, Special Matrices (symmetric, hermitian, orthogonal, unitary) – Determinant – Rank - Inverse of a Matrix - Eigen value Problem - Orthogonalization Theorem - Matrix Diagonalization - Normal Matrices - Canonical Forms - Scalar Product.

UNIT–II: DIFFERENTIAL EQUATIONS

Linear Differential Equations - Differential Equations Reducible to Linear Form - Exact Differential Equations - Integrating Factors - Change of Variables - Equations solvable for p - Equations solvable for y - Equations solvable for x - Equations that do not contain.x (or y) - Equations of the first degree in x and y – Clairauts Equation - Solution of homogeneous linear differential equations of order n with constant coefficients - Solution of the non–homogeneous linear differential equations with constant coefficients by means of polynomial operators

UNIT –III: VECTOR CALCULUS

Vector differential calculus - gradient of a scalar field - directional derivative - divergence and curl of a vector field, line and surface integrals - Path Independence - Potential Functions and Conservative Fields - Green's theorem - Divergence theorem of Gauss - Stokes's theorem - The Frenet–Serret formulas .

UNIT –IV: COMPLEX ANALYSIS

Definition of Analytic Function – Cauchy Riemann equations – Properties of analytic functions – Determination of harmonic conjugate – Milne–Thomson's method – Conformal mappings: 1/z, az , az+b and bilinear transformation.Line integral – Cauchy's integral theorem (without proof) – Cauchy's integral formulae and its applications – Taylor's and Laurent's expansions (statements only)

UNIT –V: FOURIER SERIES AND TRANSFORMS

Introduction - Periodic functions: Properties - Even & Odd functions – Properties - Special wave forms - Square wave - Half wave Rectifier - Full wave Rectifier - Sawtooth wave - Triangular wave - Euler's Formulae for Fourier Series - Fourier Series for functions of period 2π - Fourier Series for functions of period $2l$ - Fourier Series of a function with its periodic extension - Parseval's identity (statement only).Examples - Fourier Integral Theorem (statement only) - Fourier Transform of a function - Properties of Fourier Transform - Linearity, Shifting, Change of scale, Modulation - .Examples - Fourier Transform of Derivatives – Examples - Convolution Theorem (statement only) - Inverse of Fourier Transform,.

TEXT BOOKS

1. Satya Prakash, *Mathematical Physics*, Sultan Chand and Sons, Reprint 2016.
2. K.Ganesan, Sundarammal Kesavan, K.S.Ganapathy Subramanian &V.Srinivasan, *Advanced Calculus and Complex Analysis*, Revised Edition, 2013.

REFERENCES

1. Erwin Kreyszig*, Advanced Engineering Mathematics*, 10th Edition, Willey 2011.
2. Grewal B.S, *Higher EnggMaths*, Khanna Publications, 42nd Edition,2012.
3. Jain M C, *Vector Spaces And Matrices In Physics*, Narosa,2007.
4. Spiegel M R, Schaum's *Outline of Vector Analysis*, McGraw–Hill Education,2009.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
PHY1823	PHYSICS PRACTICALS – II	0	0	4	4	2

INSTRUCTIONAL OBJECTIVES	
1.	To gain knowledge in the scientific methods and learn the process of measuring different physical variables.
2.	To enable the student to explore the field of electricity.
3.	To make the student understand the basic concepts in magnetism.
4.	To allow the student to have a deep knowledge of the fundamentals electromagnetic circuits.

LIST OF EXPERIMENTS

1. Calibration of voltmeter using Potentiometer.
2. Calibration of ammeter using Potentiometer.
3. Determination of Internal resistance of the given cell using Potentiometer.
4. Determination of Magnetic Induction and Magnetic Intensity by Field along the axis of the coil.
5. Determination of Temperature Coefficient of Resistance using Post Office Box.
6. Determination of Magnetic moment and Ratio of magnetic moments by Searle‟s vibration magnetometer method.
7. Determination of Figure of merit of charge by Ballistic Galvanometer.
8. Comparison of Capacitance of two capacitors using Ballistic Galvanometer.
9. Study of resonance in series LCR circuits.

TEXT BOOKS

1. Shukla R. K.and Anchal Srivastava. *Practical Physics*, New Age International (P) Ltd, Publishers, 2006.
2. Arora C. L., *B.Sc., Practical Physics,* S. Chand and Company Ltd., 2007.

REFERENCES

1. Chattopadhyay, D., Rakshit, P. C. and Saha, B., *An Advanced Course inPractical Physics*, 8thEdition, Books and Allied Ltd., 2007.

2. Indu Prakash and Ramakrishna, *A Text Book of Practical Physics*, 11th Edition, Kitab Mahal, 2011.
3. Ouseph C., Rangarajan K., *A Text Book of Practical Physics*, Volume I,II, S.Viswanathan Publishers,1997.
4. Geeta Sanon, *B. Sc., Practical Physics*, 1st Edition. R. Chand and Co, 2007.
5. Benenson, Walter, and Horst Stöcker, *Handbook of Physics*. Springer, 2002.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
MAA1825	**Mathematics II**	4	**1**	**0**	**5**	**4**

INSTRUCTIONAL OBJECTIVES	
1.	To apply basic concepts for clear understanding of mathematical principles like set theory,
2.	To help students learn solving equations, deal with matrices and apply calculus for solving practical problems.

UNIT I: Vectors

Introduction-parallelogram law of vectors-dot product-projection of a vector-cross product-triple cross product - directional derivatives-divergence-curl- unit normal to a surface

UNIT II: INTEGRAL CALCULUS

Integral calculus- polynomial and irrational function – Partial fraction (Simple algebraic functions only) – Bernoulli's formula – Reduction formula- $\int \sin^n x\, dx$ - $\int \cos^n x\, dx$.

UNIT III: DIFFERENTIAL EQUATION

Differential Equation - Second order Differential Equation with constant coefficient- Interpretation of derivatives as slope of tangent-Simple problems on differentiation – Maxima and minima of functions of single variable – Radius of curvature (Cartesian co-ordinate) – Partial differentiation – Euler's theorem.

UNIT IV: COMPLEX NUMBER SYSTEM

Introduction-argument and modulus of complex numbers-geometrical interpretation of sum and product of complex numbers- sequence and series of complex numbers-power series-convergence of power series.

UNIT V: FOURIER SERIES

Fourier series of periodic function on interval $[0, 2\pi]$ and $[-\pi, \pi]$

TEXT BOOKS

1. Rajendra Kumar Sharma, Complex Numbers and the Theory of Equations
2. Shanti Narayan, P K Mittal, A TEXTBOOK OF VECTOR CALCULUS, 4th Revised Edition, S chand publication.

REFERENCES

1. Thomas and Finney, Calculus, Eleventh edition, Pearson Publication
2. Hall and Knight, Higher Algebra (Old Edition) Paperback

Course Code	Course Title	L	T	P	TOTAL OF LTP	C
CA1826	**Computer Skills**	2	0	4	6	4

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1. To gain knowledge on the basic computer system
2. To understand the MS-WORD.
3. To acquire knowledge with respect to MS-EXCEL
4. To learn the basics of MS-POWERPOINT and ACCESS.

UNIT I: INTRODUCTION TO COMPUTER SYSTEMS
Applications of Computers in Business – Types of Computers and Electronic devices – An overview of operation system – Single user systems – Multi user Systems – Assembler – Translator – Complier – Different Computer Language.

UNIT II: THE WORD PROCESSOR
Creating a Document -Opening a Document -Laying Out the Page-Setting paper size, margins, and orientation -Creating headers and footers -Numbering pages -Entering and Editing Text-Modifying text-Moving and copying text -Finding and replacing text -Correcting mistakes automatically-Printing -Adding character to your characters -Planning Your Paragraphs-Aligning paragraphs -Spacing your lines -Making Lists -Bulleting lists-Numbering lists-Using a style -Creating a style - tables and columns

UNIT III: THE SPREADSHEET
Creating a Spreadsheet -Inputting Your Data -Entering your data -Editing your data -Filling cells automatically -Managing Columns and Rows-Copying, pasting, cutting, dragging, and dropping your cells -Adding the Art -Formula Basics-Adding, Subtracting, and More -Adding and other arithmetic -Adding with the Sum function -Rocketing into Orbit with Functions Using the AutoPilot: Functions dialog box -Editing functions -Entering functions manually -Copying and pasting formulas -Creating formula arrays -Recalculating formulas -Creating Magic Formula-Nesting functions -Creating conditional formulas

UNIT IV: THE POWER POINT PRESENTATION
Creating a Presentation -Opening an existing presentation -Adding Slides -Adding text to a slide -Saving Your Presentation for Posterity - Making Presentations Picture Perfect -Adding Images -Clipping art -Drawing objects -Coloring Backgrounds -Creating a plain-colored background -Creating a gradient background -Hatching a background -Using a bitmap image as a background -Creating 3-D text-Inserting 3-D objects -Animating Impressively -Using Text Effects Effectively -Creating Animation Effects -Creating Animated GIF files -Adding Slide Transition Effects - Showing a Presentation -Setting slide timing -Hiding slides -Specifying slide show settings -Delivering a Slide Show .

UNIT V: MS-ACCESS

Database development-Creating Access tables-Setting the primary key-Manipulating tables-Entering data with access forms-Selecting data with queries-Creating a multiple queries-Presenting data with access reports.

Operating system and fundamentals

Computer Networks and Internet

REFERENCE BOOKS:

1. Sinha P.K. & Sinha Priti, Computer Fundamentals, BPB Publications, 2007
2. Vishnu P. Singh, "*Ms Office 2007"*, BPB Publications, 2007.
3. AnanthiSheshasaayee, Sheshasaayee G., *"Computer Applications in Business & Management"*, Margham publishers, 2004.
4. Lisa A.Bucki, John Walkenbach, FaitheWempen Michael Alexander and Dick Kusleika, "Mirosoft office 2013 Bible", Wiley India Pvt. Ltd., 2013

SEMESTER III

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1831	HEAT AND THERMODYNAMICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To know the fundamentals of heat
2	To understand the concepts involved in transmission of heat
3	To understand the basic principle and laws of thermodynamics
4	To understand the concepts of entropy

UNIT–I: INTRODUCTION OF HEAT

Basic Definitions – Newton's law of cooling – Specific heat of a liquid calendar and Barne's continuous flow method – Two specific heats of a gas – Specific heat of a gas by Jolly's differential steam calorimeter – Regnault's method – Dulong and Petit's law –Einstein's theory of specific heat – Debye's theory of specific heat – variation of specific heat and atomic heat with temperature – Transference of heat.

UNIT–II: TRANSMISSION OF HEAT

Conduction – Coefficient of the thermal conductivity – Rectilinear flow of heat along a metal bar – Methods of radial flow of heat – Spherical shell method and flow of heat along the wall of a cylindrical tube – Determination of thermal conductivity of rubber and bad conductor – Lee's disc method to find thermal conductivity of bad conductor. Conduction – Radiation – Black body – Wein's Law – Raleigh Law and its significance –Jean's Law – Stefan's law – Experimental Determination of Stefan's constant – Mathematical derivation of Stefan's law.

UNIT–III: KINETIC THEORY OF GASES

Maxwell's law of distribution of molecular velocities – Experimental verification of molecular velocities – Equilibrium speed distribution of velocities – Mean free path of gaseous molecules – Transport phenomena – Diffusion of gases – Viscosity and thermal conduction of gases – Vander walls equation of state – Determination of Vander walls constant – Comparison of vanderwall's equation with Andrews experiment – Relation between Vander Wall's constant and critical constants.

UNIT–IV: LAWS OF THERMODYNAMICS

First law of thermodynamics – Isothermal and Adiabatic process – Gas equation during an adiabatic process – Work done an adiabatic expansion of gas – Equation of an adiabatic curve – Isothermal processes – Determination of g by Clement and Desorme's method – Second law of thermodynamics – Concept of Carnot's engine– Working efficiency of Carnot's engine – Carnot's refrigerator – Carnot's Theorem and its significance.

UNIT–V: CONCEPT OF ENTROPY

Third law of thermodynamics – Concept of Entropy – Temperature entropy diagram – entropy of perfect gas – Entropy Change in entropy in a reversible process and irreversible process – temperature entropy diagram – Entropy of a perfect gas – increase of entropy in any irreversible process – Thermo dynamics functions – Maxwell's thermodynamics relations and applications – Joule Kelvin effect theory– Claussius and Clapeyron equation – Specific Heat Relation.

TEXT BOOKS

1. Brijlal, N. Subrahmanyam and P. S. Hemne,*Heat,Thermodynamics andStatistical Physics*, Revised Edition, S. Chand and Company, 2010.
2. Richard H Dittman and Zemansky MW, *Heat and Thermodynamics*, 3rd Special Edition, McGraw Hill, 2008.

REFERENCES

1. Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner and Margaret Bailey, *Fundamentals of Engineering Thermodynamics,* John Wiley and Sons, 2011.
2. D.S. Mathur, *Heat and Thermodynamics*, S. Chand and Company, 2006.
3. Kittel C and Kroemer H, *Thermal Physics,* W. H. Free man, New York, 1980.
4. Stephen Blundell and Katherine M. Blundell, *Concepts in Thermal Physics,* Oxford University Press, 2006.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1832	**ASTROPHYSICS**	4	**0**	**0**	**4**	**4**
INSTRUCTIONAL OBJECTIVES: **At the end of this course the learner is expected:**						
1	To describe the nature, structure, distribution, and formation of astronomical objects, including planets, stars, and galaxies, and the history of the universe.					
2	To demonstrate an appreciation of the universality of physical laws and apply these laws to explain phenomena in astronomical systems and the universe					
3	To define and interpret the observational properties of astronomical objects.					
4	To propose, plan, and conduct astronomical observations with professional telescopes.					

UNIT- I: INTRODUCING ASTRONOMY

Solar System Overview- Constituents- Astronomical measurements- Units of length time and mass- Constellations – Motion of the Sky- Celestial Sphere-Positions- Equinoxes And Eccentricity - The Length Of A Day - The Length Of Daylight - The Length Of A Second - Solar Calendar - Eclipses – Time Zones - The International Date Line.

UNIT- II: LIGHT AND OBSERVATION

Inertial Frames- Elliptical Orbits -Kepler's Laws Derived TheVirial Theorem-Stellar Parallax -The Magnitude Scale - Qualitative Overview: The Wave Nature of Light - Blackbody Radiation Time and Space in Special-Relativity - Relativistic Momentum and Energy- Doppler Effect of Light.Telescopes: Optical Telescopes- Short Overview of Radio Telescopes - Infrared, Ultraviolet, X-ray, and Gamma-Ray Astronomy.

UNIT - III: THE STARS

Thermonuclear Energy- A Model of the Sun - Solar Neutrinos - The Photosphere - The Chromosphere - The Corona - Sunspots - The Sunspot Cycle - The Active Sun.
Stellar Evolution: Models and Observations-The Evolution of a Star-The Stellar Evolution Cycle - Brief overview: Protostars-Giantstars- Death of Stars-Planetary Nebulae-White Dwarfs- Exploding White Dwarfs- Novae-Chandrasekhar Limit-Supernovae-Neutron Stars-Black Holes.

UNIT - IV: STELLAR PHYSICS

The Classification of Binary Stars- Mass Determination Using Visual Binaries - The Formation of Spectral Lines– The Hertzsprung-Russell Diagram - Mass Continuity - Radiative Energy Transport - Energy Conservation - The Equations of Stellar Structure - Opacity – Scaling Relations on The Main Sequence - Nuclear Energy Production - Nuclear Reaction Rates - Solution of The Equations of Stellar Structure - High Energy Phenomena - Novae And Supernovae - Pulsars - Quasars - Gamma ray bursts - Accreting black hole.

UNIT – V: COSMOLOGY

Mass and Motions in the Milky Way-The Galactic Centre and Edge-Density Waves and Spiral Arms-Early Observations of Galaxies- Distances of Galaxies-Hubble's Law - Olbers' Paradox -Universal gravitation -- The Age Of The Universe - Expansion In A Newtonian World - Thermal History of the Universe - The Early Radiation Era - Photon and Lepton Decoupling - Big Bang-Nucleosynthesis.

TEXT BOOKS

1. Bradley W. Carroll, Dale A. Ostlie, *An Introduction to Modern Astrophysics*, 2nd Edition, Pearson, 2013.
2. Stephen E. Schneider , Thomas T. Arny, *Pathways to Astronomy*, 4th Edition, McGraw-Hill Education, 2014.

REFERENCES

1. Matts Roos, *Introduction to Cosmology*, 3rdEdition, John Wiley andSons Ltd, 2003.
2. Dinah L. Moché, *Astronomy: A Self-Teaching Guide*, 7th Edition, JohnWiley and Sons, 2009.
3. Linda S. Sparke, and John S. Gallagher, 2nd Edition, *Galaxies in the Universe: An Introduction*, Cambridge University Press, 2007.
4. Richard A. Matzner, Dictionary of Geophysics*, Astrophysics andAstronomy*, 2ndSeries, CRC Press, 2001.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1833	THERMAL PHYSICS LABORATORY	0	0	4	4	2

INSTRUCTIONAL OBJECTIVES: **At the end of this course the learner is expected:**	
1	To gain knowledge in the scientific methods and learn the process of measuring different Physical variables
2	To enable the student to explore the field of thermal physics
3	To make the student understand the basic concepts in heat conductors
4	To allow the student to have a deep knowledge in the field of latent heat

List of Experiments

1. Determination of Thermal conductivity of a good conductor using Forbes method.
2. Determination of Specific heat capacity of a solid by Method of mixtures. (Half time correction).
3. Determination of Thermal conductivity of a bad conductor using Lee's disc method.
4. Calculate the Temperature coefficient of resistance of the given coil by Carey Foster Bridge.
5. Determination of saturated vapour pressure of water at different temperatures using Joly's method.
6. Determination of thermal conductivity of good conductors by Searle's method.
7. Determination of Specific Heat Capacity of the liquid using Joule's calorimeter.
8. Determination of Specific Heat Capacity of the liquid using Newton's Law of Cooling
9. Determination of specific heat capacity of a liquid by continuous flow (Callender and Barnes) method.
10. Determination of resistivity and band gap for a semiconductor material using P. O. Box method
11. Determination of resistivity and band gap for a semiconductor material using Fourprobe method
12. Determination of dielectric constant for a given material.

TEXT BOOKS

1. R. K. Shukla &Anchal Srivastava. *Practical Physics*, New Age International (P) Ltd, Publishers, (Formerly Wiley Eastern Limited), 4835/24, AnsariRaod, Daryagani, New Delhi–11002. 2006.
2. C. L. Arora, *B.Sc., Practical Physics,* S. Chand & Company Ltd. Ram nagar, New Delhi–110055. 2007.

REFERENCES

1. Chattopadhyay, D., Rakshit, P. C. and Saha, B., *An Advanced Course in Practical Physics*, 8thEdition, Books & Allied Ltd., Calcutta, 2007.

2. Indu Prakash and Ramakrishna, *A Text Book of Practical Physics*, 11th Edition, Kitab Mahal, New Delhi, 2011.
3. C.Ouseph,K.Rangarajan,*A Text Book of Practical Physics*, Volume I,II,S.Viswanathan Publishers,1997
4. GeetaSanon, *B.Sc., Practical Physics*, 1st Edition. R. Chand & Co, 2007.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+ P	c
CHM1812	STRUCTURE AND BONDING IN CHEMISTRY	4	0	0	4	4
INSTRUCTIONAL OBJECTIVES						
1.	To understand about the atomic structure.					
2.	To know the arrangement of elements in the periodic table and periodic properties.					
3.	To understand structure and bonding in molecules.					
4.	To study the theories of REDOX REACTIONS					

Unit 1: Atomic Structure

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

Unit 2: Periodicity of Elements

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

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

(b) Atomic radii (van der Waals)

(c) Ionic and crystal radii.

(d) Covalent radii (octahedral and tetrahedral)

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

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

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

Unit 3: Chemical Bonding

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

(ii) *Covalent bond:* Lewis structure, Valence Bond theory (Heitler-London approach). Energetics of hybridization, equivalent and non-equivalent hybrid orbitals. Bent's rule, Resonance and resonance energy, Molecular orbital theory. Molecular orbital diagrams of diatomic and simple polyatomic molecules N_2, O_2, C_2, B_2, F_2, CO, NO, and their ions; HCl, BeF_2, CO_2, (idea of s-p mixing and orbital interaction to be given). Formal charge, Valence shell electron pair repulsion theory (VSEPR), shapes of simple molecules and ions containing lone pairs and bond pairs of electrons, multiple bonding (σ and π bond approach) and bond lengths.

Covalent character in ionic compounds, polarizing power and polarizability. Fajan's rules and consequences of polarization.

Ionic character in covalent compounds: Bond moment and dipole moment. Percentage ionic character from dipole moment and electronegativity difference.

(iii) *Metallic Bond:* Qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids.

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

Unit 4: Oxidation-Reduction

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

TEXT BOOKS

1. D. F Shriver, P. W Atkins and C. H. Langford, *Inorganic Chemistry*, 3rd Ed., Oxford University Press, London, 2001
2. B. Douglas, D. McDaniel, andJ. Alexander, *Concepts and Models of Inorganic Chemistry*, 3rd ed., John Wiley, 1994.
3. J. D. Lee, *Concise Inorganic Chemistry*, 5th ed., Wiley, 2008.
4. P.W. Atkins, J. D. Paula, *Physical chemistry*, 9th Oxford university press, 2009.

REFERENCES

1. K. F Purcell and J. C. Kotz, *Inorganic Chemistry*, Saunders, Philadelphia, 1976.
2. T. Moeller, *Inorganic Chemistry: A Modern Introduction*, Wiley, New York, 1990.
3. B. R. Puri, L. R. Sharma,K. C. Kalia, *Principles of Inorganic Chemistry*, Shoban Lal Nagin Chand and Co, 1996.
4. J. E. Huheey, E. A. Keiter, and Keiter, R. L., *Inorganic Chemistry*, 4th Ed., Harper and Row, New York, 1983.

5. Day, M.C. and Selbin, J. *Theoretical Inorganic Chemistry*, ACS Publications 1962.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
CHM1834	**INORGANIC QUANTITATIVE ESTIMATION**	**0**	**0**	**4**	**4**	**2**

INSTRUCTIONAL OBJECTIVES	
1.	To make the students acquire quantitative skills in volumetric analysis.
2.	To gain knowledge about the neutralisation, redox and complexometric Titrations.
3.	To educate the students on the various terminologies used for expressing the concentration of the solutions.
4.	To enable the students to plan their experimental projects accordingly and execute them skillfully.

(A) Titrimetric Analysis

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

(B) Acid-Base Titrations
(i) Estimation of carbonate and hydroxide present together in mixture.
(ii) Estimation of carbonate and bicarbonate present together in a mixture.
(iii) Estimation of free alkali present in different soaps/detergents

(C) Oxidation-Reduction Titrimetry
(i) Estimation of Fe(II) and oxalic acid using standardized KMnO4 solution.
(ii) Estimation of oxalic acid and sodium oxalate in a given mixture.
(iii) Estimation of Fe(II) with K2Cr2O7 using internal (diphenylamine, anthranilic acid) and external indicator.

REFERENCES

1. Vogel, *Textbook of Quantitative Inorganic Analysis*, Longmann, 12th edition, 2011.
2. J. N. Gurtu and R. Kapoor, *Advanced experimental Chemistry*, S. Chand and Co. 6th edition, 2010.
3. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, *Basic principles of Practical Chemistry*, 2nd edition, New Delhi, Sultan Chand & sons, 1997.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18C1	ELEMENTS OF EARTH SCIENCE	3	0	0	3	3

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To understand the basic laws governing the earth's energy.
2	To understand the different processes of earth atmosphere interactions.
3	To understand the role of aerosols in energy budget.
4	To have over all idea on climate change concepts.

UNIT – I : SOLAR SYSTEM AND EARTH ATMOSPHERE

Kepler's Laws of Planetary Motion – Structure - composition and atmosphere of our solar system (all nine planets) - Solar Energy - Solar constant - solar radiation at the Earth's surface - earth energy budget - Composition of earth atmosphere - layers of the atmosphere and Vertical structure of atmosphere - global air circulation

UNIT – II : AIR TEMPERATURE, HUMIDITY AND CONDENSATION

Daily temperature variations - day time warming - night time cooling - the controls of temperature - Circulation of water in the atmosphere – evaporation - condensation and saturation – Humidity - vapour pressure - relative humidity and dew point

UNIT – III : CLOUDS AND PRECIPITATION

Classification of clouds - cloud identification - clouds with vertical development - Atmospheric stability - unstable air - conditionally unstable air - convection and clouds - precipitation processes and precipitation types

UNIT – IV : AEROSOLS

Various aerosol sources - formation processes and types of aerosols - background of marine aerosols - sulphur cycle and sulphate aerosols - dust aerosols - carbon aerosols - urban aerosols - volcanic aerosols - high latitude atmospheric aerosols - global spatial and temporal variability of aerosols - Interaction between aerosols and minor gas components - photochemical processes with the participation of aerosols

UNIT – V : CLIMATE CHANGE

Earth's changing climate - climate during last 100 years - possible causes of climate change - climate change and variations in earth's orbit - climate change and atmospheric particles - carbon dioxide - greenhouse gas effect and global warming.

TEXT BOOKS:

1. C. Donald Ahrens and Brooks/Cole,*Essentials of Meteorology*, Cengage Learning, 2008
2. Kirill yakondratyev et al, *Atmospheric aerosol properties*, Praxiz Publishing Springer, 2006

REFERENCES :

1. Chandrasekhar A., *Basics of Atmospheric Science*, PHI Learning Private

Limited, 2010.
2. MurrySalby, *Fundamentals of Atmospheric Physics*, Academic Press, 1996.
3. David G Andrews,*An Introduction to Atmospheric Physics*, 2nd Edition, Cambridge University Press, 2010.
4. John T Houghton, *The Physics of the Atmospheres*, Cambridge University Press, 2009.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18S1	BASIC INSTRUMENTATION SKILLS	1	0	2	3	2

	INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:
1	To get exposure with various aspects of instruments.
2	To understand and learn the different principles and instruments adopted for measurements.
3	To enable the students to explore different instrumentational skills.
4	To understand their usage through hands-on mode.

UNIT I – BASIC OF MEASUREMENT

Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects. Multimeter- Principles of measurement.

UNIT II – ELECTRONIC VOLTMETER

Advantage over conventional multimeter for voltage measurement. Principles of voltage, measurement (block diagram only). AC millivoltmeter- Type and block diagram AC millivoltmeter.

UNIT III – CATHODE RAY OSCILLOSCOPE/ DIGITAL STORAGE OSCILLOSCOPE

Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment). Use of CRO for the measurement of voltage, frequency and time period. Digital storage Oscilloscope: Block diagram and principle of working.

UNIT IV – SIGNAL GENERATORS, IMPEDANCE BRIDGES AND Q-METERS

Block diagram, explanation of signal generators, pulse generator and function generator. Block diagram of bridge. Working principles of basic (balancing type) LCR bridge. Block diagram and working principles of a Q- Meter.

UNIT V- DIGITAL INSTRUMENTS AND DIGITAL MULTIMETER

Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter. Working principles of digital voltmeter. Block diagram and working of a digital multimeter.

TEXT BOOKS

1. B L Theraja, *A text book in Electrical Technology*, S Chand and Co.
2. Hlefrick A.D., *Modern Electronic Instrumentation and Measurement Techniques*, Dorling Kindersley (India) Pvt Limited, 3rd Edition, 2005.
3. Venugopal, *Digital Circuits and systems*, 2011, Tata McGraw Hill.
4. M.J.Moroney, *Facts From Figures*, Pelican Original

REFERENCES

1. Shimon P. Vingron, *Logic circuit design*, 2012, Springer.
2. Subrata Ghoshal, *Digital Electronics*, 2012, Cengage Learning.
3. U.Tietze, Ch.Schenk, *Electronic circuits: Handbook of design and applications*, 2008, Springer.
4. M G Say, *Performance and design of AC machines*, ELBS Edn.
5. S. Salivahanan & N. S.Kumar, *Electronic Devices and circuits*, 3rd Ed., 2012, Tata Mc-Graw Hill.
6. Thomas L. Floyd, *Electronic Devices*, 2008, Pearson India.

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

1. Use of an oscilloscope

2. CRO as a versatile measuring device

3. Circuit tracing of Laboratory electronic equipment

4. Use of Digital multimeter/VTVM for measuring voltages

5. Study the layout of receiver circuit.

6. Trouble shooting a circuit

7. Balancing of bridges

Laboratory Exercises:

1. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.

2. To observe the limitations of a multimeter for measuring high frequency voltage and currents.

3. To measure Q of a coil and its dependence on frequency, using a Q- meter.

4. Measurement of voltage, frequency, time period and phase angle using CRO.

5. Measurement of rise, fall and delay times using a CRO.

6. Measurement of R, L and C using a LCR bridge/ universal bridge.

SEMESTER IV

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1841	QUANTUM MECHANICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To understand wave–particle duality and Heisenberg Uncertainty
2	To understand the postulates of Quantum Frame Work
3	To apply the Schrodinger wave equation to different problems
4	To develop the understanding and application of Quantum Mechanics in modern physics.

UNIT –I: WAVE NATURE OF MATTER

Inadequacy of classical mechanics – Black body radiation – Quantum theory – Photo electric effect – Compton effect –Wave Particle Duality – Expressions for de–Broglie wavelength – Davisson and Germer's experiment – G.P. Thomson experiment – Phase and group velocity and relation between them – Wave packet – Heisenberg's uncertainity principle – Its consequences (free electron cannot reside inside the nucleus and gamma ray microscope).

UNIT –II: POSTULATES OF QUANTUM MECHANICS

Basic postulates of quantum mechanics– Schrodinger's equation – Time Independent –Time Dependent – Properties of wave function.

Operator formalism: Eigen values and Eigen functions – Energy – Momentum and Hamiltonian Operators – Hermitian operator (definition and examples).

Interpretation of Wave Function– Probability Density and Probability – Conditions for Physical Acceptability of Wave Function – Normalization – Orthogonality – Linearity and Superposition Principles – Expectation Values – Wave Function of a Free Particle.

UNIT –III: QUANTUM MECHANICS IN ONE DIMENSION

Free Particle Solution and Plane Wave Normalization – Particle in a box of length L – Energy Eigen value and normalized Eigen function.

Barrier penetration problems: Finite potential well – Tunnel effect – Scanning Tunneling Microscope (Principle and Working)

Simple Harmonic Oscillator: Classical picture of Harmonic Oscillator – Quantum Harmonic Oscillator wave function – Energy levels – Zero point energy.

UNIT –IV: QUANTUM THEORY OF HYDROGEN–LIKE ATOMS

Schrödinger's Equation for the Hydrogen Atom (Spherical Polar Coordinates) –Separation of Variables–**Quantum Numbers**: Principle –Orbital and Magnetic – shapes of the probability densities for ground states– Radiative Transitions and selection rules.

UNIT –V: EFFECTS OF FIELDS ON ATOMS

Electron angular momentum– Space quantization–Electron Spin and Spin Angular Momentum– Larmor's Theorem–Pauli Exclusion Principle – Symmetric and Antisymmetric Wave Functions–Spin Magnetic Moment and Energy– Stern–Gerlach Experiment – Normal Zeeman Effect – Magnetic dipole

moment and energy – spin–orbit coupling and Energy – Lande' g–factor – qualitative discussion of Fine structure – Total angular momentum –L–S and J–J couplings (basic concept only).

TEXT BOOKS

1. ArthurBeiser, Concepts of Modern Physics, 6th Edition, McGraw Hill Education, 2009.
2. Robert Eisberg and Robert Resnick, Quantum Physics, Wiley, 2nd Edition, 2002.

REFERENCES

1. David J. Griffiths,*Introduction to Quantum Mechanics*, 2nd Edition, Pearson Publication, 2009.
2. Merzbacher E.,*Quantum Mechanics*, 3rd edition, Wiley Publishing, 1998.
3. Leonard I Schiff: *Quantum Mechanics*, 3rd Edition, McGraw Hill Book Company, 1968.
4. Thankappan V.K.,*Quantum Mechanics*, 2nd Edition, New Age International (P) Ltd, 1996.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1842	MODERN OPTICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To understand the concept of basic optics
2	To understand the concept of Interference
3	To study the fundamentals of diffraction
4	To apply the concept of optics in holography and fiber optics

UNIT –I: INTRODUCTION TO OPTICS

Huygen's principles and its applications – Lissajous figures – Generation – Application–Fermat's Principle, verification of laws of reflection and refraction, Matrix methods refraction and translation, translation matrix, refraction matrix, system matrix, position of the image plane, magnification, system matrix for thick lens, system matrix for thin lens.

UNIT –II: INTERFERENCE

Interference by division of wavefront, Superposition of two sinusoidal waves, Interference, coherence ,conditions for interference, the inference patterns, intensity distribution .Fresnel's two mirror arrangement, Fresnal Biprism, Determination of λ and dλ of Sodium Light

Interference by division of amplitude: Interference by a plane film illuminated by a plane wave, cosine law, non–reflecting films (the subsections excluded), interference by a film with two nonparallel reflecting surfaces, colours of thin films, Newton's rings, The Michelson interferometer, white light fringes

UNIT –III: DIFFRACTION

Fraunhofer Diffaraction: Preliminaries, single slit diffraction pattern, diffraction by circular aperture, limit of resolution, two slit Fraunhofer diffraction pattern, N slit diffraction pattern, plane diffraction grating, resolving power.

Fresnel Diffraction: Prelimanaries, Fresnal half period zones, explanation of rectilinear propagation of light, zone plate, diffraction at straight edge

UNIT –IV: POLARIZATION AND HOLOGRAPHY

Double refraction – Nicol prism – polarizer and analyzer, Hygiene's explanation of double refraction, positive and negative uniaxial crystals, quarter and half wave plates, types of polarized light, production and analysis of plane, circularly and elliptically polarized light, optical activity. Principles of

holography, Theory of construction and reconstruction, Hologram, Applications of Holography.

UNIT –V: FIBER OPTICS

Fiber Optics: Total internal reflection, optical fiber (step and multi–mode)**,** Numerical aperture, attenuation in optical fiber, multimode fibers, pulse dispersion, power law profile, fiber optic sensors.

TEXT BOOKS

1. AjoyGhatak, *Optics*, Mc Graw Hill, 2010.
2. Subramaniam,Brijlal and Avadhanulu, *A Text book ofOptics*, S. Chand, 2006

REFERENCES

1. Eugene Hecht, *Optics*, 4thEdition, Addison Wesley, 2002.
2. Brooker, Geoffrey, *Modern Classical Optics*, Oxford Univ. Press, 2003.
3. Guenther, Robert D and Robert Guenther, *Modern Optics*, Vol. 1. Wiley, 1990.
4. F. Jankins and H White, *Fundamentals of Optics,* Mc Graw Hill, 2017

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1843	ADVANCED OPTICS LABORATORY	0	0	4	4	2

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To gain knowledge in the scientific methods and learn the process of measuring different Physical variables
2	To enable the student to explore the field of optics
3	To make the student understand the basic concepts in spectroscopy
4	To enhance the students understand the concepts in modern optics and laser technology

List of Experiments

1. Determination of wave lengths of mercury spectrum using prism in minimum deviation
2. Determination of wave lengths of mercury spectrum using diffraction grating in minimum deviation
3. Determination of wave lengths of mercury spectrum using diffraction grating in normal incidence
4. Determination of dispersive power of a prism using spectrometer
5. Determination of refractive index of the material of the prism by drawing the i–d curve
6. Spectrometer – Narrow angled prism
7. Spectrometer – refractive index of the liquid
8. Spectrometer– i – i' curve
9. Spectrometer – Cauchy's constants
10. Determination of wavelength of sodium light – Newton's Rings
11. Determination of thickness of thin wire–Air Wedge.
12. Determination of numerical aperture and acceptance angle of the optical fiber using laser

TEXT BOOKS

1. S. K. Gupta, *Engineering Physics Practical*, Ninth Edition, Krishna Prakashan Media publishers, 2010.
2. C. L. Arora, B.Sc., Practical Physics, S. Chand & Company Ltd. Ram nagar, New Delhi–110055. 2007.

REFERENCES

1. Callister, Jr. W.D. *Materials Science and Engineering*: An Introduction, Seventh Edition, Wiley, New York, 2007.
2. S.O. Kasap, *Principles of Electronic Materials and Devices*, Tata McGraw Hill Edition, New Delhi, 2002.
3. Sam Zhang, *Materials Characterization Techniques*, CRC Press, 2008.
4. Chaikin, Paul M., and Tom C. Lubensky. *Principles of condensed matter physics.*Vol. 1. Cambridge university press, 2000.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
CHM1823	**Basic Concepts of Organic Chemistry**	**4**	**0**	**0**	**4**	**4**
INSTRUCTIONAL OBJECTIVES						
1.	To gain knowledge about the basic concepts in organic chemistry.					
2.	To understand the importance of stereochemistry.					
3.	To gain knowledge about aromaticity.					
4.	To understand about organic reactions and reaction intermediate.					

Unit 1: Basics of Organic Chemistry

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties.
Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.
Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit 2: Stereochemistry

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis–trans and, syn-anti isomerism E/Z notations with C.I.P rules.

Optical Isomerism: Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Unit 3: Chemistry of Aliphatic Hydrocarbons

A. Carbon-Carbon sigma bonds

Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.

B. Carbon-Carbon pi bonds:

Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations.
Reactions of alkenes: Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroborationoxidation,
ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction;
Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene.
Reactions of alkynes: Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.

C. Cycloalkanes and Conformational Analysis

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Unit 4: Aromatic Hydrocarbons
Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

TEXT BOOKS

1. T. W.Graham Solomons, *Organic Chemistry*, 6th edition, John Wiley and Sons, New York, 1996.
2. L. G. Wade, *Organic Chemistry*, 8th edition, Pearson, 2016.
3. Kalsi, P. S. *Stereochemistry Conformation and Mechanism*; New Age International, 2005.
4. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.

REFERENCES

1. S.H Pine, *Organic Chemistry*, 5th edition, McGraw Hill, New York,1987.

2. S.N. Ege ,*Organic Chemistry Structure and Reactivity*, 3rd edition: A.I.T.B.S., New Delhi, 1998.
3. F.A .Carey, *Organic Chemistry*, 3rd edition, Tata-McGraw Hill Publications, New Delhi, 1999.
4. B.Y. Paula, *Organic Chemistry*, 3rd edition, Pearson Education Inc., Singapore, 2002.
5. J. Clayden, N. Greeves, S. Warren, *Organic Chemistry*, 2nd edition, Oxford, 2014.

COURSE CODE	COURSE TITLE	L	T	P	Total L+T+P	C
CHM1844	**LABORATORY COURSE ON METHODS AND SYNTHESIS IN ORGANIC CHEMISTRY**		**0**	**4**	**4**	**2**

INSTRUCTIONAL OBJECTIVES	
1.	To learn qualitative analysis of organic functional groups.
2.	To learn various purification techniques in organic chemistry.
3.	To learn synthesis of organic chemistry.
4.	To learn to work with models to understand stereochemistry.

1. Qualitative organic functional group analysis - tests for alcohols, phenols, amines, carbonyls, carboxylic acids and nitro compounds.

2. Preparation of organic compounds: Dibenzylidene acetone, Aromatic sulphonation, Nitration of acetanilide, Bromination of acetanilide (Green Synthesis)

3. Purification techniques: recrystallization, sublimation, distillation and steam distillation.

4. Thin layer chromatography, column chromatography& paper chromatography.

5. Preparation of soap - saponification.

6. Preparation of methyl orange and aspirin.

7. Specific rotation of chiral compounds (sugars) using a polarimeter.

8. Plotting of molecular orbitals of aromatic compounds and conjugated systems.

9. Conformational analysis – butane and substituted butanes, cyclohexane and di-substituted cyclohexane with stress on *cis* and *trans* isomerism.

10. Molecular modelling:

a) Stereo-chemistry: R-S configuration.

b) Modeling on hybridization, geometry of some organic & inorganic compounds.

References

1. Introduction to Organic Laboratory Techniques by D.L. Pavia, G.M. Lampman, and G.S. Kriz, 2nd Ed., Saunders College Publishing, 1982.

2. Experimental Organic Chemistry by P.R. Singh ,D.S. Gupta and K.S. Bajpai, Vols I & II, Tata McGraw Hill, 1980.

3. Vogel's Text Book of Qualitative organic Analysis, 5th Ed., ELBS, 1994.

4. Experimental Physical Chemistry by V.D. Athawale, Parul Mathur, New Age International Publishers, 2001.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18S2	MATERIAL CHARACTERISATION TECHNIQUES	0	1	2	3	2

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To make the student familiarize with the basics of materials science experiments.
2	To enable the student to explore the field of semiconductors.
3	To make the student understand the basic concepts in magnetism
4	To enhance the students understand the concepts in crystal physics.

List of Experiments

1. Determination of the resistivity of a given material using two probe and four probe method.
2. Determination of dielectric constant of a given material.
3. Determination of Planck's constant using light emitting diode.
4. Study of laser beam parameters: (a) measurement of wavelength of He–Ne laser light using ruler (b) measurement of the thickness of thin wire with laser (c) determination of particle size using a given laser source.
5. Determination of Hall voltage and carrier type of a given semiconducting material.
6. Trace the magnetic hysteresis loop on various magnetic materials.
7. Determination of magnetic susceptibility of a given paramagnetic liquid by Quincke's method.
8. Determination of lattice parameters using x–ray diffraction.
9. Study of coherence on Michelson interferometer and Fabry–Perot etalon
10. Resistance and Magnetoresistance of some standard materials.

TEXT BOOKS

1. Thiruvadigal, J. D., Ponnusamy, S. Preferencial Kala, C. and Krishna Mohan, M. *Materials Science*, Vibrant Publications, Chennai. 2014.
2. Gupta S. K., *Engineering Physics Practical*, 9th Edition, Krishna Prakashan Media Publishers, 2010.

REFERENCES

1. Callister, Jr. W.D. *Materials Science and Engineering: An Introduction*, 7th Edition, Wiley, 2007.
2. Kasap S.O., *Principles of Electronic Materials and Devices*, Tata McGraw Hill Edition, 2002.
3. Sam Zhang, *Materials Characterization Techniques*, CRC Press, 2008.

Course Code	Course Name	L	T	P	C
CA1841	Computer Programming	3	0	4	5

LEARNING OUTCOMES:

At the end of this course the learner is expected:

1. To acquire basic knowledge about Programming in C.
2. To develop problem solving skills through C Programming.
3. To apply pointers concepts and functions in C Programming.

UNIT I - OVERVIEW OF C

Importance of C - sample C program - C program structure- executing C program - Constants- variables and data types - Operators and expression - Managing input and output operators.

UNIT II - DECISION MAKING, BRANCHING & LOOPING

Decision making, Branching: simple IF- IF ELSE- nested IF ELSE- ELSE IF ladder- Switch statement – Conditional Operator. Decision making and looping: While-Do-For-Jumps in loops.

UNIT III - ARRAYS AND FUNCTIONS

One Dimensional & Two Dimensional Arrays: Declaration – Initialization - multidimensional arrays. C functions- Return values and types- calling a function- categories of functions- Recursion- functions with arrays- call by value- call by reference- String Handling.

UNIT IV – POINTERS, STRUCTURES & UNIONS

Pointers: Definition- declaring and initializing pointers- accessing - pointer expressions- pointers and arrays- pointers and functions- pointers and structures.
Structures & Unions: Defining- initialization and comparison of structure variables- arrays of structure- arrays within structures- structures within structures- structures and functions- unions- size of Structures.

UNIT V –FILE MANAGEMENT

File Management in C: Opening- closing and I/O operations on files- random access to files-command line arguments.

TEXT BOOKS:

1. E. Balagurusamy, “Programming in ANSI C”, Sixth Edition, Tata McGraw Hill.

REFERENCE BOOKS:

1. Byron Gottfried, Schaum’s, “Outline Programming with C”, Second Edition, Tata McGraw Hill.
2. Yashavant Kanetkar, “Let Us C”, Eighth Edition, BPB Publications.
3. Kernighan and Ritchie, “The C Programming Language”, Second Edition, Prentice Hall, 1998.

SEMESTER V

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1851	SOLID STATE PHYSICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To understand the basic knowledge on crystal structures and crystal systems
2	To acquire the knowledge of bonding in solids
3	To acquire knowledge on lattice vibrations, thermal properties and electric conductivity of solids
4	To comprehend the concepts of dielectric properties of solids and superconductivity

UNIT –I: CRYSTAL PHYSICS

Crystalline and amorphous solids – Lattice and basis – Unit cell and primitive cell – Crystal systems – Translation vectors – Number of atoms per unit cell in a Cubic Crystal – Bravais lattice – Simple cubic– BCC FCC lattices – HCP and diamond structure – Miller indices – Interplanar spacing –Crystal symmetry –Crystal diffraction – Bragg's law – Experimental diffraction methods – Laue method – Powder diffraction method – Reciprocal lattice.

UNIT –II: BONDING IN SOLIDS

Crystal binding – Crystals of inert gas – Van der Walls – Cohesive energy – Compressibility and bulk modulus – Ionic Crystals – Madelung energy – Evaluation of Madelung constant – Covalent crystals – Energy value for single covalent bonds – Metallic crystals – Hydrogen bonding – Atomic radii – Tetrahedral covalent radii and ionic crystal radii.

UNIT –III: LATTICE VIBRATION AND THERMAL PROPERTIES OF SOLIDS

Vibration of one dimensional monatomic linear lattice – Derivation of force constant – Dispersion relation – Brillouin zone – Phase velocity – Group velocity – Phonons – Characteristics of phonons – Phonon momentum – Thermal Properties of Solids – Classical theory of specific heat – Einstein's theory of specific heat – Debye's theory of specific heat.

UNIT – IV: FREE ELECTRON THEORY OF METALS

Free electron theory –Fermi Dirac statistics and electronic distribution in solids – Density of energy states and Fermi energy – The Fermi distribution function –Drude Lorentz theory – Electrical conductivity – Thermal conductivity – Wied–Mann and Franz ratio – Hall effect – Hall voltage and Hall coefficient – Mobility and Hall angle – Importance of Hall effect – Experimental determination of Hall coefficient.

UNIT –V: DILECTRICS AND SUPERCONDUCTIVITY

Dielectrics – Dielectric constant and displacement vecto r– Clausissmossotti relation – Atomic or molecular polarizability – Types of polarizability – Superconductivity – Occurrence of superconductivity – Destruction of superconductivity by magnetic fields – Meissner effect – London equation – Josephson effect – Energy gap – Elements of BCS theory – Classification of Superconductivity – Application

TEXT BOOKS

1. Pillai S.O., *Soild State Physics*, 6th Edition, New Age Science, 2013.
2. Charles Kittel, *Introduction to Solid State Physics*, Wiley, 2005.

REFERENCES

1. Ashcroft W. and Mermin N.D., *Solid State Physics, H*olt–Rinehart–Winston, 1976.
2. Blakemore J. S., Solid State Physics, 2nd Edition, Cambridge University Press, Cambridge, 1974.
3. Dekker A. J., *Solid State Physics*, Mac Millan, 1971.
4. Giuseppe Grosso, Giuseppe Pastori Parravicini, *Solid State Physics,* Academic Press, Second Edition, 2014.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1852	STATISTICAL MECHANICS	4	0	0	4	4
INSTRUCTIONAL OBJECTIVES: **At the end of this course the learner is expected:**						
1	To understand the basic concepts of statistical mechanics					
2	To enable the student to explore the field of statistical mechanics					
3	To emphasize the significance of classical and quantum statistics					
4	To understand the significance of different statistics					

UNIT – I: BASIC STATISTICS AND PHASE SPACE

Probability - distribution functions - Binomial distribution - Probability distribution for large–scale N - Guassian probability distributions - Basic postulates of Statistical Physics - Specification of states - Macro state - Micro State - Phase Space - Density distribution in phase space and its division - Statistical average values - Condition of equilibrium - Stirling's Approximation - Entropy and Thermodynamic probability ($S=K \ln \Omega$) - Boltzmann entropy relation.

UNIT – II: ENSEMBLES AND THERMODYNAMIC CONNECTIONS

Definition - Micro–canonical - Canonical and Grand Canonical ensembles - their thermodynamic connections - Statistical definition of temperature and interpretation of second law of thermodynamics – Pressure - Entropy and Chemical potential - Entropy of mixing and Gibb's paradox - Partition function and Physical significances of various statistical quantities.

UNIT – III: CLASSICAL STATISTICS

Maxwell–Boltzmann statistics and Distribution law - Energy distribution function - Maxwell–Boltzmann law of velocity distribution (most probable velocity - average velocity, RMS velocity) - Limitations of M–B statistics.

UNIT – IV: BOSE–EINSTEIN STATISTICS

Bridging Microscopic and Macroscopic behavior - indistinguishability of particles and its consequences - Transition to quantum statistics and its implications - Bose–Einstein Statistics B–E distribution law - Thermodynamic functions of a Completely Degenerate Bose Gas - Bose–Einstein condensation, properties of liquid He (qualitative description) - Radiation as photon gas - Bose's derivation of Planck's law.

UNIT – V: FERMI–DIRAC STATISTICS

Fermi–Dirac Statistics - Fermi–Dirac Distribution Law - Thermodynamic functions of an ideal Completely Degenerate Fermi Gas - Fermi Energy - Electron gas in a Metal - Specific Heat of Metals.

TEXT BOOKS

1. B.B.Laud "Introductions to Statistical Mech."(McMillan)
2. Bhattarjee J.K. "Statistical Physics", (Allied Publishers)

REFERENCES

1. F.Reif, "*Statistical Physics*", (Mc.Graw Hill)
2. Kamal Singh "*Elements of Statistical Mechanics*", (S.Chand).
3. K.Hung "*Statistical Physics*"(Chapman and Hall/CRC)

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1853	**ATOMIC PHYSICS AND SPECTROSCOPY**	**4**	**0**	**0**	**4**	**4**

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To understand the principles of atomic physics
2	To familiarize with various atomic models and atomic spectra
3	To understand the electric and magnetic field effects on atomic spectra
4	To learn basic principles and applications of spectroscopy

UNIT – I: ATOMIC STRUCTURE I

Early models of the atom – Rutherford's experiment – Rutherford model of the atom – Bohr model of the atom – Bohr's theory of hydrogen spectrum – Spectral series and energy levels of hydrogen atom – Bohr's correspondence principle – Sommerfeld theory of hydrogen atom – Sommerfeld's relativistic theory

UNIT –II: ATOMIC STRUCTURE II

Vector atom model – Quantum numbers associated with vector atom model – The exclusion principle and the periodic table – Coupling schemes – Fine structure of spectral lines – Term symbol – Stern–Gerlach experiment – Interpretation of results –Normal and Anomalous Zeeman effect – Paschen Back and Stark effects

UNIT –III: X–RAY SPECTRA

Origin of X–ray spectra – Continuous and Characteristic X–rays – Moseley's law–Absorption of X–rays – Hydrogen like character of X–ray spectrum – X–ray absorption spectrum. Compton Effect – derivation of expression for change in wavelength – experimental verification.

UNIT –IV: MOLECULAR SPECTRA

Basic elements of spectroscopy – Rotational spectra of rigid diatomic molecules – Isotopic shift and Intensities of spectral lines – Vibrational, Rotation–Vibration spectra of diatomic molecules – Introduction to Electronic spectra of molecules.

UNIT –V: RAMAN SPECTRA

Raman scattering – classical description – Theoretical explanation based on quantum theory – Characteristic properties of Raman lines – Stoke's and Anti–Stoke's Lines – Vibrational and rotational Raman spectra of diatomic and polyatomic molecules –Structure determination from Raman and Infrared spectroscopy.

TEXT BOOKS

1. Subrahmanyam N, Brij Lal, Jevan Shesan, *Atomic and Nuclear Physics,* 3rd Edition, S Chand and Company Ltd, 1986.
2. Banwell C N, McCash E M, *Fundamentals of Molecular Spectroscopy*, Tata McGraw-Hill, 2008

REFERENCES

1. Beiser A, *Concepts of Modern Physics*, 6th Edition, Mc–Graw Hill, 2009
2. Christopher J. Foot, *Atomic Physics*, Oxford University Press, 2005
3. Krane K S, *Modern Physics*, Wiley, 2016
4. Singh R. B, *Introduction to Modern Physics*, New Age International (P) Limited Publishers, 2009

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1854	ANALOG AND DIGITAL ELECTRONICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To understand the concept of networks and semiconductors
2	To understand the working principles of a transistors
3	To familiarize the operation of amplifiers and oscillators
4	To understand the basic concepts of number systems. To develop the digital concepts using logic gates. To apply digital concepts in combinational and sequential logic systems

UNIT – I: NETWORK THEOREM AND SEMICONDUCTORS

Circuit Elements and Kirchhoff's Law – Methods of Analysing circuits – Mesh and Nodal Method – Thevenin Theorem – Norton theorem – Intrinsic and extrinsic semi conductor – PN junction diode–construction–Biasing of PN junction–VI characteristics of diode–Zener diode–Bipolar Junction Transistors – Construction–CE, CB configuration–input and output characteristics–Two port network analysis of transistor–FET – Construction and characteristics of JFET– Biasing of JFET– Depletion and Enhancement modes–Important Relationships – MOSFET– Depletion type of MOSFET – Enhancement type of MOSFET

UNIT – II: AMPLIFIERS AND OSCILLATORS

RC coupled single stage amplifiers–Frequency response –Feedback constant–Gain with feedback – Advantages of negative feedback amplifier–(quantitative treatment only) – Power amplifiers –Class A and Class B amplifiers,. Principle of Feedback and oscillators– Feedback amplifier— Oscillator operations – Burcausan criteria–Sinusoidal oscillators–Hartly oscillator–Colpit's oscillators–Phase shift oscillator– Wien bridge oscillator

UNIT – III: WAVE SHAPING AND SWEEP CIRCUITS

Operational Amplifiers – Open loop and closed loop –OP–AMP characteristics– Ideal OP–AMP with virtual ground–Inverting and Non inverting OP–AMP–Basic OP–AMP with applications– Adder –

Subtractor –Voltage follower – Clipping circuit – Positive clipper – Biased clipper – Combinations clipper – Applications of clipper– Clamping Circuits–Basic idea of a clamper – Positive clamper – negative clamper–.IC555 (Timer IC) – Astable multivibrator – Monostable multivibrator.

UNIT – IV: NUMBER SYSTEMS AND LOGIC GATES

Introduction to decimal– Binary– Octal– Hexadecimal number systems–Inter conversions–BCD code– Excess –3 code– Gray code –One's complement andtwo's complements– Arithmetic operations– Addition– Subtraction– Basic and derived logic gates– Symbols and their truth tables– AND–OR– NOT– NAND– NOR– XOR– XNOR– Universal NAND and NOR gates–Boolean algebra – Basic laws of Boolean algebra – De– Morgan's theorems– Reducing Boolean expressions using Boolean laws– SOP and POS forms of expressions–Min term and max terms– Karnaugh map simplification

UNIT – V: COMBINATIONAL AND SEQUENTIAL LOGIC SYSTEMS

Half and full adders– Half and full subtractors– Binary adders and subtractors–Two's complement adder/subtractor circuits– Binary Coded Decimal (BCD) adder–Decoder–Encoder–Multiplexer– Demultiplexer–.Flip flop–RS flip flop – Clocked RS flip flop–D flip flops – JK flip flop – JK as master slave flip flops–Registers– Shift registers–Shift left and Shift right registers–Counters–Synchronous and asynchronous counters–Ripple counter–Ring counter–Up and Down counter –Decade counter– .SISO and SIPO Shift registers

TEXT BOOKS

1. Sudhakar A and Shyammohan S Palli, *Circuits and Network Analysis andSynthesis*, 4thEdition, Tata McGraw Hill, 2010.
2. Metha V.K., Mehta R., *Principles of Electronics*, S. Chand and Company Ltd., 2008.

REFERENCES

1. Jacob Millman, Christos C Halkias, Satyabrata Jit, *Electron Devices andCircuits*, Tata McGraw Hill, 2010.
2. Millman and Halkias ,*Electronics Devices and Circuits*, Tata Mc Graw Hill,2008.
3. William H.Hyte, Jr, J.E.Kemmerly and Steven M.Durban, *Engineering CircuitAnalysis*, 7thEdition, McGraw Hill, 2010.
4. Robert L. Boylestad and Louis Nashelsky, *Electronic Devices and CircuitTheory*, Pearson Education, 9thEdition, 2009.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1855	GENERAL PHYSICS LABORATORY–II	0	0	4	4	2

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To gain knowledge in the scientific methods and learn the process of measuring different Physical variables
2	To enable the student to explore the field of properties of matter
3	To allow the student to have a deep knowledge in the field of materials science.
4	To make the student understand the basic concepts in Electricity and Magnetism.

List of Experiments

1. Young's modulus – Koenig's method – Uniform bending.
2. Young's modulus – Koenig's method – Non uniform bending.
3. Young's modulus – cantilever – depression – (Static method)–(Scale and

telescope)

4. Potentiometer–calibration of high range voltmeter
5. EMF of a thermocouple–Mirror galvanometer(or table galvanometer)
6. B.G.–Absolute capacitance of a capacitor.
7. Ballistic Galvanometer – comparison of emf's of two cells.
8. To study V–I characteristics of a light dependent resistor (LDR).
9. Determination of Planks constant using Light Emitting Diode.
10. Determination of Hall coefficient and carrier type for a given semiconductor material.
11. To trace the hysteresis loop for a magnetic material.
12. Determination of Magnetic susceptibility for a given paramagnetic liquid by Quincke's method.
13. To measure of voltage, frequency, time period and phase angle using CRO.
14. Measurement of R, L and C using a LCR bridge/ universal bridge.

TEXT BOOKS

1. R. K. Shukla & Anchal Srivastava. *Practical Physics*, NEW AGE INTERNATIONAL (P) Ltd, Publishers, (Formerly Wiley Eastern Limited), 4835/24, Ansari Raod, Daryagani, New Delhi–11002. 2006.
2. Thiruvadigal, J. D., Ponnusamy, S. Preferencial Kala, C. and Krishna Mohan, M. *Materials Science*, Vibrant Publications, Chennai. 2014.

REFERENCES

1. G. L. Squires, *Practical Physics*, Fourth edition, Cambridge University Press, 2001.
2. D. Halliday, R. Resnick and J. Walker, *Fundamentals of Physics*, 6th Ed., John Wiley and Sons, Inc., New York, 2001.
3. F.A. Jenkins and H.E. White, *Fundamentals of Optics*, 4th Ed., Reprint McGraw–Hill Book Co., 2007.
4. GeetaSanon, *B. Sc., Practical Physics*, 1st Edition. R. Chand & Co, 2007.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1856	ANALOG AND DIGITAL ELECTRONICS LABORATORY	0	0	4	4	2

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To impart hands on experience in verification of circuit laws and theorems
2	To study experimentally the characte
3	To familiarize the operation of amplifiers and oscillators
4	To understand the basic concepts of number systems. To develop the digital concepts using logic gates. To apply digital concepts in combinational and sequential logic systems

LIST OF EXPERIMENTS

1. To verify the Thevenin theorem.
2. To obtain the static characteristics of a PN junction diode and then obtain the forward resistance of the diode at a given operating point.
3. Study the V–I characteristics of a Zener diode and note down its breakdown potential.
4. Study the characteristics curves of BJT and FET.
5. CE amplifier and make the (i) Upper cut off (ii) Lower cutoff frequencies and hence estimate the BW.
6. Study of class A and class B power amplifiers.
7. Study of Colpitt's Oscillators.
8. Study of Hartley Oscillators.
9. Study of Diode as clipper and clamper.
10. Study of timer circuit using IC555 and configuration for monostable and astable multivibrator.
11. Logic gates using Discrete components and ICs
12. Universal logic gates using NAND and NOR gates
13. FlipFlops.
14. Decade counter.
15. Double digit seconds counter – 7 segment.
16. Half adder, Full adder, Half subtractor and Full subtractor using IC.
17. Shift Registers.
18. Ring and Ripple counters , up and down counters

TEXT BOOKS

1. David A. Bell, *Laboratory Manual for Electronic Devices and Circuits*, 4th Edition, Oxford University Press, 2009.
2. Maheswari.L.K and Anand.M.M.S, *Laboratory Manual for Introductory Electronic Experiments,* New Age, 2010.

REFERENCES

1. Gaykwad A., *Operational Amplifier and Linear Integrated Circuits,* Prentice Hall, 2006
2. David A Bell, *Fundamentals of Electrical Circuits: Lab Manual,* 4th Edition, Oxford University Press, 2009.
3. Ouseph C.C, Rangarajan C., Balakrishnan R., *A Text Book of Practical Physics*, S.Viswanathan Publisher–Part II, 2005.
4. Malvino A.P.and Leach D.P., *Digital Principles and Applications,* 4th Edition, McGraw Hill, 2007.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18C2	**RADIATION PHYSICS**	3	**0**	**0**	**3**	**3**

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To demonstrate a knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter
2	To describe experimental techniques used for Radiation physics purposes discuss their influence on development of new technologies in instrumentation
3	To allow the student to have a good knowledge on

	modern radiation therapies, dosimeters and computed tomography and magnetic resonance imaging
4	To demonstrate a knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter

UNIT – I: STRUCTURE OF MATTER AND X–RAYS

Structure of matter and nucleus, atomic mass and energy units – Energy levels–Nuclear forces – Nuclear energy levels – Particle radiation – Elementary particles – Electromagnetic radiation– Wave model and Quantum model. Nuclear Transformation – Radioactivity – Decay constant – Radioactive series – Radioactive equilibrium –Activation of nuclides–Production of X–rays – X–ray tube – X–ray circuit – voltage rectification – X–ray energy spectra – Operating characteristics.

UNIT – II: CLINICAL RADIATION GENERATORS

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 Graaff generator – Linear accelerator – Betatron – Cyclotron – Microtron – Machines using radionuclides–The role of Cobalt60 in Therapy – Heavy particle beams.

UNIT – III: IONIZING RADIATION

Ionizing Radiation – Interaction of ionizing radiation— Photon beam description and 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

Dose distribution and scatter analysis–Phantoms – Depth dose distribution –Dependence on beam quality and depth – Tissue air ratio (TAR)– Dose calculation parameters– Collimator Scatter Factor – Phantom Scatter Factor – Tissue–Phantom and TissueMaximum Ratios (TMR)– ScatterMaximum Ratio (SMR) – 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 AND PROTECTION

Modern Radiation Therapy–ImageGuided Radiation Therapy – Proton Beam Therapy–Dosimetry– Dosimeter – Film badge dosimeter – Pocket Dosimeter–Radiation Protection– Dose Equivalent – Effective Dose – Background Radiation – LowLevel Radiation Effects – Effective DoseEquivalent Limits– Occupational and Public Dose Limits.

TEXT BOOKS

1. Fiaz.M.Khan, *The Physics of Radiation Therapy*, Lippincott Williams and Wilkins, 4th Edition, 2010.
2. Meredith W.J. and J.B. Massey, *Fundamental Physics of Radiology*, A. John Wright and Sons Ltd.,3rd Edition, 1983.

REFERENCES

1. William.R.Hendee, Geoffery.S.Ibbott and Eric.G.Hendee, *Radiation TherapyPhysics*, A.John Wiley and Sons.,Inc, 3rdEdition, 2005.

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

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18C3	SOLAR TECHNOLOGY	3	0	0	3	3

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To learn the fundamentals of Solar Energy Technologies
2	To learn the Solar thermal based energy systems
3	To learn basic principles and applications of Photovoltaic systems
4	To learn solar passive architecture

UNIT –I: SOLAR RADIATION AND COLLECTORS

Energy emitted by sun and energy that reaches the earth – Sun–Earth geometry–Solar angles – Angles of incidence– Zenith angle – Azimuthal angle – Hour angle – Latitude and longitude – Solar Spectrum and Solar constant – Extraterrestrial characteristics – Measurement and estimation on horizontal and tilted surfaces – Solar Collector Basics – Flat plate collector – Evacuated tubular collectors – Concentrator collectors – Tracking systems – Compound parabolic concentrators – Parabolic trough concentrators – Concentrators with point focus.

UNIT –II: SOLAR THERMAL TECHNOLOGIES

Solar heating and cooling system – Principle of working – Types – Design and operation – Thermal Energy storage – Types of thermal Energy Storage systems – Sensible Heat Storage – Liquids – Latent heat Storage –Thermo chemical storage – Solar thermal power plant – Solar Desalination – Solar cooker – Domestic – Community – Solar pond technology – Principle of working and description – Solar drying.

UNIT –III: 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 –IV: SPV SYSTEM DESIGN AND APPLICATIONS

Photovoltaic cell – Photovoltaic module – PV array – Solar cell array designconcepts – PV system design – Maximum power points tracking – Storage autonomy – Centralized and decentralized SPV systems – Stand alone – Hybrid and Grid connected system – System installation – Operation and maintenances – Field experience – PV market analysis and Economics of Solar Photovoltaic systems.

UNIT –V: SOLAR PASSIVE ARCHITECTURE

Passive heating concepts – Direct heat gain – Indirect heat gain – Thermal storage wall – Attached Green house – Isolated gain and sunspaces – Passive cooling concepts – Evaporative cooling – Shading and ventilation – Radiative cooling – Green coupling – Application of wind – Water and earth for cooling – Paints and cavity walls for cooling – Roof radiation traps – Energy efficient landscape design.

TEXT BOOKS:

1. Sukhatme S P, J K Nayak, *Solar Energy, Principle of Thermal Storage andCollection*, 3rdEdition, Tata McGraw Hill, 2008.
2. *Chetan Singh Solanki, Solar Photovoltatics, Fundamentals, Technologies and* Applications, PHI Learning Private Limited, 2011.

REFERENCES:

1. Peter Würfel, *Physics of Solar Cells: From Basic Principles to AdvancedConcepts*, Wiley–VCH, 2009.Jeffrey M. Gordon, Solar Energy: The State of the Art, Earthscan, 2013.
2. Garg H. P. and Prakash J., *Solar Energy Fundamentals and application*,TataMcGraw– Hill Publishing, 7th Reprint 2006.
3. Roger A. Messenger and Jerry Vnetre, *Photovoltaic Systems Engineering*, CRC Press, 2010.
4. Kalogirou S. A., *Solar Energy Engineering: Processes and Systems*, 2ndEdition, Academic Press, 2013.

SEMESTER VI

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1861	**ELEMENTS OF NANOSCIENCE AND NANOTECHNOLOGY**	**4**	0	**0**	**4**	**4**

INSTRUCTIONAL OBJECTIVES: **At the end of this course the learner is expected:**	
1	To make the student understand the basic concepts in nanoscience.
2	To enable the student to explore the field of nanomaterials.
3	To make the student understand the principles of nanotechnology
4	To acquire knowledge on the various applications of nanotechnology.

UNIT – I: BASICS OF NANOSCIENCE

Nano revolution of the 20th century – Difference between bulk and nanoscale materials and their significance – Properties at the nanoscale – Optical property – Magnetic property and electronic property – Size dependent behavior – Scaling – Mechanical properties of Nano materials and Chemical properties of Nanoparticles.

UNIT– II: CLASSES OF NANOMATERIALS

Metals and Semiconductor Nanomaterials – Quantum dots – Nano wells – Nano ribbons and Nano Wires – Bucky balls – Carbon nanotubes – Single walled and Multi walled CNT–Structure – Synthesis– Properties– Functionalization and applications – Fullerenes/Bucky Balls/ C60– Synthesis – Properties – Functionalization and application

UNIT – III: SYNTHESIS OF NANOMATERIALS

Top–down approach – Nanolithography – Soft lithography and hard lithography – Physical Vapor deposition (PVD) – Chemical Vapor Deposition(CVD) – E–beam lithography – Bottom–up approach– Sol–gel processing and chemical methods – Self assembly.

UNIT – IV: CHARACTERIZATION OF NANOMATERIALS

Scanning Electron Microscope (SEM) – Transmission Electron Microscope (TEM) – Atomic Force Microscope (AFM) – Scanning Tunneling Microscopy (STM) – Types– Manipulating atoms and Molecules with STM – Scanning Tunneling Spectroscopy and Dip pen Nanolithography.

UNIT – V: APPLICATIONS OF NANOTECHNOLOGY

Nanotechnology in Energy systems – Electronics – Environment – Space and Aviation – Textiles – Food and Agriculture – Automotive Industry – Solar Technology – Chemical engineering – Building and Construction – Biotech and Biomedical Engineering – Pharmaceutical and drugs – Molecular Nanoelectronics

TEXT BOOKS

1. Pradeep T, *Fundamentals of Nanoscience and Nanotechnology,* Mc Graw Hill, 2012.
2. Chris Binns, *Introduction to Nanoscience and Nanotechnology,* 1st Edition, Willey– Publication, 2010.

REFERENCES

1. Gabor L.Hornyak, H.F.Tibbals, Joydeep Dutta, John J.Moore, *Introduction to Nanoscience and Nanotechnology*, CRC Press, 2008.
2. Chattopadhay K.K., *Introduction to Nanoscience and Nanotechnology–,* APH Publishing Corporation, 2006.
3. Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan*, NanoscaleScience and Technology*, John Wiley and Sons, Ltd., 2005.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1862	NUCLEAR PHYSICS	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To study the basic characteristics of nucleus and nuclear properties
2	To understand the concepts of nucleus structure
3	To study interaction of nuclear particle and their decays
4	To study the basics principles of acceleration and detection of nuclear particles

UNIT – I: NUCLEAR PROPERTIES

Constituents of nucleus and their Intrinsic properties – quantitative facts about size – mass – charge density (matter energy) – binding energy (B.E.) – average binding energy and its variation with mass number – main features of B.E. vs Mass Number curve – Neutrons vs Nucleons plot – angular momentum – parity – magnetic moment – electric moments.

UNIT – II: NUCLEAR MODELS

Properties of nuclear forces and saturation – Non–existence of electrons in the nucleus and neutron proton model – Assumptions of liquid drop model – semi–empirical mass formula – conditions of nuclear stability – Nuclear Shell Model – Experimental evidence of magic numbers and its explanation.

UNIT – III: NUCLEAR PROCESSES

Radioactivity: Alpha emission – qualitative discussion of alpha spectra – Geiger–Nuttal rule – Beta emission – qualitative discussion of beta spectra–positron emission – electron capture – Neutrino hypothesis of beta decay – Evidence of existence of Neutrino – gamma–ray emission – qualitative discussion of gamma–ray spectra – internal conversion. Interaction with Matter: Energy loss due to ionization (Bethe–Bloch formula) – Energy loss of electrons – Gamma–ray through matter – pair production– radiation loss by fast electrons – electron–positron annihilation. Reactions: Conservation principles in nuclear reactions – Q–values and thresholds– nuclear reaction cross–sections – examples of different types of reactions and their characteristics– Bohr's postulate of compound nuclear reaction.

UNIT – IV: ACCELERATION AND DETECTION

Accelerators: Cyclotron – Van–de–graaff generator – Qualitative discussion of Synchrotron – Linear accelerators.Detectors: Ionization chamber – G.M. counter – Basic principle of Scintillation Detectors and construction of photo–multiplier tube (PMT) – Semiconductor Detectors (Si and Ge) for charge particle and photon detection.

UNIT – V: INTRODUCTION OF ELEMENTARY PARTICLES

Elementary particles and their classification – types of fundamental interactions – Conservation laws and quantum numbers – concepts of isospin – strangeness – charge conjugation – antiparticles– introduction to quarks – leptons – hadrons – qualitative discussion of the quark model.

TEXT BOOKS

1. Mittal, V.K., Verma R.C. and Gupta S.C, *Introduction to Nuclear and Particle Physics,* PHI Learning, 3rd Edition, 2013
2. Kaplan, I.,*Nuclear Physics*, Narosa Publishers, 2002.
3. Ghoshal S.N.,*Nuclear Physics,* S. Chand, 2nd Edition, 1994.

REFERENCES

1. Segre E., *Nuclei & Particles*, W.A. Benjamin Inc., 1965.
2. Krane K. S., *Introductory Nuclear Physics*, John–Wiley, 1987.
3. Cohen, B.L., *Concepts of Nuclear Physics*, TMH Edition, 1971.
4. Verma, J.,*Fundamentals of Nuclear Physics,* CBS, 2013

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1863	**MICROPROCESSORS**	**4**	0	**0**	**4**	**4**

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To understand the architecture of 8085, 8086 and 8051
2	To impart knowledge on instruction sets
3	To understand data transfer schemes and applications
4	To develop skill in writing simple program for 8085, 8086 and 8051

UNIT – I: ARCHITECTURE OF 8085

Introduction to microprocessor and microcontrollers - General purpose of computer systems - Basic block diagram - Architecture of embedded system - classification and features of 8085 - Architecture of 8085–Organization of 8085– Control – Data and Address buses–registers in 8085–Addressing modes in 8085– Pin configuration of 8085.

UNIT – II: INSTRUCTION SET AND PROGRAMMING OF 8085

Instruction and operation code of 8085–Instruction types(based on number of bytes, operation), data transfer –Arithmetic–Logical–Branching–Stack and I/O instructions–Timing and sequencing instruction cycles–Machine cycle of weight state–timing diagram of opcode fetch–Memory read and memory write cycles. – Simple programs using arithmetic and logical operations – Instructionclassification - stacks and its implementation - interrupts – Maskable–Non maskable – Hardware, Software and multilevel interrupts.

UNIT –III DATA TRANSFER SCHEMES AND APPLICATIONS

Programmed data transfer scheme–Synchronous and Asynchronous and serial data transfer schemes– Interfacing devices–Types of interfacing devices– Programmable Peripheral Interface (PPI– 8255)– Communication interfacing device (Universal Synchronous Asynchronous Receiver Transmitter (USART– 8251)– Programmable Direct Memory Access(DMA) controller (8257).

UNIT –IV: ARCHITECTURE AND PROGRAMMING OF 8086

Architecture–Memory organization–Input and output structure–Programmable hard ware resistors– Addressing modes–Minimum and maximum modes–Systems bus timing–Interrupts and interrupts service routines– Assembler instruction format–Data transfer instructions–Arithmetic and logical instructions–Branch instructions–processor control instructions–String operator instructions–Simple programs

UNIT – V: ARCHITECTURE AND PROGRAMMING OF MICROCONTROLLER 8051

Introduction –Comparison between microprocessor and microcontroller–architecture of 8051–Key features of 8051–Memory organization–Data and program memory–Internal RAM organization– Internal ROM organization –Special function registers–Accumulator–Data pointer–Control registers– I/O port–Counters and timers–Interrupt structures- Instruction set of 8051–Arithmetic–Logical–Data movable–Jump and call instructions– Addressing modes–Immediate–Register–Direct and indirect addressing modes–Assembly language programming–Simple programs

TEXT BOOKS

1. Ramesh S Goankar*, Micro Processor Architecture,* Programming and Applications with the 8085, 6thEdition, Penram International Publishing (India) Pvt. Ltd., 2011.
2. Kenneth J. Ayala, The 8051 *Microcontroller*, 3rdEdition, Publisher Cengage Learning, 2007.

REFERENCES

1. Anokhsingh, A.K. Chhabra, *Fundamentals of Digital Electronics and Microprocessors,* S.Chand, 2011.
2. Mazidi, The 8051 *Microcontroller And Embedded Systems*, 2ndEdition, Pearson Education India, 2007.
3. Kenneth J.Ayala, *The Microprocessor 8086 Programming and Interfacing*, West Publishing Company, 1995.
4. Barry B.Bery, Intel *Microprocessor: Architecture*, Programming and Interfacing– 8086, 8088,80186,80286,80386 and 80486, Prentice Hall PTR Upper Saddle River, NJ, 1993.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY1864	MICROPROCESSORS LABORATORY	0	0	4	4	2

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To understand the basic operations of 8085, 8086 and 8051
2	To impart knowledge on code conversions with 8085 and 8051
3	To understand temperature conversions logic with 8085 and 8051
4	To develop skills in 8085 interfacing.

LIST OF EXPERIMENTS

1. Perform the Arithmetic operations (addition and Subtraction) using microprocessor 8085.
2. Perform the Arithmetic operations (multiplication and division) using microprocessor 8085.
3. Code conversion using microprocessor 8085.
4. Temperature conversion using microprocessor 8085.
5. Decimal counters using microprocessor 8085.
6. Perform the Arithmetic operations (addition and Subtraction) using microprocessor 8086.
7. Perform the Arithmetic operations (multiplication and division) using microprocessor 8086.
8. Perform the Arithmetic operations (addition and Subtraction) using microcontroller 8051.
9. Perform the Arithmetic operations (multiplication and division) using microcontroller 8051.
10. Code conversion using microcontroller 8051.
11. Temperature conversion using microcontroller 8051.
12. Decimal counter using microcontroller 8051.
13. Programmable Peripharal Interfacing (PPI– 8251) – Mode 0 and Mode 1 operations using microprocessor 8085.
14. Traffic light control systems using microprocessor 8085.
15. Stepper motor control using microprocessor 8085.

TEXT BOOKS

1. Ramesh S Goankar, *Micro Processor Architecture*, Programming & Applications with the 8085, 6th Edition, Penram International Publishing (India) Pvt. Ltd., 2011.
2. Kenneth J. Ayala, *The 8051Microcontroller,* 3rd Edition, Publisher Cengage Learning, 2007.

REFERENCES

1. Anokhsingh, A.K. Chhabra, *Fundamentals of Digital electronics and Microprocessors,* S.Chand, 2011.
2. Mazidi, The 8051 *Microcontroller and Embedded Systems*, 2ndEdition, Publisher Pearson, Education India, 2007.
3. Kenneth J.Ayala, *The Microprocessor 8086 Programming and Interfacing,* West Publishing Company, 1995.
4. Anokhsingh, A.K. Chhabra, *Fundamentals of Digital Electronics and Microprocessors,*S. Chand, 2011.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18C4	NONLINEAR OPTICS	3	0	0	3	3

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To provide the learners with a full–fledged understanding of integrated optics so that they may be able to develop the sound theoretical and experimental tools to study and control the linear and non–linear optical properties of various optical components.
2	To understand and discuss non–linear equations required for the simple and complexed situations and present a lecture on a topic within: nonlinear optics.
3	To carry out smaller research type projects based on contemporary and modern photophysical phenomena involved in NLO materials and analyse and present the achieved results in form of posters an oral presentation and a technical article.
4	To understand and perform simple evaluations of nonlinear phenomena in optics.

UNIT – I: INFORMATION IN LIGHT

Light In The Era Of Electronics – Electronics1900–1960 – Principles of Optical Telegraphy – Photophone –Early rectification devices – The solid–state rectifier – The transistor – New 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

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

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

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

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. Sergey A. Ponomarenko, *Fundamentals of Nonlinear Optics ECED 6400Lecture Note*s, Dalhousie University, 2012.
2. Goure P and Verrier I, *Optical Fibre Devices Series in Optics and Optoelectronics,* Institute of Physics Publishing Ltd, 2002.

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.
4. Richard L Sutherland, *Handbook of Nonlinear Optics, 2nd Edition (Revisedand Expanded),* Marcel Dekker, Inc, 2003.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18C5	SEMICONDUCTOR DEVICE PHYSICS	3	0	0	3	3

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To outline the classification of solids as metals, semiconductors, and insulators and distinguish direct and indirect semiconductors
2	To elucidate the importance of Quantum theory and its related principles
3	To know the physics of semiconductor junctions, metal–semiconductor junctions and metal–insulator–semiconductor junctions and related device operations
4	To understand the fabrication technology and principles of operation of new and future electronic and photonic devices based on semiconductors

UNIT – I: **STRUCTURAL PROPERTIES OF SEMICONDUCTORS**

Crystal Structure –Space lattices – Primitive and unit cell– Types of crystal structures – Crystal planes and Miller Indices– Energy Bands and origin of Energy Gap – Carrier Concentration at Thermal Equilibrium – Carrier–Transport Phenomena – Phonon, Optical, and Thermal Properties of solids – Imperfections in Solids

UNIT – II: QUANTUM THEORY OF SOLIDS

Principles of quantum mechanics – wave particle duality – de–Broglie hypothesis – The uncertainty principle – The physical meaning of Schrodinger's Wave equation – Boundary conditions – Applications of Schrodinger's wave equation – the Infinite Potential well– the Step Potential Function – allowed energy bands–forbidden zones–

UNIT – III: DEVICE BUILDING BLOCKS

Homo and Heterojunctions – Depletion Region – Current–Voltage Characteristics – Junction Breakdown – Transient Behavior and Noise – Terminal Functions – Heterojunctions – Formation of barriers – Current Transport Processes – Measurement of Barrier Height – Device Structures – Ideal MIS Capacitor – Silicon MOS Capacitor

UNIT – IV: TRANSISTORS AND POWER DEVICES

The Basic Principle of Operation – Simplified Transistor Current Relations– The Modes of Operation – Amplification with Bipolar Transistors –Static Characteristics – Microwave Characteristics – Device Scaling and Short–Channel Effects – Nonvolatile Memory Devices – JFETs, MESFETs, and MODFETs –Tunnel Devices – IMPATT devices – Real–Space–Transfer Devices.

UNIT – V: OPTICAL DEVICES

Optical Absorption –Photon Absorption Coefficient – Electron–Hole Pair Generation Rate – Emission processes –Photoluminescence and Electroluminescence –Basic Transitions – Luminescent Efficiency – Materials –Solar Cells – The PN Junction Solar Cell – Conversion Efficiency and Solar concentration– Non–uniform Absorption Effects – Amorphous Silicon Solar Cells – Tandem cells– Photodetectors– Photoconductors–phototransistors

TEXT BOOKS

1. Donald A. Neamen, *Semiconductor Physics and Devices – Basic Principles,* 3rd edition, *McGraw–Hill Higher– Education 2003.*
2. S M Sze, *Physics of Semiconductor Devices,* 2nd edition, John Wiley & Sons, Inc 2007.

REFERENCES

1. Peter YU, *Fundamentals of Semiconductors: Physics and Materials Properties* (Graduate Texts in Physics), 4th edition,2010.
2. Jacques I Pankove, *Optical Processes in Semiconductors* 2nd edition, Dover Books on Physics, 2010.

COURSE CODE	COURSE TITLE	L	T	P	Total	C
PHY1865	CORE BASED PROJECT	0	0	8	8	4

Project Work Evaluation

Internal Assessment: 50 Marks

Assessment Tool	Marks
First Review (Abstract)	10
Second Review	10
Final Review	20
Attendance	10

External Examination: 50 Marks

Assessment Tool	Marks
Report and Presentation	10
Analysis	10
Findings and Conclusion	20
Viva-Voce	10

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18A1	ALLIED PHYSICS – I	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To understand the fundamentals of physics
2	To give the basic understanding of material properties
3	To educate and motivate the students in the field of science
4	To acquire knowledge on magnetism and dielectrics

UNIT - I: SIMPLE HARMONIC MOTION AND CIRCULAR MOTION

Time period – Amplitude – Phase – Spring mass system – Simple pendulum –Composition of two simple harmonic motions of equal periods in a straight line and at right angles – Lissajous figures – Damping force – Damped harmonic oscillator – Uniform circular motion – Acceleration of a particle in a circle – Centripetal and centrifugal forces – Banking on curved roads.

UNIT - II: PROPERTIES OF MATTER

Elasticity and plasticity – Elastic constants – Bending of beams – Young's modulus by non – Uniform bending – Torsion in a wire – Determination of rigidity modulus of torsion pendulum – Viscosity – Coefficient of viscosity – Stoke's law – terminal velocity – Surface tension – Molecular theory of surface tension – Excess pressure inside a drop and bubble.

UNIT - III: HEAT AND THERMODYNAMICS

Kinetic theory of gases – Basic postulates – Ideal gas laws – Van Der Waal's equation of states – Pressure of an ideal gas – Laws of thermodynamics – Entropy – change of entropy in reversible and irreversible processes – Low temperature – Joule – Kelvin effect – Theory and applications – Liquefaction of gases – Linde's process – Adiabatic demagnetization.

UNIT - IV: ELECTRICITY AND MAGNETISM

Electric charge – Conservation of charge – Permittivity – Coulomb's law – Electric field – Electric potential – Gauss's law and its applications – Conductors – Dielectrics – Electric Current – Ohm's law – Magnetic induction – Permeability – Susceptibility – Magnetic field due to a current carrying conductor – Biot Savart's law – Field along the axis of a coil – Force on a conductor carrying current in a magnetic field – Ampere's circuital law – Faraday's law – Gradient – Curl and Divergence – EM waves.

UNIT - V: GEOMETRICAL OPTICS

Light and Optics – Fermat's principle – Laws of reflection and refraction – Total internal reflection and its illustrations – Mirrors and lenses – Lens formula – Refraction through a prism – Combination of two prisms to produce dispersion without deviation and deviation without dispersion – Defects of images – Coma distortion – Spherical and chromatic aberration in lenses.

TEXT BOOKS

1. Resnick R. and Halliday D., *Fundamentals of Physics*, Wiley Publication, 8th Edition, 2011.
2. Sundaravelusamy A., *Allied Physics I*, Priya Publications, 2009.

REFERENCES

1. Naik P.V., *Principles of Physics*, PHI Learning Pvt. Ltd, 2006.
2. John Thiruvadigal D., Ponnusamy S., Sudha L. and Krishnamohan M., *Physics for Technologists*, Vibrant Publication, 2013.
3. Rajam J. B., *Physics for Technologists*, S. Chand, 1981.
4. Brijilal and Subramanian, *Elements of Properties of Matter*, S. Chand Limited, 2014 (Reprint).

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18A2	ALLIED PHYSICS LABORATORY–I		0	4	4	2

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To acquire basic understanding of laboratory techniques
2	To educate the basics of instrumentation, data acquisition and interpretation of results
3	To educate and motivate the students in the field of science
4	To allow the students to acquire knowledge of fundamentals of optics

List of Experiments:

1. Determination of Young's Modulus– Uniform bending Method
2. Determination of Young's Modulus– Non Uniform bending Method
3. Determination of Rigidity Modulus of a wire – Torsional pendulum
4. Determination of thermal conductivity of a bad conductor using Lee's disc method
5. Calibration of Voltmeter using potentiometer
6. Calibration of Ammeter using potentiometer
7. Determination of magnetic susceptibility using Quincke's Method
8. Determination of dispersive power of a prism using spectrometer
9. Determination of Cauchy's constant using spectrometer

TEXT BOOKS

1. C.H. Bernard and C.D. Epp, John, *Laboratory Experiments in College Physics,* Wiley and Sons, Inc., 1995.
2. F.A. Jenkins and H.E. White, *Fundamentals of Optics*, 4th Ed., McGraw–Hill Book Co., 1981.

REFERENCES

1. G. L. Squires, *Practical Physics*, Fourth edition, Cambridge University Press, 2001.
2. D. Halliday, R. Resnick and J. Walker, *Fundamentals of Physics*, 6th Ed., John Wiley and Sons, Inc., 2001.
3. F.A. Jenkins and H.E. White, *Fundamentals of Optics*, 4th Ed., Reprint McGraw–Hill Book Co., 2007.
4. GeetaSanon, B. Sc., *Practical Physics*, 1st Edition. R. Chand & Co, 2007.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18A3	ALLIED PHYSICS – II	4	0	0	4	4

INSTRUCTIONAL OBJECTIVES: At the end of this course the learner is expected:	
1	To understand the fundamentals of physics
2	To emphasize the significance of Green technology and its applications
3	To understand the structural, optical, nuclear and electronic properties of solids
4	To acquire knowledge on elementary ideas of integrated circuits

UNIT - I: RENEWABLE ENERGY PHYSICS

Sources of conventional energy – Need for non – Conventional energy – Resources – Solar energy – Solar cells and its applications – Wind energy – Generation and applications – Bio mass energy – Generation and applications – Geothermal energy – Generation – Applications – Tidal energy – Generation and applications.

UNIT - II: MODERN PHYSICS

Atomic structure – Alpha, beta and gamma radiation – Law of radioactive decay – Decay constant – Half life – Mean life – Nuclear energy – Mass defect – Binding energy – Fission and fusion – Biological effects of radiation – Black body radiation – Planck's quantum hypothesis – Photoelectric effect – Compton effect – De Broglie equation – Uncertainty principle.

UNIT - III: WAVE AND FIBRE OPTICS

Wave nature of light – Huygens's principle – Interference – Young's double slit experiment – Coherence – Interference from thin films – Michelson's interferometer. Diffraction – Wave theory of light – Single slit experiment – Diffraction grating – Polarization – Fiber optics – Propagation of light in optical fiber – Acceptance angle – Numerical aperture – Attenuation – Types of optical fibers and its Applications.

UNIT - IV: CRYSTAL PHYSICS

Space lattice – Basis – Unit Cell – Lattice parameters – Two dimensional and three dimensional Bravais lattices and Crystal systems – Cubic crystal system – Crystal symmetry – Reciprocal lattice and its importance – Density and atomic packing fraction – Directions – Planes and Miller indices – Interplanar distance – Hexagonal Closely Packed (HCP) structure – Crystal imperfections – X ray diffraction – Laue method – Single crystal and powder diffraction.

UNIT - V: ELECTRONICS

Basic Electronics – P and N type semiconductors – Junction Diode and their characteristics – Half wave – Full wave rectifiers – Voltage regulations – Zener diode – Junction transistor – PNP – Digital electronics – AND, OR, NOT gates – NAND and NOR as universal building Blocks – Boolean algebra – Laws of Boolean algebra – De Morgan's theorem, basics of integrated circuit (IC).

TEXT BOOKS

1. Kittel C., *Introduction to Solid State Physics*, 8th Edition, Wiley Eastern Ltd, 2005.
2. Malvino and Leach, *Digital Principles & their Applications*, Tata McGraw Hill, 2010.

REFERENCES

1. Jha A.K., *Textbook of Applied Physics*, International Publishing House Pvt. Ltd, 2011.
2. Mansi Karkare and RajniBahuguna, *Applied Physics*, Volume – II International Publishing House Pvt. Ltd, 2010.
3. Tasneem Abbasi, Abbasi S. A, *Renewable Energy Sources: Their Impact on Global Warming and Pollution*, PHI Learning Pvt. Ltd. 2013.
4. Thyagarajan K. and Ajay Ghatak, *Introduction to Fiber Optics*, Cambridge, University Press, 1998.

COURSE CODE	COURSE TITLE	L	T	P	TOTAL	C
PHY18A4	ALLIED PHYSICS LABORATORY–II	0	0	4	4	2

INSTRUCTIONAL OBJECTIVES:
At the end of this course the learner is expected:

1	To familiarized with the concept of material properties
2	To educate the basics of instrumentation, data acquisition and analysis
3	To understand the optical and electronic properties of solids through experimentations
4	To understand the instrumentation of electronics experiments

List of Experiments:

1. Study the I–V Characteristic of a Solar Cell
2. Determination of wire thickness using air wedge experiment.
3. Study of attenuation and propagation characteristics of optical fiber cable
4. Band gap determination using Post Office Box – Specific resistance

5. Band gap determination using Four Probe Method.
6. Dielectric constant Measurement
7. Hall effect– Hall coefficient determination
8. Determination of regulation properties of a given power supply using a integrated circuit (IC)
9. Construction of AND, OR, NOT gates using diodes, resistors and Transistors

TEXT BOOKS

1. S.O. Kasap, *Principles of Electronic Materials and Devices*, Tata McGraw Hill Edition, 2002
2. Thiruvadigal, J. D., Ponnusamy, S. and C.P.Kala and Krishna Mohan.M., *Materials Science*, Vibrant Publications, 2012.

REFERENCES

1. C.Ouseph, K.Rangarajan,*A Text Book of Practical Physics*, Volume I,II,S.Viswanathan Publishers,1997
2. Chauhan and Singh, *Advanced Practical Physics*, Revised Edition, PragatiPrakashan, 1985.
3. Van Vlack, L.H., *Material Science for Engineers*, 6th Edition, .Addison Wesley, 1985
4. Callister, Jr. W.D., *Materials Science and Engineering: An Introduction*, Seventh Edition, 2007.