CURRICULUM & SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

FOR

BACHELOR OF SCIENCE (B.Sc. HONS.)

(3 Year Undergraduate Degree Program)

IN

PHYSICS

[w. e. f. 2020-21]

FACULTY OF SCIENCE AND HUMANITIES

SRM UNIVERSITY DELHI-NCR, SONEPAT

Plot No.39, Rajiv Gandhi Education City, P.S. Rai, Sonepat

Haryana-131029

SRM UNIVERSITY DELHI-NCR, SONEPAT (HARYANA)

VISION

- To create a diverse community campus that inspires freedom and innovation.
- Strengthen Excellence in educational & skill development processes
- Continue to build productive international alliances
- Explore optimal development opportunities available to students and faculty
- Cultivate an exciting and rigorous research environment

MISSION

SRM University Haryana aims to emerge as a leading World Class Institution that creates and disseminates knowledge upholding the highest standards of instruction in Engineering & Technology, Science & Humanities, Commerce, Management, Hotel Management & Medicine & Health Science. Along with academic excellence, our curriculum imparts integrity and social sensitivity so that our graduates may best serve the Nation and the World.

DEPARTMENT OF PHYSICS

VISION

1. Build a holistic, comprehensive and personalized learning environment so that the necessities of every individual student are taken care of.

2. Offer a contemporary and comprehensive skill-based curriculum at all levels.

3. Grow as an international level centre for research and innovation in both basic and applied areas of Physics.

4. Develop a direct lab-to-industry industry relationship so that discoveries, at least in the applied areas of physics, can be smoothly converted to technology for the betterment of the society.

5. Strive to become a centre of excellence for comprehensive teaching, learning and cutting-edge research in Physics.

6. And above all, to build an academic ambience where 'knowledge is free' of all bounds, innovative and creative ideas are encouraged, and talents are nurtured to realize their full potential.

MISSION

Our mission is to lend a helping hand to the students in their pursuit of this enormous field of knowledge. We aim to imbibe the right kind of skills and aptitude in students which will not only help them to build a career in physics but as a human being as a whole.

1. We aim to offer a balanced blending of comprehensive training in the core areas of physics along with the cutting-edge recent topics of physics.
2. We tried to keep a balance between the theoretical courses and experimental courses with an emphasis on problem-solving. This will help the students to develop fundamental concepts, verify them in the lab and thereby discourage the rote-learning.
3. Our motto is to prepare a student with the fundamental concepts of physics as well as the skills required to apply them so that they can go on to become a professional physicist in future.
4. Overall, we intend to equip a student with the right aptitude and skills so that they can go on to become a professional Physicist in future.
5. Additionally, we also intends to inculcate skills like logical thinking, quantitative argumentation, and capability of analyzing a large amount of information (or data) in the students so that even those, who are not going to build a career as a professional physicist, will benefit both professionally and also as a human being.

PROGRAM REQUIREMENT

General Education Requirements: Applied Science and Humanities (ASH)

Basic Science and Engineering Requirements: Fundamental Sciences (FS) through regular/online mode

Disciplinary Requirements comprising of:

PHYSICS DEPARTIMENT Core courses (through regular/online mode)

PHYSICS DEPARTIMENT Discipline Specific Electives (through regular/online mode)

CHEMISTRY, MATHEMATICS, COMPUTER SCIENCE Generic Electives (regular/online)

Practical and Research component:

1. Regular Practical.
2. Minor and Major Project

SEMESTER-I

Code	Category	Course	L	T	P	C
Theory						
20BSPH101	Core Course	Mechanics & General Properties of Matter	3	1	0	4
20BSPH103		Mathematical Physics I	3	1	0	4
20GECH101/ 20GECH103	Generic Elective theory	Physical Chemistry/Inorganic & General Organic Chemistry	4	0	0	4
20GEMH101/ 20GEPH103		Mathematics/ Introduction to FOTRAN	4 4	2 0	0 0	6 4
20AEC101	Ability Enhancement	Communicative English	2	0	0	2
20SEC101	Skill Enhancement	Soft Skills	2	0	0	2
Practical						
20BSPH105	Core Lab	Physics Lab-I	0	0	4	2
20GECH105/ 20GECH107	Generic Elective Lab	Physical Chemistry Lab/ Inorganic & General Organic Chemistry Lab	0	0	4	2
20GEPH105	Generic Elective Lab	FOTRAN Programming Lab	0	0	2	2
Total			18	4	08	26
Total Contact Hours			30			26

SEMESTER-II

Code	Category	Course	L	T	P	C
Theory						
20BSPH202	Core Course	Electricity & Magnetism	3	1	0	4
20BSPH204		Waves & Oscillations	3	1	0	4
20GECS202/ 20GEMH203	Generic Elective Theory	Introduction to C++ Programming (OOP)/ Numerical Techniques	4	0	0	4
20GEPH202/ 20GEMH206		Computational Physics/ Introduction to Mat lab	4 4	2 0	0 0	6 4
20AEC202	Ability Enhancement Compulsory Course	Environmental Studies	2	0	0	2
20SEC202	Skill Enhancement Compulsory Course	Progressive English	2	0	0	2
Practical						
20BSPH206	Core Lab	Physics Lab-II	0	0	4	2
20GECS204	Generic Elective Lab	C++ Programming Lab	0	0	4	2
20GEMH208	Generic Elective Lab	Mat Lab Programming Lab	0	0	4	2
Total			18	2	12	26
Total Contact Hours			32			26

SEMESTER-III

Code	Category	Course	L	T	P	C
Theory						
20BSPH307	Core Course	Optics	3	1	0	4
20BSPH309		Thermal Physics	3	1	0	4
20BSPH311		Analogue Electronics	4	0	0	4
20BSPH313		Mathematical Physics II	4	0	0	4
20BSPH315		Elements of Classical Mechanics	3	1	0	4
Practical						
20BSPH317	Core Lab	Physics Lab-III	0	0	4	2
Total			17	3	4	22
Total Contact Hours			24			22

SEMESTER-IV

Code	Category	Course	L	T	P	C
Theory						
20BSPH408	Core Course	Digital Electronics	3	1	0	4
20BSPH410		Electromagnetic Theory	4	0	0	4
20BSPH412		Quantum Mechanics I	4	0	0	4
20BSPH414		Fundamentals of Statistical Mechanics	4	0	0	4
20BSPH416		Condensed Matter Physics I	3	1	0	4
Practical						
20BSPH418	Core Lab	Physics Lab-IV	0	0	4	2
Total			18	2	4	22
Total Contact Hours			24			22

SEMESTER-V

Code	Category	Course	L	T	P	C
Theory						
20BSPH519	Core Courses	Quantum Mechanics II	3	1	0	4
20BSPH521		Atomic & Molecular Physics	3	1	0	4
20BSPH523		Nuclear Physics	3	1	0	4
DSE-I	Discipline Specific Elective (DSE) Courses	Any two of the following: - Physics of Materials (20DEPH501) - Biophysics (20DEPH503) - Atmospheric Physics(20DEPH505) - Fiber optics (20DEPH507) - Astronomy & Astrophysics (20DEPH509)	4	0	0	4
DSE-II			4	0	0	4
Practical						
20BSPH525	Core Lab	Physics Lab-V	0	0	4	2
Total			17	3	4	22
Total Contact Hours			24			22

SEMESTER-VI

Code	Category	Course	L	T	P	C
Theory						
20BSPH620	Core Course	Laser Physics	4	0	0	4
20BSPH622		Condensed Matter Physics II	4	0	0	4
DSE-III	Discipline Specific Elective (DSE) Course	Any two of the following: - Physics at Nano scale (20DEPH602) - Radiation Physics(20DEPH604) - Renewable Energy Physics(20DEPH606) - Semiconductor Physics(20DEPH608) - Medical Physics(20DEPH610) - Experimental Techniques(20DEPH612)	4	0	0	4
DSE-IV			4	0	0	4
20BSPH142	Project	Project	0	0	12	6
Total			16	0	12	22
Total Contact Hours			28			22

SUMMARY OF CREDITS

Category	I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem	Total	%
CORE	10	10	22	22	14	8	86	61.4
GENERIC ELECTIVE	12	12	-	-	-	-	24	17.1
DISCIPLINE SPECIFIC ELECTIVE	-	-	-	--	8	8	16	11.4
ABILITY ENHANCEMENT	2	2	--	--	-	-	4	2.9
SKILL ENHANCEMENT	2	2	-	-	-	-	4	2.9
PROECT	-	-	-	-	-	6	6	4.3
TOTAL	26	26	22	22	22	22	140	

EVALUATION SCHEME

INTERNAL EVALUATION (THEORY)

Assessment	Internal Assessment				Assignment/Presentation/ Class participation	Total
	UNIT-1	UNIT-II	UNIT-III	UNIT-IV		
Marks	10	10	10	10	10	50

INTERNAL EVALUATION (PRACTICAL)

Assessment	Daily Assessment/Observation	Programs performed during Lab hours	Programs performed during Internal practical Examinations	Viva- Voce	Total
Marks	10	15	15	10	50

EXTERNAL EVALUATION (THEORY)

Assessment	End Semester Examination	Total
Marks	100	Will be scaled in 50

EXTERNAL EVALUATION (PRACTICAL)

Assessment	Record File	Programs performed during External Practical Examinations	Written Work	Viva- Voce	Total
Marks	15	15	10	10	50

PROGRAM OBJECTIVE

B.Sc. Physics (Hons.) is the first degree in the formal training of Physics. The main objective of this course is to introduce the students with the fundamental concepts of physics and skills to apply them in real life and prepare them for more advanced courses.

1. To equip students with the fundamental concepts of Physics such as mechanics, optics, electricity, Magnetism, Thermodynamics etc and skill to apply them in addressing the practical and heuristic issues.
2. To make students familiar with the broad overview of the advanced topics and recent developments in the subject.
3. To promote curiosity about the subject and aptitude to systematically pursue the new ideas.
4. To imbibe the ability of logical thinking, reasoning and quantitative analysis.

PROGRAM OUTCOME

1. Knowledge about fundamental concepts of physics like mechanics, optics, electricity and magnetism, thermodynamics and ability to apply them.
2. Basic familiarity with the modern concepts such as quantum mechanics, statistical mechanics, modern physics etc.
3. Ability of quantitative analysis and overall scientific temperament

LIST OF GENERIC ELECTIVES

Code	Category	Course	L	T	P	C
Generic Elective-I						
20GECH101	Generic elective	Physical Chemistry	4	0	0	4
20GECH103	Generic elective	Inorganic & General Organic Chemistry	4	0	0	4
Generic Elective-II						
20GEMH101	Generic elective	Mathematics	4	2	0	6
20GEPH104	Generic elective	Introduction to FOTRAN	4	0	0	4
20GEPH106	Generic elective	FORTRAN PROGRAMMING LAB	0	0	4	2
Generic Elective-III						
20GECH105	Generic elective Lab	Physical Chemistry Lab	0	0	4	2
20GECH107	Generic elective Lab	Inorganic & General Organic Chemistry Lab	0	0	4	2
Generic Elective –IV						
20GECS202	Generic elective	Introduction to C++ Programming (OOP)	4	0	0	4
20GECS204	Generic elective Lab	C++ Programming Lab	0	0	4	2
20GEMH203	Generic elective	NUMERICAL TECHNIQUES	4	2	0	6
Generic Elective –V						
20GEPH202	Generic elective	Computational Physics	4	2	0	6
20GEMH206	Generic elective	Introduction to Mat lab	4	0	0	4
20GEMH208		Mat Lab Programming Lab	0	0	4	2

LIST OF DISCIPLINE SELECTIVE ELECTIVES

Code	Category	Course	L	T	P	C
Discipline Selective Elective-I & II						
20DEPH501	DSE-I	Physics of Materials	4	0	0	4
20DEPH503		Biophysics	4	0	0	4
20DEPH505	DSE-II	Atmospheric Physics	4	0	0	4
20DEPH507		Fiber optics	4	0	0	4
20DEPH509		Astronomy & Astrophysics	4	0	0	4
Discipline Selective Elective-III & IV						
20DEPH602	DSE-III	Physics at Nano scale	4	0	0	4
20DEPH604		Radiation Physics	4	0	0	4
20DEPH606		Renewable Energy Physics	4	0	0	4
20DEPH608	DSE-IV	Semiconductor Physics	4	0	0	4
20DEPH610		Medical Physics	4	0	0	4
20DEPH612		Experimental Techniques	4	0	0	4

		L	T	P	C
20BSPH101	**MECHANICS & GENERAL PROPERTIES OF MATTER**	**4**	**0**	**0**	**4**
Core Subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To introduce and define reference frames, and center of mass.
2. To make the students able to understand the dynamics of rigid body
3. To introduce the ideas of general relativity and demonstrate its relevance to modern astrophysics
4. To develop the basic knowledge about mechanical properties of matter.

UNIT	Course contents	Contact Hours
Unit-I	**Fundamentals of dynamics:** Review of Newton's law of motion: concept of Inertial frame, Force & mass. Galilean transformations; Galilean invariance. Work & Potential energy. Conservative and non-conservative forces. Stable, unstable and neutral equilibrium. Work done by non-conservative forces. Principle of conservation of Energy and momentum. Rocket motion. Non-inertial frame and fictitious forces. Uniformly rotating frame. Centrifugal force & Coriolis force. Laws of Physics in a laboratory on the surface of the earth.	9
Unit-II	**Central Force field and gravitation:** Equation of motion, Conservation of energy, Determination of orbit from force law, Determination of force law from orbit equation, Kepler's law, Newton's law of gravitation, Satellite in circular orbit, Geosynchronous orbit, Basic idea of global positioning system (GPS), motion of a projectile in gravitational field, Motion in an inverse square field.	9
Unit-III	**System of Particles**: Discrete and continuous systems, Center of mass and center of gravity, Motion of center of mass, Elastic and inelastic collisions, Centre of Mass frame and Laboratory frames.	9
Unit-IV	**Plane motion of Rigid bodies:** Translations and rotations, Euler's theorem, Instantaneous axis of rotation, General motion of rigid body, Chasle's theorem, Plane motion of rigid bodies, Moment of Inertia, Radius of gyration, Parallel axis theorem, Perpendicular axis theorem, Calculation of moment of inertia for rectangular, cylindrical and spherical bodies, Motion of a rigid body about a fixed axis, Compound pendulum, General plane motion of a rigid body, Instantaneous center, Space and body centrodes.	9
Unit-V	**General properties of matter**: Hook's law, Elastic constants, Relation between Elastic constants. Determination of Young Modulus of rectangular beam by Uniform & Non-Uniform Bending. Twisting couple of a cylinder	9

LEARNING OUTCOME:

1. The ability to explain different reference frames.
2. Understanding of the concept and motion of rigid body.
3. A broad and up-to-date knowledge of the basic ideas, and outstanding problems in relativity.
4. Understand the relation between mass and energy.
5. The ability to calculate mechanical properties of matter.

Learning Resources	
Text Book	1. Introduction to Theoretical Mechanics, Murry R Spiegel, Tata McGrwa-Hill. 2. Introduction to Classical Mechanics, R. G. Takawale, P. S. Puranik, Tata McGraw Hill.

	3. An Introduction to Mechanics, D. Kleppner and R. J. Kolenkow, Tata McGraw Hill. 4. Mechanics,D.S.Mathur, S. Chand.

		L	T	P	C
20BSPH103	**MATHEMATICAL PHYSICS I**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquire general knowledge in advanced Mathematics and Physics.
2. To introduce higher mathematics like beta, gamma functions used in physics problems.
3. To introduce first order and second order differential equations and their applications.
4. To develop the vector analogy for differentiation and integration.
5. To introduce Cartesian, spherical and cylindrical coordinate system.

UNIT	Course contents	Contact Hours
Unit-I	**CALCULUS:**Plotting and properties of linear, quadratic, polynomials, trigonometric, inverse, exponential, logarithmic and modulus functions. Limits, continuity and derivatives. Infinite sequences and series, convergence and divergence, conditional and absolute convergence, ratio test for convergence. Taylor's series, Binomial series. First order differential equations: Euler method, Variable separation method. Exact and inexact differential equations and integrating factor. Applications in Physical Problems. Second order differential equations: Homogeneous equation with constant coefficients. Wronskian and general solutions, Particular Integral, variation method. Applications in Physical problems.	9
Unit-II	**BETA, GAMMA AND DIRAC DELTA FUNCTIONS:** Beta and Gamma Functions and Relation between them. Expression of Integrals in terms of Gamma Functions. Euler integrals, Evaluation of $\Gamma(1/2)$, recurrence relation for gamma functions, various forms of beta functions, reduction of definite integrals to gamma functions. Dirac delta function and properties.	9
Unit-III	**VECTOR ANALYSIS:** Directional derivatives and normal derivative. Laplacian operators. Gradient of a scalar field and its geometrical interpretation. Divergence and curl of a vector field. Vector identities. Vector Integration: Ordinary Integrals of Vectors. Multiple integrals. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems (no rigorous proofs).	9
Unit-IV	**ORTHOGONAL CURVILINEAR COORDINATES:** Orthogonal Curvilinear Coordinates. Spherical and Cylindrical Coordinate Systems. Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.	9
Unit-V	**INTRODUCTION TO PROBABILITY:**Independent random variables: Sample space and Probability distribution functions; binomial, Gaussian, and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.	9

LEARNING OUTCOME:

1. Gain good knowledge on basic methods of mathematical physics to apply for physical systems.
2. Become familiar to statistical distribution functions.
3. Understand the Beta and gamma functions approach.
4. Understand the differential equation applications to physics problems
5. Appreciates the physics behind the vector differentiation, vector integrations and its analogy.

Learning Resources	
Text Book	1. Mathematical Methods for Physicists, G. B. Arfken, H.J. Weber, and F. E. Harris, Assoc. Press. & Mathematical Physics, P. K. Chattopadhyay. 2. Mathematical Methods in Physical Sciences, Boas.

	3. Mathematics for Physicists and Engineers, Pipes. 4. Mathematical Methods for Physics, J. Mathews and R. L. Walker, Addison-Wesley. 5. Mathematical Physics, H. K. Dass and R. Verma, S. Chand.				
		L	**T**	**P**	**C**
20BSPH202	**ELECTRICITY & MAGNETISM**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To introduce the fundamental concepts and principles of electrostatics, magnetostatics, electromagnetism and Maxwell"s equations, and EM waves.
2. To introduce differential vector analysis in the context of electromagnetism.
3. To develop the ability of students to apply Maxwell"s equations in free space.
4. To develop the concepts of field theories in Physics using electromagnetism as an example.
5. To introduce light as an electromagnetic wave.

UNIT	Course contents	Contact Hours
Unit-I	**ELECTROSTATICS:** Coulomb's law. Superposition principle, Electric field: Electric field lines. Electric flux. Gauss' Law with simple applications. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Electric Field and Potential of a dipole. Force and Torque on a dipole. Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Method of Images and its application to (1) Plane Infinite Sheet and (2) Sphere.	9
Unit-II	**DIELECTRIC PROPERTIES OF MATTER:** Dielectric Properties of Matter: Electric Field in matter. Polarization, Polarization Charges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector **D**. Relations between **E**, **P** and **D**. Gauss' Law in dielectrics.	9
Unit-III	**MAGNETOSTATICS** Lorentz force law, Biot-Savart's Law and its applications, Force between two straight current carrying wires, Ampere's Circuital Law and its applications, Curl and Divergence of the magnetic field, Magnetic vector potential.Potential and field due to a magnetic dipole, Magnetic dipole moment, Force and torque on a magnetic dipole. Magnetic fields inside matter, magnetization, Bound currents, The magnetic intensity **H**. Linear media. Magnetic susceptibility and Permeability,Relation between **B**, **H**, **M**.	9
Unit-IV	**ELECTROMAGNETICINDUCTION**: Electromotive force; electromagnetic induction, Faraday's Law, Lenz's Law. MutualInductance and Self-Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field.	9
Unit-V	**CIRCUIT THEORY:** Series and parallel LCR circuit: Resonance, quality factor & band width, Ideal constant-voltage and constant-current Sources. Kirchhoff"s Current Law &Kirchhoff"s Voltage Law. Mesh & Node Analysis. Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity Theorem, Maximum Power Transfer theorem	9

LEARNING OUTCOME:

1. Demonstrate a good knowledge of the laws of electricity and magnetism
2. Apply differential vector analysis to electromagnetism.
3. Demonstrate simple knowledge and understanding of how the presence of matter affects electrostatics and magnetostatics, and the ability to solve simple problems in these situations.
4. Demonstrate knowledge and understanding of how the laws are altered in the case of non-static electric and magnetic fields and the ability to solve simple problems in these situations

Learning Resources

Text Book	1. Introduction to Electrodynamics, D. J. Griffiths, Prentice Hall. 2. Electricity and Magnetism, E. M. Purcell, and D. J. Morin, Cambridge University Press. 3. Electromagnetics, B B Laud, New Age International Publishers. 4. Electricty and Magnetism,D. Chattopadhay and P. C. Rakshit, New Central Book Agency (P) Ltd. 5. Fundamentals of Electric Circuit Theory, D. Chattopadhay and P. C. Rakshit, S. Chand.

		L	T	P	C
20BSPH204	**WAVE & OSCILLATON**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquire the knowledge of different harmonic oscillators and giving electrical and mechanical analogous of the oscillators.
2. To familiarize the damping nature of oscillators and its applications in LCR circuits.
3. To introduce coupled oscillators and consequences of energy exchange between them.
4. To acquire the fundamental properties of wave and its application in mechanical waves.

UNIT	Course contents	Contact Hours
Unit-I	**FREE OSCILLATIONS:** Conditions for oscillatory motion, Equation of simple harmonic motion (SHM). Kinematics of SHM. Examples of Free Vibration- Simple & Compound pendulum. LC- Circuit & energy considerations. Mass spring system-Horizontal, Vertical oscillations. Two springs-mass systems. Superpositions of two perpendicular oscillators (Lissajous Figures), Simple numerical examples	9
Unit-II	**DAMPED OSCILLATIONS AND FORCED OSCILLATIONS:** Equation of Motion of a Damped Oscillator and its Solutions, Heavy Damping, Critical Damping, Weak Damping; Characterizing Weak Damping: Logarithmic Decrement; Relaxation Time, Quality Factor; LCR-circuit; Differential Equation of an Undamped Forced Oscillator and its Solution; Differential Equation of a Weakly Damped Forced Oscillator and its Solutions.	9
Unit-III	**COUPLED OSCILLATIONS:** Equation of Motion of a Coupled Oscillator comprising Two Oscillators and its Solution; Normal Coordinates and Normal Modes; Modulation and Energy Exchange in Coupled Oscillator; Oscillations of Coupled Pendulums; Forced Oscillations of Coupled Oscillators; Longitudinal Oscillations of N Coupled Masses.	9
Unit-IV	**BASIC CONCEPTS OF WAVE MOTION:** Formation of a Wave; Graphical Representation of Wave Motion, Relation between Wave Velocity, Frequency and Wavelength; Mathematical Description of Wave Motion: Phase and Phase Difference, Phase Velocity, Energy Transported by Progressive Waves, Intensity and the Inverse Square Law; One-dimensional Wave Equation: Waves on a Stretched String. Doppler effect.	9
Unit-V	**SUPERPOSITION OF WAVE:** Principle of Superposition and Linearity, Phenomena arising from superposition of Waves- Interference & Diffraction, Beats and Stationary waves. Analytical Treatment of Interference and Beats. Distinction between Stationary Interference & Beats. Simple Numericals. Applications of Beats. Standing waves on a string of fixed length. Modes of Vibrations.	9

LEARNING OUTCOME: (Specific learning outcome must be mentioned)

1. Solves harmonic oscillator problems in mechanical and electric circuits.
2. Understands the damped harmonic oscillators and can construct the wave equation related to it.
3. Become familiar with coupled harmonic oscillators
4. Able to apply superimposition principle in mechanical and sound wave applications.

Learning Resources						
Text Book	1. Waves and Oscillations,N. Subrahmanyam, Brij Lal 2. Waves, Oscillation & Acoustics, S. L.Kakani& C.Hemrajani 3. The Physics of Waves and Oscillations, N. Bajaj 4. Waves and Oscillations: A Prelude to Quantum Mechanics, Walter Fox Smith 5. Oscillations and Waves: An Introduction, Richard Fitzpatrick					
		L	**T**	**P**	**C**	
20BSPH307	**OPTICS**	**3**	**1**	**0**	**4**	
Core subject	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To introduce the fundamental concepts and principles of wave phenomena.
2. To highlight the many diverse areas of physics in which an understanding of waves is crucial.
3. To introduce the concepts of interference, diffraction and polarization.
4. To make aware the students about Optical fiber communication and sensors.

UNIT	Course contents	Contact Hours
Unit-I	**INTERFERENCE:** Huygen's wave theory, Superposition principle, Conditions for sustained interference, Interference by division of Wavefront - Young's double slit experiment, Fresnel's Biprism, Lloyd's mirror, Interference by division of amplitude - Interference in thin parallel and wedge-shaped films. Cosine law, reflecting and non-reflecting applications of thin film, Newton's ring. Interference by multiple reflections in plane parallel films, Interferometer - Mach-Zender, Michelson and Fabry Perot interferometer.	9
Unit-II	**DIFFRACTION:** Fraunhofer diffraction- Single slit; Double Slit. Multiple slits and Diffraction grating and its resolving power, Diffraction at Circular aperture, Rayleigh Criterion. Fresnel Diffraction: Half-period zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis.	9
Unit-III	**POLARIZATION:** Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering, Malus Law, Polarization by double refraction and Huygen's theory, Nicol prism, wave plates (Quarter, Half & Full), Production and analysis of circularly and elliptically polarized light. Optical activity, Fresnel's theory of optical activity, Laurent's Half shade Polarimeter, Photoelasticity and Polariscope.	9
Unit-IV	**FIBER OTICS:** Optical Fiber: Principles-Physical structure and types, Modes, Single mode and multimode fibers, Step Index and Graded Index-Refractive index profiles, Numerical aperture and V-number. Attenuation in optical fibers, Pulse dispersion and bit rates, Optical fiber communication system.	9
Unit-V	**FIBER OPTICS SENSORS AND HOLOGRAPHY:** Basics of optical sensors, Types of fiber optic sensors (Intensity based, wavelength modulation, Phase modulation and Polarization modulation), Applications- Fiber optics Current Sensor, temperature sensor, pressure sensor, Magnetic and electric field sensor, Elementary concepts of Spectroscopy based sensors, Photonic crystal fiber sensors. Basic principle and theory of Holography: coherence, resolution, Types of holograms, white light reflection hologram, application of holography in microscopy, interferometry, and character recognition	9

LEARNING OUTCOME:

1. Understand the fundamental principles underlying wave phenomena.
2. Understand inteference and diffraction effects.
3. Understand linear and circular polarization, Optical activity and Photoelasticity.
4. Understand Fiber optics and optical fiber communication.
5. Apply Fourier techniques and understand their link to diffraction patterns.
6. Understand the basic principles of optical sensors.

Learning Resources

Text Book	1. Optics, A. Ghatak, McGraw-Hill. & Geometrical and Physical Optics, Longhurst. 2. Introduction to Modern Optics, G. R. Fowels. 3. A textbook of Optics, N. Subrahmanyam, Brijlal and M. N. Avadhanulu. 4. Introduction to Fiber Optics, A. Ghatak, and K. Thyagarajan, Cambridge University Press. 5. Optical Fiber Sensor Technology: Chemical and Environmental Sensing, K. T. V. Grattan& B. T. Meggitt, 6. Fundamentals of Photonics, Bahaa E. A. Saleh , Malvin Carl Tech.

		L	T	P	C
20BSPH309	**THERMAL PHYSICS**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

To make the student familiar with

1. The concepts of thermal physics & the zeroth, first and second laws of thermodynamics
2. Heat engines & the kinetic theory of gasses
3. Entropy & the basis of statistical mechanics.

UNIT	Course contents	Hours
Unit-I	**KINETIC THEORY OF GASES** Maxwell-Boltzmann distribution Law of distribution of velocities in an ideal gas and its experimental verification, Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases; mono-atomic and diatomic gases. Mean Free Path. Collision Probability. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance	9
Unit-II	**REAL GAS.** Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Van der Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling.	9
Unit-III	**LAWS OF THERMODYNAMIC** Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law andinternal energy, conversion of heat into work, Various Thermodynamic Processes, Applications of First Law: General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes. Compressibility and Expansion Coefficients. Second law: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Kelvin-Planck and Clausius Statements and their Equivalence. Carnot's Theorem. Applications of Second Law of Thermodynamics: Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale.	9
Unit-IV	**ENTROPY** Entropy: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Temperature–Entropy diagrams for Carnot's Cycle. Third Law ofThermodynamics. Unattainability of Absolute Zero.	9
Unit-V	**MAXWELL EQUATIONS** Thermodynamic functions: Internal Energy, Enthalpy, Helmholtz function, Gibb's function, Derivation of Maxwell Relationsand applications: Joule-Thompson Effect, First and second order Phase Transitions with examples, Clausius-Clapeyron Equation and Ehrenfest equations, Expression for (CP and CV). T-dS equations.	9

LEARNING OUTCOME: (Specific learning outcome must be mentioned)

1. To calculate the heat flow into and work done by a system and how that is constrained by the first law of thermodynamics
2. Relate the second law of thermodynamics to the operation of heat engines, particularly the Carnot engine
3. Understand the kinetic theory of gases and calculate properties of gases including the heat capacity and mean free path
4. Use the theory of equi-partition to relate the structure of the molecules to the measured heat capacity
5. Understand the basis of entropy and relate this to the second law of thermodynamics and calculate entropy changes

6. Be able to link the microscopic view of a system to its macroscopic state variables be able to derive and use Maxwell's equations.

Learning Resources	
Text Book	1. Heat and Thermodynamics, R. H. Dittmanand M.W. Zemansky,7th Ed., McGraw-Hill. 2. Introduction to Statistical Physics, K Huang, CRC Press. 3. Heat Thermodynamics &Statistical Physics, B. Lal, N. Subrahmanyam, and P. S. Hemme, S. Chand. 4. Thermal Physics: A B Gupta & H. P. Roy, New Central Book Agency.

		L	**T**	**P**	**C**
20BSPH311	**ANALOGUE ELECTRONICS**	**4**	**0**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired basic knowledge on Analogue electronics and devices.
2. To develop understanding of diode application as rectifier, voltage regulator, LED, Photo diode and Solar Cell.
3. To introduce the transistor application as amplifier and oscillator.

UNIT	Course contents	Contact Hours
Unit-I	**SEMICONDUCTOR DIODES:** P and N type semiconductors. Energy Level Diagram, Conductivity and Mobility, Concept of Drift velocity. Barrier Formation in PN Junction Diode. Derivation for Barrier Potential, Barrier Width and Current for abrupt Junction. Equation of continuity, Current Flow Mechanism in Forward and Reverse Biased Diode, Static and Dynamic Resistance.	9
Unit-II	**TWO-TERMINAL DEVICES AND THEIR APPLICATIONS:** (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.	9
Unit-III	**BIPOLAR JUNCTION TRANSISTORS:** n-p-n and p-n-p Transistors. I-V characteristics of CB and CE Configurations. Active, Cutoff and Saturation Regions. Current gains α and β. Relations between α and β. Load Line analysis of Transistors. DC Load line and Q-point. Physical Mechanism of Current Flow. Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. h-parameter Equivalent Circuit. Analysis of single-stage CE amplifier using hybrid Model. Input & output Impedance. Current, Voltage and Power gains. Class A, B & C Amplifiers**.**	9
Unit-IV	**TRANSISTOR APPLICATOIN AS AMPLIFIER AND OSCILLATOR** Couple Amplifier -Two stageRC-coupled amplifier and its frequency response, Feedback in Amplifiers - Positive and Negative Feedback. Effect of negative feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise, Sinusoidal Oscillators:Barkhausen's Criterion for self-sustained oscillations. RC Phase shift oscillator, determination of Frequency. Hartley & Colpitts oscillators.	9
Unit-V	**OPERATIONAL AMPLIFIERS** Characteristics of an Ideal and Practical Op-Amp (IC 741), Open-loop and closed loop Gain, Frequency response, CMRR, slew rate and concept of Virtual ground. Applications of Op-Amps: (1) Inverting and non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Comparator and Zero crossing detector, (7) Log amplifier (8) Wein bridge oscillator.	9

LEARNING OUTCOME: (Specific learning outcome must be mentioned)

1. N- and P- type semiconductors, mobility, drift velocity, fabrication of P-N junctions; Application of PN junction for different type of rectifiers and voltage regulators.
2. NPN and PNP basic biasing configurations namely common base, common emitter and common collector, and also about current and voltage gain.
3. Biasing and equivalent circuits coupled amplifiers and feedback in amplifiers and oscillators.
4. To characterize various devices namely PN junction diodes, LEDs, Zener diode, solar cells, PNP and NPN transistors. Also construct amplifiers and oscillators using discrete components. Demonstrate inverting and non-inverting amplifiers using op-amps.

Learning Resources

Text Book	1. Principle of Digital Electronics: Malvino and Leach. 2. Electronic Devices: T.L. Floyd. 3. Digital Principles and Applications: A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw 4. Integrated Electronics: J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill 5. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India 6. OP-Amps and Linear Integrated Circuit: R. A. Gayakwad, 4th edition, 2000, Prentice Hall 7. Electronics Fundamental and Application: Chattopadhyay and Rakshit.

		L	T	P	C
20BSPH313	**MATHEMATICAL PHYSICS II**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired general knowledge in advanced Mathematics and Physics and to introduce matrix approach on transformations and Eigen value problems.
2. To introduce special functions including Legendre, Bessel, Hermite and Laguerre.
3. To develop the second order partial differential equations.
4. To introduce complex variable approach and Cauchy theorem.
5. To introduce Fourier transformation..

UNIT	Course contents	Contact Hours
Unit-I	**MATRICES AND LINEAR VECTOR SPACE:**Matrices and their algebra; Transpose, adjoint, conjugate and inverse of a matrix; Hermitian, orthogonal, and unitary matrices; Vector spaces and subspaces, Linear dependence and independence, Basis and Dimensions, linear operators, Matrix representation, Inner product, Orthogonality, Schmidt orthogonalization procedure, Unitary transformations, Similarity transformation; Eigenvalue and eigenvector, Caley Hamilton theorem; diagonalization of matrices.	9
Unit-II	**SPECIAL FUNCTIONS:** Second order differential equation: singular points, Series solution, Frobenius method. Legendre, Bessel, Hermite and Laguerre Differential Equations. Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions ($J_0(x)$ and $J_1(x)$) and Orthogonality	9
Unit-III	**SECOND ORDER PARTIAL DIFFERENTIAL EQUATIONS:**Solution by the method of separation of variables: Laplace's equation and its solution in Cartesian, spherical polar (axially symmetric problems), and cylindrical polar (`infinite cylinder' problems) coordinate systems. Poisson's equation and its solution; Solution of heat flow equation, Variable linear flow, Variable heat flow in an infinite bar, Two-dimensional heat flow, Heat flow in a circular plate.	9
Unit-IV	**COMPLEX VARIABLES** Complex numbers and their algebra; De Moivre's theorem, roots of complex numbers; Analytic function, Cauchy-Riemann equations , Harmonic functions; Taylor & Laurent series; simply and multiply connected regions, singular points, poles, residues, calculation of residues, The Residues Theorem; Cauchy integral theorem , Cauchy integral Formula, Complex line integral, evaluation of complex integrals	9
Unit-V	**FOURIER SERIES AND INTEGRAL TRANSFORM:** Fourier series, Dirichlet conditions, Expansion of periodic functions in Fourier series, Sine and Cosine form, Complex form of Fourier series, Fourier Integral theorem. Physical applications of Fourier series analysis: Square waves, Half wave and full wave rectifier. Fourier Transform (FT), Examples: FT of Gaussian, trigonometric and finite wave trains. Properties of FT, Fourier convolution theorem, Laplace Transform, Properties of Laplace transforms, Laplace convolution transforms, Inverse Laplace transforms, Application to differential equation: heat flow.	9

LEARNING OUTCOME: (Specific learning outcome must be mentioned)

1. Gains good knowledge on higher mathematics applicable to physics systems.
2. Become familiar to special functions and understand the Laplace's equations and its applications.
3. Understand the complex variable and Cauchy theorem.
4. Understand the partial differential equation and its applications to physics problems

5. Gets familiar to Fourier transformation and appreciates its applications to physics problems such as full wave and half wave rectifiers.

Learning Resources						
Text Book	1. Mathematical Methods for Physicists: Arfken and Weber. 2. Mathematical Physics: P. K. Chattopadhyay. 3. Mathematical Methods in Physical Sciences: Boas. 4. Mathematics for Physicists and Engineers: Pipes. 5. Mathematical physics, Rajput, Pragati prakashan.					
		L	**T**	**P**	**C**	
20BSPH315	**ELEMENTS OF CLASSICAL MECHANICS**	**3**	**1**	**0**	**4**	
Core subject	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To introduce the concept of constraints, Lagrangian.
2. To make the students able to understand the mechanics of system of particles.
3. To develop the understanding of scattering theory.

UNIT	Course contents	Contact Hours
Unit-I	**SPACE MOTION OF RIGID BODY** Pure rotation, Motion of a rigid body about a fixed axis, Angular momentum and kinetic energy about a point, Moment of Inertia tensor, principle axis of inertia, Angular momentum and kinetic energy about principal axis of inertia, Ellipsoid of Inertia, Euler's equation of motion, Euler angles, Motion of a spinning top, Precision of the equinoxes and satellite orbits.	9
Unit-II	**FLUID DYNAMICS** Kinematics of Moving Fluids: Idea of compressible and incompressible fluids, Equation of continuity; streamlineand turbulent flow, Reynold's number. Euler's Equation. The special case of fluid statics $\vec{F} = \vec{\nabla}P$. Simpleapplications (e.g: Pascal's law and Archimedes principle). Bernoulli's Theorem.	9
Unit-III	**LANGRANGIAN AND HAMILTONIAN FORMULATION** Limitations of Newtonian formulation; Constraints, degrees of freedom, generalized coordinates, configuration space; D' Alembert's principle of virtual work and Lagrange's equation. Cyclic coordinates,Simple applications. Legendre Transformation, Hamilton's equations of motion, Simple applications.	9
Unit-IV	**CANONICAL TRANSFORMATION AND POISSON'S BRACKET** Generating function, condition for Canonical transformation and problems, Definitions,Identities; Poisson's Bracket, Jacobi identity	9
Unit-V	**SPECIAL THEORY OF RELATIVITY** Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. Transformation of Energy and Momentum	9

LEARNING OUTCOME:

1. Students able to understand the mechanics of system of particles.
2. Understanding of the system of particles.
3. A broad and up-to-date knowledge of the Lagrangian and Hamiltonian formalism.
4. Understand motion in central field and scattering theory.

Learning Resources	
Text	1. Introduction to Classical Mechanics: R. G. Takawale, P. S. Puranik, Tata McGraw Hill

Book	Publishing Company Ltd. 2. Classical Mechanics, N. C. Rana, P. S. Joag, Tata McGraw Hill Publishing company Ltd. 3. Principles of mechanics: J. L. Synge, B. A. Griffith, TataMcGraw Hill Publishing company Ltd. 4. Classical Mechanics: H. Goldstein, C. Poole and J. Safko, Addison Wesley. 5. An Introduction to Mechanics: D. Kleppner and R. J. Kolenkow, Tata McGraw Hill Publishing company Ltd. 6. Introduction to Special Relativity: R. Resnik, Wiley. **7.** Classical Mechanics: A course of lectures: A. K. Raychaudhuri, Oxford University Press

		L	T	P	C
20BSPH408	**DIGITAL ELECTRONICS**	**4**	**0**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired basic knowledge on digital electronics.
2. To develop understanding of Boolen algebra and its implication in digital electronics.
3. To provide a basic idea about memory including RAM, ROM by choosing Flip Flop, multivibrators, counters as building blocks.
4. To introduce microprocessor and assembly language programming with special reference to Intel μP 8085.

UNIT	Course contents	Hours
Unit-I	**INTRODUCTION TO CRO** Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.	9
Unit-II	**DIGITAL CIRCUITS** Difference between Analog and Digital Circuits. Examples of linear and digital ICs, Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.	9
Unit-III	**BOOLEAN ALGEBRA** De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean Algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map. Binary Addition. Binary Subtraction using 2's Complement Method. Half Adders and Full Adders and Subtractors, 4-bit binary Adder-Subtractor.	9
Unit-IV	**FLIP FLOP, TIMERS, REGISTERS AND MULTIPLEXER** Sequential Circuits -SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JKFlip-Flop. Timers - IC 555: block diagram and applications: Astablemultivibrator and Monostable multivibrator. Shift registers - Serial-in-Serial-out, Serial-in-Parallel-out, Parallel-in-Serial-out and Parallel-in- Parallel-out Shift Registers (only up to 4 bits). Counters - Ring Counter. Asynchronous counters, Decade Counter. Synchronous Counter. Computer Organization- Input/output Devices. Data storage (idea of RAM and ROM). Computer memory. Memory organization and addressing. Memory Interfacing. Memory Map.Data processing circuits - Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders	9
Unit-V	**INTEL 8085 MICROPROCESSOR ARCHITECTURE** Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU. Memory. Stack memory. Timing and Control circuitry. Timing states. Instruction cycle, Timing diagram of MOV and MVI.	9

LEARNING OUTCOME:

1. Basic working of an oscilloscope including its different components and to employ the same to study different wave forms and to measure voltage, current, frequency and phase.
2. About analog systems and digital systems and their differences, fundamental logic gates, combinational as well as sequential and number systems.
3. Synthesis of Boolean functions, simplification and construction of digital circuits by employing Boolean algebra.
4. Sequential systems by choosing Flip-Flop as a building bock- construct multivibrators, counters to provide a basic idea about memory including RAM, ROM and also about memory organization.
5. Microprocessor and assembly language programming with special reference to Intel μP 8085.

Learning Resources

Text Book	1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw 2. Fundamentals of Digital Circuits, A. Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd. 3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill. 4. Digital Electronics, G K Kharate ,2010, Oxford University Press 5. Digital Systems: Principles & Applications,R.J.Tocci, N.S.Widmer, 2001, PHI Learning 6. Logic circuit design, Shimon P. Vingron, 2012, Springer. 7. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning. 8. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill 9. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.					
		L	**T**	**P**	**C**
20BSPH410	**ELECTROMAGNETIC THEORY**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquire the knowledge of electromagnetic wave propagation different homogeneous-isotropic as well as anisotropic unbounded and bounded media.
2. To make aware of reflection and refractions laws at different dielectric media.
3. To make aware of production and detection of different types of polarized em waves.
4. To introduce fiber optical waveguides..

UNIT	Course contents	Contact Hours
Unit-I	**MAXWELL'S EQUATION:**Equation of continuity, Maxwell's modification to Ampere's law, Displacement current, Maxwell's equation, Gauge Transformations: Lorentz and Coulomb Gauge. Wave Equations. Plane Waves in vacuum and isotropic dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density, Momentum Density and Angular Momentum Density.	9
Unit-II	**EM WAVE PROPAGATION IN UNBOUNDED MEDIA** Plane EM waves through vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.	9
Unit-III	**EM WAVE PROAGATION IN BOUNDED MEDIA** Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media. Laws of Reflection & Refraction. Fresnel's formulae for perpendicular & parallel polarization cases, Reflection & Transmission coefficients, Brewster's law. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence).	9
Unit-IV	**POLARISATION:** Description of Linear, Circular and Elliptical Polarization. Propagation of E.M. Waves in birefringent medium. Uniaxial and Biaxial Crystals. Light Propagation in Uniaxial Crystal. Double Refraction. Polarization by Double Refraction. Nicol Prism. Ordinary &extraordinary refractive indices. Phase Retardation Plates: Quarter-Wave and Half-Wave Plates. Production & analysis of polarized light. Babinet Compensator and its Uses. Optical Rotation. Biot's Laws for Rotatory Polarization. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.	9
Unit-V	**WAVEGUIDE** Planar optical wave guides. Planar dielectric wave guide. Condition of continuity at interface. Phase shift on total reflection. Eigenvalue equations. Phase and group velocity of guided waves. Field energy and Power transmission.	9

LEARNING OUTCOME: (Specific learning outcome must be mentioned)

1. Understanding of the EM propagations in free space, dielectric and metals.

2. Understanding the reflections, refraction and polarization of EM waves.
3. Apply the concepts of light propagation in optical fibers, light wave communication systems.

Learning Resources						
Text Book	1. Introduction to Electrodynamics, David J. Griffiths, 3rd Edn, Prentice Hall. 2. EM Waves and Fields, P. Lorrain and O. Corson. 3. Classical Electrodynamics, J.D. Jackson, 3rd Edn., 2010, Wiley 4. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill. 5. Optical Electronics, A.Ghatak, K. Thyagarajan, Cambridge University Press.					
		L	**T**	**P**	**C**	
20BSPH412	**QUANTUM MECHANICS I**	**3**	**1**	**0**	**4**	
Core subject	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To understand the classical and quantum approach of light matter interaction.
2. To familiarize the basics of micro size quantum particle properties.
3. To develop Schrödinger's wave equation for quantum mechanical particle and its application in 1-D harmonic oscillator.

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION TO QUANTUM PHYSICS:** Blackbody Radiation problem, Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle: Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle, Energy-time uncertainty principle- application to virtual particles and range of an interaction.	9
Unit-II	**MATHEMATICAL TOOLS OF QUANTUM MECHANICS:** Hilbert space & wave functions. Dirac notation, Hermitian operators, Commutator algebra, Measurements, Observables, and Uncertainty relations. Inverse & unitary operators. Matrix representation of Kets, Bras and Operators,Eigen values and Eigen vectors of an operators. Change of basis, Position and momentum representations	9
Unit-III	**WAVE MECHANICS:** Basic postulates of Quantum Mechanics. The state of a system-Probability density & Superposition principle. Time evolution of System's state,Time dependent Schrodinger equation and wave packets. Quantum to Classical Mechanics-Poisson brackets and commutators, The Ehrenfest Theorem. Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of wave-function, probabilities and normalization; Probability and probability current densities in one dimension	9
Unit-IV	**APPLICATIONS TO ONE-DIMENSIONAL PROBLEMS:** One Dimensional Motion- Bound & Unbound states, Mixed spectrum, Symmetric potentials & parity. One dimensional infinite square well - energy eigenvalues and eigenfunctions, normalization, stationary states; Quantum dot as an example. The finite square well potential,a step potential: tunneling in one dimension.The Harmonic Oscillator (by solving wave equation).	9
Unit-V	**APPLICATIONS TO HIGHER-DIMENSIONAL PROBLEMS** Separation of Variables, The Two-dimensional and three-dimensional Box potential, Rectangular and Cubic Potential box potential: concept of degeneracy. Three-dimensional isotropic harmonic oscillator (in cartesian coordinates).	9

LEARNING OUTCOME:

1. Understand the dual nature of light and matter.
2. Able to understand the details of quantum properties of micro size particles and quantum descriptions of its physical properties.
3. Able to apply quantum mechanical approach to solve simple 1D problem

Learning Resources	
Text Book	1. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition. 2. Quantum Mechanics-Concepts & Applications: N. Zettili

	3. Introduction to Quantum Mechanics: David J. Griffiths 4. Principles of Quantum Mechanics: I. S. Tyagi 5. Quantum Physics: S. Gasiorowicz. 6. Quantum Mechanics: B. H. Bransden and C. J. Joachain. 7. Quantum Physics of Atoms, Molecules, Nuclei and Solids: R. M. Eisberg and R. Resnick. 8. Quantum Mechanics: V. Devanathan. 6. Quantum Mechanics: C. S. Chaddha..

		L	T	P	C
20BSPH414	**FUNDAMENTALS OF STATISTICAL MECHANICS**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired basic knowledge of statistical mechanics.
2. To introduce concept of ensembles.
3. To understand classical and quantum mechanics.
4. To develop the understanding of statistical ensembles.

UNIT	Course contents	Contact Hours
Unit-I	**CLASSICAL STATISTICAL MECHANICS:** Macrostate& Microstate, Phase Space, Ergodic Hypothesis (statement only). Microcanonical ensemble, Postulate of equal a-priori probabilities. Boltzmann hypothesis: Entropy and Thermodynamic Probability. Canonical ensemble, Partition Function, Thermodynamic Functions of an Ideal Gas, Classical Entropy Expression, Gibbs Paradox. Equivalence of microcanonical and canonical ensemble. Sackur Tetrode equation, Law of Equipartition of Energy (with proof) Applications to Specific Heat and its Limitations. Thermodynamic Functions of a Two-Energy Level System. Negative Temperature. Grand canonical ensemble. Application of ideal gas using grand canonical ensemble. chemical potential	9
Unit-II	**SYSTEMS OF IDENTICAL PARTICLE:** Collection of non-interacting identical particles. Classical approach and quantum approach: distinguishability and indistinguishability. Occupation number and MB distribution, emergence of Boltzmann factor. Composite system postulate and symmetry postulate of quantum mechanics (for a pair of particles only). Bosons and Fermions. Symmetric and Antisymmetric wave functions. state counting for bosons and fermions.	9
Unit-III	**BOSE-EINSTEIN STATISTICS:** B-E distribution law. Thermodynamic functions of a strongly degenerate Bose Gas, Bose Einstein condensation and properties of liquid He IV (qualitative description only).	9
Unit-IV	**FERMI-DIRAC STATISTICS :** Fermi-DiracDistribution Law, Thermodynamic functions of a Completely and strongly Degenerate Fermi Gas, Fermi Energy, Electron gas in a Metal, Specific Heat of Metals, Relativistic Fermi gas, White Dwarf Stars, Chandrasekhar Mass Limit.	9
Unit-V	**RADIATION** Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution Law. Saha Ionization Formula. Rayleigh-Jean's Law. Ultraviolet Catastrophe. Planck's Quantum Postulates. Planck's Law of Blackbody Radiation: Experimental Verification. Deduction of (1) Wien's Distribution Law, (2) Rayleigh-Jeans Law, (3) Stefan-Boltzmann Law, (4) Wien's Displacement law from Planck's law.	9

LEARNING OUTCOME:

1. Gains basic knowledge of mathematical statistics.

2. Become familiar to classical statistical mechanics.
3. Understand the random walk problem.
4. Understand the Fermi Dirac and Bose Einstein Statistics.

Learning Resources						
Text Book	1. Fundamentals of Statistical and Thermal Physics, F. Reif, Waveland Press. 2. Statistical Mechanics, R.K. Pathria and P. D. Beale, Elsevier. 3. Statistical Mechanics, K. Huang,Wiley. **4.** Fundamental of Statistical Mechanics, B.B. Laud, New Age International Publishers					
		L	**T**	**P**	**C**	
20BSPH416	**Condensed Matter Physics I**	**3**	**1**	**0**	**4**	
Core subject	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To understand physical properties of solid state
2. To make the students to able to understand various crystal structures.
3. To understand use of X-ray diffraction in solid state physics
4. To develop the understanding of free electron theory and band theory.

UNIT	Course contents	Contact Hours
Unit-I	**THE CRYSTALLINE STATE** Lattice, Basis, Translational vectors, Primitive unit cell, Symmetry operations, Different types of lattices2D and 3D (Bravais lattices),Miller indices, Inter planer distances, SC, BCC and FCC structures, Packing fraction, Crystal structures NaCl, diamond, CsCl, ZnS, HCP, Concept of reciprocal lattice and its properties	9
Unit-II	**X-RAY DIFFRACTION** Introduction, Crystal as a grating, Bragg's law and Bragg's Diffraction condition indirect and reciprocal lattice Ewald's construction, Experimental methods of X-ray diffraction: Laue method, Rotating Crystal method, Powder (Debye Scherer) method, Analysis of cubic structure by powder method.	9
Unit-III	**LATTICE VIBRATIONS:** Dynamics of mono-atomic and diatomic linear chains, optical and acoustic modes, concept of phonons, inelastic scattering of photons and neutrons by phonons, density of states (one & Three dimensions) Einstein and Debye models of heat capacity, thermal expansion.	9
Unit-IV	**FREE ELECTRON THEORY AND BAND THEORY OF SOLIDS** Classical free electron theory, Quantum Free Electron model, Energy levels and Density of orbital in 1D and 3D, Bloch theorem (statement only), Nearly free electron model, Fermi energy, Fermi level.Kronig Penny model. Band Gaps. Conductors, Semiconductors and insulators. P and N type Semiconductors. Conductivity of Semiconductors, mobility, Hall Effect, Hall coefficient.	9
Unit-V	**IMPERFECTIONS IN SOLIDS** Types of defects, lattice defects in ionic crystals, colour centres, V-centre, F-centre, Luminescence, Dislocation, screw dislocation and dislocation ring, Frank-Read mechanism for the multiplication of dislocations, Dislocations and crystal growth, Diffusion and the Kirkendall effect..	9

LEARNING OUTCOME:

5. To calculate the heat flow into and work done by a system and how that is constrained by the first law of thermodynamics
6. Relate the second law of thermodynamics to the operation of heat engines, particularly the Carnot engine
7. Understand the kinetic theory of gases and calculate properties of gases including the heat capacity and mean free path
8. Use the theory of equi-partition to relate the structure of the molecules to the measured heat capacity
9. Understand the basis of entropy and relate this to the second law of thermodynamics and calculate entropy changes
10. Be able to link the microscopic view of a system to its macroscopic state variables
    be able to derive and use Maxwell's equations.

Learning Resources	
Text Book	1. Solid State Physics,S.O.Pillai, 3rdEdition, New Age International (P) Ltd, Publisher, (1999). 2. Solid State Physics,Kakani and Hemrajani, S. Chand Publication.

	3. Solid State Physics, Saxena, Gupta and Saxena, Pragati Prakation. 4. Introduction to Solid State Physics, Charles Kittel, John Wiley and Sons, 7Edition. 5. Solid State Physics, A.J.Dekker, Macmillan India Ltd, (1998). 6. Solid State Physics, R.K. Puri, V.K. Babbar, S. Chand Publication. 7. Problems in Solid State Physics, S.O. Pillai, New Age International (P) Ltd. 8. Solid State Physics,Palanyswamy. 9. Solid State Physics, David, Snoke, Pearson Publication.

		L	T	P	C
20BSPH519	**QUANTUM MECHANICS II**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To introduce the advance level of quantum mechanics.
2. To make the students able to understand the application of Schrödinger wave theory.
3. To develop the understanding of many electron system.

UNIT	Course contents	Contact Hours
Unit-I	**ANGULAR MOMENTUM:** Rotation and Orbital angular momentum, Commutation relations, Matrix and geometrical representation of angular momentum.Eigenvalues andeigenfunctions of orbital angular momentum (spherical coordinate system): spherical harmonics	9
Unit-II	**GENERALISED ANGULAR MOMENTUM:** Stern-Gerlach experiment and concept of Spin, Generalized angular momentum, Matrix representations, Eigen values of $\vec{J^2}$and $\vec{J}_z$. Addition of Two Angular Momenta - Clebsch-Gordan Coefficients,Wigner-Ekrat theorem,Coupling of Orbital and Spin Angular Momenta with illustrations. Spin-orbit functions.	9
Unit-III	**THREE-DIMENSIONAL PROBLEM:** Three Dimensional Problems in Spherical Coordinates - Central potential. Separation of the Schrödinger equation in spherical polar coordinate, free particle, Solution of Radial Equations for Isotropic Harmonic Oscillator and Hydrogen Atom: Energy Levels, Radial wave functions and their properties.	9
Unit-IV	**SYMMETRY AND IDENTICAL PARTICLES:** Conservation laws and degeneracy associated with symmetries, Discrete symmetries: Parity and Time-reversal symmetry, Many –Particle Systems, Interchange symmetry, Systems of Distinguishable Non-interacting Particles, Identical Particlesin Classical & QuantumMechanics, Exchange degeneracy,Symmetric and Antisymmetric wave functions,Pauli's exclusion principle, connection with statistical mechanics, Systems of Identical Noninteracting Particles.	9
Unit-V	**PERTURBATION THEORY:** Time-Independent Nondegenerate Perturbation Theory - First and second order correction. Applications: Charged oscillator in an electric field, The Stark effect. Degenerate Perturbation Theory. Fine Structures and the Zeeman Effect.	9

LEARNING OUTCOME:

1. The ability to understand quantum mechanical operator.
2. Understanding of the bra and ket algebra of quantum mechanics.
3. A broad and up-to-date knowledge of the Schrödinger wave theory and their application.
4. Understand to deal with many electron systems.

Learning Resources	
Text Book	1. Quantum Mechanics-Concepts & Applications, N. Zettili 2. Introduction to Quantum Mechanics, David J. Griffiths 3. Principles of Quantum Mechanics, I. S. Tyagi & Quantum Physics, S. Gasiorowicz. 4. Quantum Mechanics, B. H. Bransden and C. J. Joachain. 5. Quantum Physics of Atoms, Molecules, Nuclei and Solids, R. M. Eisberg and R. Resnick. 6. Quantum Mechanics, V. Devanathan & Quantum Mechanics, C. S. Chaddha.

		L	T	P	C
20BSPH521	**ATOMIC & MOLECULAR PHYSICS**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To introduce atomic models and quantization concept
2. To introduce the spin-orbital and other electronic coupling schemes.
3. To acquired general knowledge of microwave spectroscopy and its application to diatomic molecule.
4. To familiarize about the infra-red and Raman spectroscopy.

UNIT	Course contents	Contact Hours
Unit-I	**ATOMIC PHYSICS AND QUANTUM NUMBERS:** Brief review of Bohr and Sommerfeld model of atom, Idea of discrete energy levels and electron spin: Fanck – Hertz and Stern – Gerlach experiments. Significance of four quantum numbers and concept of atomic orbitals. One valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular momentum, Larmor precession	9
Unit-II	**ELECTRONIC CONFIGURATION:** Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman effect. Two valence electron atoms: LS and JJ coupling schemes and resulting spectra.	9
Unit-III	**MICROWAVE SPECTROSCOPY:** Microwave spectroscopy: Diatomic molecule as rigid rotator; its energy level and spectra, Intensity of rotational lines, Diatomic molecule as non-rigid rotator. Isotope effect in rotational spectra.	9
Unit-IV	**INFRARED SPECTROSCOPY:** Diatomic molecules as harmonic and anharmonic oscillator, Diatomic molecule as vibrating rotator, Energy levels and spectrum, thermal distribution of quantum states, Isotope effect in vibration spectra..	9
Unit-V	**RAMAN SPECTROSCOPY:** Raman spectroscopy: Introduction, Pure rotational Raman spectra, Pure Vibrational Raman spectra, Raman rotational vibrational spectra, Surface enhanced Raman scattering (SERS)- Chemical and Electromagnetic field enhancements	9

LEARNING OUTCOME:

1. Gains good knowledge on atomic models, quantum electronic properties.
2. Become familiar to electronic coupling interactions.
3. Able to apply microwave spectroscopy to understand the rotation spectra.
4. Understand the infrared and Raman spectroscopy and can analyze the vibration spectra of molecules.

Learning Resources	
Text	Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, R.Eisberg and R.

Book	Resnick. Introduction to Atomic Spectra, H.E. White. Modern Spectroscopy, J. Hollas. An introduction to Lasers – Theory and applications, M.N. Avadhanulu **5.** Atomic & Molecular Spectra: Laser, Raj Kumar.

		L	T	P	C
20BSPH523	**NUCLEAR PHYSICS**	**4**	**0**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired basic knowledge of nuclear properties.
2. To develop understanding of Radioactivity.
3. To introduce Meson theory of nuclear forces and stability of nucleus.
4. To introduce the working principle of particle accelerators and nuclear energy reactors.

UNIT	Course contents	Contact Hours
Unit-I	**NUCLEAR STRUCTURE:** Composition, charge, size, density of nucleus, Nuclear Angular momentum, Nuclear magnetic dipole moment, Electric quadrupole moment, parity and symmetry, Mass defect and Binding energy, packing fraction, classification of nuclei, stability of nuclei (N Vs Z Curve), Nature of nuclear force, Nuclear Models: Liquid Drop model. semi-empirical mass formula and binding energy. Nuclear Shell Model. Magic numbers.	9
Unit-II	**RADIOACTIVITY AND NUCLEAR REACTIONS:** Laws of radioactive decay, half-life, mean life, specific activity and its units, successive disintegration and equilibriums. (a) Alpha decay: basics of α-decay processes, theory of α-emission, Gamow factor, Geiger Nuttall law, α-decay spectroscopy. (b) β-decay: energy kinematics for β-decay, continuous spectrum, positron emission, electron capture, neutrino hypothesis. (c) Gamma decay: Gamma rays emission from the excited state of the nucleus & kinematics, internal conversion. Types of Reactions, units of related physical quantities, Conservation Laws, kinematics of reactions, Q-value, reaction rate, reaction cross section, Concept of compound and direct reaction, resonance reaction, Coulomb scattering (Rutherford scattering).	9
Unit-III	**PARTICLEACCELERATOR AND DETECTORS:** Introduction to particle Accelerators, Accelerator facility available in India, Different type of accelerators: Van-de Graaff generator, Linear accelerator, Cyclotron, Betatron, SynchrotronsClassification of Nuclear Detectors: Gas filled Detectors (G. M. counter), Solid state detectors, scintillation counter	9
Unit-IV	**NUCLEAR ENERGY:** Fission and fusion: mass deficit, relativity and generation of energy. Fission - nature of fragments and emission of neutrons. Chain reactions, critical mass, Nuclear reactor: basic components, homogeneous and heterogeneous reactors, power reactor, fast breeders, slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions driving stellar energy (brief qualitative discussions).	9
Unit-V	**ELEMENTARY PARTICLES:** Fundamental particles and their families. Fundamental particle-interactions and their basic features. Gellmann-Nishijima formula. Quark structure of hadrons. Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm. concept of quark model, color quantum number and gluons.	9

LEARNING OUTCOME:

1. Become familiar with nuclear structure and its fundamental properties.
2. Gains good knowledge on radioactive decay and its application.
3. Become familiar to construction and working of particle accelerators and ionization chambers.
4. Gets knowledge of energy generation in nuclear fission

Learning Resources	
Text Book	1. Nuclear Physics, S.N.Ghosal, S. Chand Publishing 2. Nuclear Physics, Irving Kaplan, Oxford & Publishing Co. Pvt. Ltd 3. Nuclear Physics, An Introduction, S.B. Patel, New Age International (P) Ltd. Publishers 4. Introduction to Nuclear Physics, H.A.Enge, Addition Wesley co. 5. The Atomic Nucleus, R.D.Evans, Tata McGraw Hill co. 6. Concepts of Nuclear Physics, B.L.Cohen, Tata McGraw Hill Co. 7. Schaum's Outline Series Modern Physics, R.Gautrearu, McGraw Hill co.

		L	T	P	C
20BSPH620	**LASER PHYSICS**	**3**	**1**	**0**	**4**
Core subject	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To develop understanding of laser generation conditions.
2. To get knowledge of different laser arrangements.
3. Laser applications in various fields.

UNIT	Course contents	Contact Hours
Unit-I	**PRINCIPLES OF LASER** Principles and characteristics of Laser-Directionality, Coherence, Intensity. Spatial coherence and temporal coherence. Light-matter interaction, basic theory of laser (absorption, spontaneous emission and stimulated emission), rate equation, Einstein Coefficients, Requirements of Lasing action, Population Inversion, Pumping methods, Gain & Threshold. Relation between Einstein Coefficients and their physical significance. Three & Four level Lasers.	9
Unit-II	**BASIC LASING SYSTEM** Laser components, Optical resonators, various types of resonators, evaluation of beam waist of such combination, longitudinal modes and transverse modes, Gaussian beams, single mode laser and tunable lasers. Pulsed laser, Q-Switching, Mode Locking, active and passive mode locking, line broadening mechanisms, thermal broadening, doplar broadening, collision broadening, broadening due to impurities in solids.	9
Unit-III	**DIFFERENT LASERS** Principle, construction and working of Ruby Laser, Nd:YAG laser, Helium Neon laser, Argon Laser, Nitrogen laser, Carbon dioxide (CO_2) laser, Dye laser, Excimer laser, Titanium-sapphire laser - Threshold condition for oscillations. Free electron laser. Homojunction and heterojunction semiconductor lasers	9
Unit-IV	**NON-LINEAR PROCESSES** Propagation of Electromagnetic Waves in Nonlinear medium. Second harmonic generation using non-linear optical methods. Self-Focusing, Phase matching condition, Frequency doubling, Optical mixing.	9
Unit-V	**APPLICATIONS OF LASERS** Optical tweezing, Cooling and Trapping of Atoms, Health Monitoring-Endoscopy, Clinical diagnostic. Military applications, Industrial applications. Laser based optical diagnostic techniques-Raman, Laser Induced Fluorescence, Laser Induced Breakdown Spectroscopy (LIBS).	9

LEARNING OUTCOME:

1. Gains good knowledge lasing action.

2. Become familiar to construction and working of different laser systems.
3. Gets knowledge of laser applications in various fields

Learning Resources						
Text Book	Laser Spectroscopy and Instrumentation, W. Demtroder. 2. Principles of Lasers, O. Svelto & 3. Laser Cooling and Trapping, P.N. Ghosh. 4.Frontiers in Atomic, Molecular and Optical Physics, S.P. Sengupta. 5. Laser Fundamentals, William T. Silfvast 6. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich.					
		L	**T**	**P**	**C**	
20BSPH622	**CONDENSED MATTER PHYSICS II**	**3**	**1**	**0**	**4**	
Core subject	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To understand the theory involved behind semiconductor physics
2. To make the students to able to understand different magnetic materials.
3. To develop the understanding of dielectric and ferroelectric materials.
4. To develop the understanding of superconducting materials.

UNIT	Course contents	Contact Hours
Unit-I	**SEMICONDUCTORS** Intrinsic & Extrinsic Semiconductors (*p* and *n*- type)- Expression for the Density of Electrons in Conduction Band & Holes in Conduction band, Fermi level Dependence on Temperature and Carrier Concentrations. Mobility in the intrinsic region. Impurity conductivity. Mobility in the presence of impurity atoms. Experimental Determination of Hall Coefficient, Mobility of *p* and *n*- type Semiconductors.	9
Unit-II	**MAGNETIC PROPERTIES OF MATTER** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia – and Paramagnetic Domains. Quantum Mechanical Treatment of Paramagnetism. Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains. Discussion of B-H Curve. Hysteresis and Energy Loss	9
Unit-III	**DIELECTRIC PROPERTIES OF MATERIALS** Polarization. Local Electric Field at an Atom. Depolarization Field. Electric Susceptibility. Polarizability. Clausius Mosotti Equation. Classical Theory of Electric Polarizability. Normal and Anomalous Dispersion. Cauchy and Sellmeir relations. Langevin-Debye equation. Complex Dielectric Constant. Optical Phenomena. Application: Plasma Oscillations, Plasma Frequency, Plasmons	9
Unit-IV	**FERROELECTRIC AND ANITFERROELCTRIC MATERIALS** Classification of ferroelectric crystals. Theory of barium titanate. The polarization catastrophe in ferroelectrics. Local field in the perovskite structure. Dielectric constants near the Curie point. Ferroelectric domains. Antiferroelectric crystals	9
Unit-V	**SUPERCONDUCTIVITY:** Experimental Results. Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London's Equation and Penetration Depth. Isotope effect. Superconductivity at high frequencies, susceptibility of a sphere and the particle size effect. Intermediate state and domain structure. Quantum theories of superconductivity.	9

LEARNING OUTCOME:

1. The ability to understand the behavior of dielectric and ferroelectric materials.
2. Understanding of the physics behind semiconductor materials
3. Understand the different magnetic behavior of materials.
4. Basic knowledge of the superconducting nature of the materials

Learning Resources	
Text Book	1. Introduction to Solid State Physics, C. Kittel, 7th Edition, John Wiley and Sons. 2. Solid State Physics, A.J.Dekker, Macmillan India Ltd.

	3. Solid State Physics, S.O.Pillai, 3rdEdition, New Age International (P) Ltd, Publisher, (1999). 4. Solid State Physics,Kakani and Hemrajani, S. Chand Publication. 5. Solid State Physics, R.K. Puri, V.K. Babbar, S. Chand Publication. 6. Problems in Solid State Physics, S.O. Pillai, New Age International (P) Ltd. 7. Solid State Physics,Palanyswamy. 8. Solid State Physics - David, Snoke, Pearson Publication.

Discipline Specific Elective (DSE) Courses

- Physics of Materials (20DEPH501)
- Biophysics (20DEPH503)
- Atmospheric Physics (20DEPH505)
- Fiber optics (20DEPH507)
- Astronomy & Astrophysics (20DEPH509)
- Physics at Nano-scale (20DEPH602)
- Radiation Physics (20DEPH604)
- Renewable Energy Physics (20DEPH606)
- Semiconductor Physics (20DEPH608)
- Medical Physics (20DEPH610)

		L	T	P	C
20DEPH501	**PHYSICS OF MATERIALS**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired knowledge of material science.
2. To understand single phase materials.
3. To understand ceramic materials.
4. To develop the understanding of defects and deformations in solids.
5. To introduce smart materials.

UNIT	Course contents	Contact Hours
Unit-I	**DEFECTS IN SOLIDS** Material Properties – Mechanical, Electrical and thermal, Impurities in solids, Solid solutions in metals, Rules of solid solubility, Imperfection in crystals, Defects in solids point, line, surface and volume.	9
Unit-II	**SINGLE PHASE METALS** Single phase alloys, Deformation, Elastic Deformation and Plastic Deformation, Mechanism of plastic Deformation by slip, Critical resolved shear stress (CRSS), Plastic deformation in poly crystalline materials.	9
Unit-III	**MOLECULAR PHASES** Introduction, Polymers, Polymerization, Molecular weight of polymers, Linear polymers addition and condensation, Cross linked polymer vulcanization of rubber	9
Unit-IV	**CERAMIC MATERIALS** Ceramic Phases, Classification of ceramic materials, Ceramic crystals (AX), Mechanical behavior of ceramics, Electromagnetic behavior of ceramics – a) Electric propertiesdielectrics, semiconductors, piezoelectric b) Magnetic Properties MagneticCeramics, hard and soft ferrites	9
Unit-V	**INTRODUCTION TO SMART MATERIALS** Definition of smart materials, Types and structure of smart materials, Properties of smartmaterials, Applications of smart materials.	9

LEARNING OUTCOME:

1. Gains good knowledge on defects in solids.
2. Become familiar to ceramic materials.
3. Understand the various mechanism of deformation.
4. Understand the differential material properties

Learning Resources	
Text Book	1. Elements of materials science and Engineering, I.H.Vanvlach, 4th Edition. 2. Materials science and Engineering, V. Raghvan. 3. Callister's Materials Science and Engineering, R. Balasubramaniam. 4. Materials Science, R.S.Sedha and R.S.Khurmi..

		L	T	P	C
20DEPH503	**BIOPHYSICS**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired general knowledge in bio physics.
2. To introduce DNA structures, generic codes.
3. To acquired knowledge of biosnstruments.
4. To introduce biometry.

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION OF BIOPHYSICS** Physical properties applied to biology- Surface tension, Viscosity, adsorption, diffusion, osmosis, dialysis and colloidsGenetic code- symmetry, DNA structure	9
Unit-II	**BIOPOTENTIALS:** Bioelectric signals: structure of neuron, resting potential, action Potential, Nernst equation Compound action potentials of the human body ECG, EEG, ERG, EOG (in brief) Transducers: Definition, types- resistive, capacitive and inductive transducers, LVDT, photo diode	9
Unit-III	**BIOINSTRUMENTS:** Basic principle, Construction and working of colorimeters, spectrophotometer, ECG machine, PH meter, Centrifuge measurement.	9
Unit-IV	**RADIATION BIOPHYSICS** Definition, Units of Radioactivity and radiation doses, X-Ray Crystallography as a method for a structure determination of biomolecules, Nuclear Magnetic Resonance (NMR).Nuclear detector (G M Counter)	9
Unit-V	**BIOMETRY AND ELECTRON MICROSCOPY** Biostatistics and Biometry, Definition and concept in brief.Electron microscope: Scanning Electron Microscope (SEM), Transmission Electron Microscopy (TEM)	9

LEARNING OUTCOME:

1. Understand the basics of bio physics.
2. Become familiar to bio instrumrnts.
3. Understand the electron microscope and biometry.
4. Understand the radiation biophysics

Learning Resources	
Text	1. Introduction to Biophysics - by P. Narayanan New Age P.

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

		L	T	P	C
20DEPH505	**ATMOSPHERIC PHYSICS**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired general knowledge in atmospheric science.
2. To introduce cloud microphysics and cloud chemistry.
3. To acquired knowledge of atmospheric instruments.
4. To introduce atmospheric optics.

UNIT	Course contents	Contact Hours
Unit-I	**PROPERTIES OF ATMOSPHERE** Structure and Composition of atmosphere. Different layers of atmosphere, Characteristics of gases, gas laws, temperature, atmospheric thermodynamics.	9
Unit-II	**OBSERVING THE ATMOSPHERE** Instrumentation- Temperature, Pressure and Humidity of atmosphere, Measurement of Temperature, Pressure and Humidity of atmosphere; Clouds and Precipitation: – Cloud types, Precipitation types, Measurement of precipitation; Cloud microphysics – Warm clouds, cold clouds and Rain making, lightning and cloud chemistry; Wind-measurement	9
Unit-III	**ATMOSPHERIC OPTICS AND RADIATION** Visibility - attenuation of light, turbidity – optical phenomena – rainbows – haloes – corona – glory – mirage – blue of the sky – colours at sunrise and sunset – atmospheric refraction, Radiation in the atmosphere – The spectrum, black body radiation, scattering.	9
Unit-IV	**ATMOSPHERIC EFFECTS AND ENERGY** The atmosphere as a heat Engine – Solar energy – The earth's Heat balance - Distribution of heat energy over the earth – temperature lag, Green house effect and its impact, Global warming.	9
Unit-V	**REMOTE SENSING** Air in motion and Remote sensing: General circulation, monsoons, weather disturbances in tropics, Reading weather maps. Remote Sensing– general principles, Radar and GPS (elementary ideas).	9

LEARNING OUTCOME:

1. Understand the structure of atmosphere.
2. Become familiar to various instrumentation in atmospheric science.
3. Understand the clouds and precipitation.
4. Understand the radar, GPS.

Learning Resources	
Text Book	1. Meteorology, Albert Miller Merril Physical Science Series 2. Atmospheric Science, An introductory survey, J M Wallace and P V Hobbs 3. Meteorology, Albert Miller Merril Physical Science Series 4. Meteorology, William Donn, McGraw Hill Book Company. 5. Introduction to the Atmosphere, H. Reihl, McGraw Hill Book Company. 6. Introduction to Meteorology, Franklyn W Cole, John Wiley & Sons, INC, New York, U.SA

		L	T	P	C
20DEPH507	**FIBER OPTICS**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired knowledge of fiber optics.
2. To introduce concept of coherence, dispersion etc.
3. To acquired knowledge of propagation characteristics of optical fiber.
4. To introduce fiber communication.

UNIT	Course contents	Contact Hours
Unit-I	**BASIC OPTICS:** Introduction: The fiber optics revolution. Plane, circularly and elliptically polarized wave. Reflection at a plane interface-Brewster angle and Total internal reflection. Two beam interference-Fiber optic Mach-Zehnder interferometer. Concept of coherence. Diffraction of Gaussian beam	9
Unit-II	**FUNDAMENTALS OF OPTICAL FIBER:** Optical Fiber: Principles-Physical structure, Wave guide parameter (V-Number), Optical Fiber Types: Multi mode and single mode optical fibers. Optical Fiber Profiles-Step Index & Parabolic Index, Concept of optical modes-Field Patterns of some low order guided modes, TE modes of a symmetric step index planar waveguide.	9
Unit-III	**DISPERSION IN OPTICAL FIBER:** Pulse Dispersion in Multimode Optical fiber-Ray & Material Dispersion in Step Index fiber, Pulse Dispersion in Singlemode Optical fiber-Intramodal Dispersion, Waveguide dispersion, Optical Fibers for dispersion compensation, Polarization mode Dispersion, Fiber Amplifiers	9
Unit-IV	**PROPAGATION CHARACTERISTICS OF OPTICAL FIBER** Propagation characteristics of a Step index fiber:Modal analysis for a step index fiber. Fractional modal power in the core. Single mode fibers- Gaussian approximation, splice loss. Propagation characteristics of a Graded index fiber: Modal analysis of a parabolic index fiber. The LP_{lm} modes.	9
Unit-V	**FIBER OPTICS COMMUNICATION & SENSORS** Communication requirements, Elementary ideas on semiconductor laser, diode laser. Principle of optical detection. Intrinsic & Extrinsic Sensors, Basic Optical Fiber Sensor Components-Isolators, Couplers, Modulators. Optical Fiber Sensor (OFS) based on principles: Fiber Braggs Grating, Evanescent Wave, Raman Spectroscopy	9

LEARNING OUTCOME:

1. Understand the basic optical fiber.
2. Become familiar to various instrumentation in atmospheric science.
3. Understand the dispersion of optical fiber.

4. Understand the fiber Brags grating and other communicating devices

Learning Resources						
Text Book	1. Fiber Optic Sensors, Principles and Applications: B. D. Gupta 2. Introduction to Fiber Optics, A. Ghatak and K.Thyagrajan, Cambridge University Press. 3. Fiber Optic Essentials, A. Ghatak and K.Thyagrajan. 4. Optical Fiber Sensors, Advanced Techniques and Applications, G. Rajan 5. Fiber Optics, Physics and Technology,F. Mitschke					
		L	**T**	**P**	**C**	
20DEPH509	**Astronomy & Astrophysics**	**5**	**1**	**0**	**6**	
Discipline Specific Elective course	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. Learning tools to study the universe, planetary systems, Stars
2. To gain a basic knowledge about the Universe – Galaxies, stars, planet
3. To gain basic knowledge about the birth history of the Universe.

UNIT	Course contents	Contact Hours
Unit-I	**Tools of Astronomy** (a) Astronomical Scales:Mass, length, time and magnitude scales in astronomy. (b)Basic concepts of positional astronomy:Celestial Sphere, Geometry of a Sphere, Spherical Triangle,Astronomical Coordinate Systems, Geographical Coordinate Systems, Horizon System, Equatorial System, Diurnal Motion of the Stars, Conversion of Coordinates. (c) Overview of Stellar spectroscopy: Interaction of light and matter fundamentals of radiative transfer (emission, absorption, radiative transferequation, mean free path, optical depth), thermal radiation and thermodynamic equilibrium (Kirchhoff's lawof thermal emission, Boltzmann and Saha equation, thermodynamics of black body radiation,concept of localthermodynamic equilibrium). (d) Observational tools for multi-wavelength astronomy (Brief overview):Telescope as a camera, optical telescopes (refracting and reflecting telescopes), radio telescopes, astronomical instruments and detectors, observations at other wavelengths (infrared, ultraviolet, X-ray and Gamma ray astronomy), all-sky surveys.	9
Unit-II	**Stars and stellar systems** (a)Properties of stars (distance, brightness, size, mass, temperature, luminosity). (b)Measurement of stellar parameters: distance parallax, Cepheid variables, nova and supernovae, red shift),stellar spectra, spectral lines, the Hertzsprung-Russell diagram, luminosity and radius, binary system and massdetermination, scaling relation on the Main Sequence. (c) Basic equation of stellar structure hydrostatic equilibrium and the virial theorem, radiative and convectiveenergy transport inside stars, nuclear energy production. Equation of state. (d) Formation and evolution of stars, star formation, pre-main-sequence collapse (gravitational instability andmass scales, collapse of spherical cloud,contraction onto the Main Sequence, Brown Dwarfs), evolution of high-massand low-mass stars (core and shell hydrogen burning, helium ignition), late-stage evolution of stars, evolution ofSun-like stars and solar system. (e) End stages of stars white dwarfs (electron-degeneracy pressure, mass-radius relation), neutron stars (masslimit of neutron stars, neutron stars observable as	9

	pulsars), black holes as end point of stellar evolution, supernovae.	
Unit-III	**TheSun and the Solar family:** The sun: Solar Parameters, Solar Photosphere, Solar Atmosphere, Chromosphere. Corona, Solar Activity, Basics of Solar Magneto-hydrodynamics. Helioseismology, The Solar System: Facts and Figures, Origin of the Solar System: TheNebular Model, Tidal Forces and Planetary Rings, Extra-Solar Planets.	9
Unit-IV	**Galaxies and the Universe** (a) Milky Way galaxy: components, morphology and kinematics of the Milky way, the galactic center, spiralarms. (b) Classification and morphology of galaxies - quiet and active galaxies, types of active galaxies, Active GalacticNuclei (AGN) and Quasars, accretion by supermassive black holes	9
Unit-V	**COSMOLOGY** (a) Newtonian cosmology, Olber's paradox, Hubble's law and the expanding Universe, scale factor and comovingcoordinate. (b) Standard cosmology, the Friedmann equations from Newtonian cosmology, fluid equation, equation ofstate for matter, dust etc. from basicthermodynamics, cosmological redshift, dark matter, dark energy and theaccelerating universe, tests and probes of Big Bang cosmology (the Cosmic Microwave Background, primordialnucleosynthesis).	9

LEARNING OUTCOME:

1. Familiarity with the tools required to study Astronomy
2. Basic knowledge about the composition of the universe
3. Basic knowledge about the birth history of the universe

Learning Resources	
Text Book	1. An Invitation to Astrophysics, T. Padmanabhan, World Scientic Publishing Co. 2. An Introduction to Modern Astrophysics, B.W. Carroll & D.A. Ostlie, Addison-Wesley Publishing Co. 3. Introductory Astronomy and Astrophysics, M. Zeilik and S.A. Gregory, 4th Edition, Saunders College Publishing. 4. Astrophysics in a Nutshell (Basic Astrophysics), Dan Maoz, Princeton University Press. 5. Foundations of Astrophysics, Barbara Ryden and Bradley M. Peterson, Addison Wesley. 6. Astrophysics for Physicists, Arnab Rai Choudhuri, Cambridge University Press. 7. Astronomy and Astrophysics, A. B. Bhattacharya, S. Joardar, R. Bhattacharya, Overseas Press (India) Pvt.Ltd. 8. Theoretical Astrophysics, Volume III: Galaxies and Cosmology, T. Padmanabhan, Cambridge University Press. 9. K.S. Krishnasamy, 'Astro Physics a modern perspective,' Reprint, New AgeInternational (p) Ltd, New Delhi,2002.

	10. BaidyanathBasu, 'An introduction to Astro physics', Second printing, Prentice - Hall of India Private limited, New Delhi,2001. 11. Textbook of Astronomy and Astrophysics with elements of cosmology, V.B. Bhatia, Narosa Publication..

		L	T	P	C
20DEPH602	**PHYSICS AT NANOSCALE**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired basic knowledge of nano science.
2. To introduce concept of quantum confinement effect.
3. To acquired knowledge of synthesis and characterization of nano materials.
4. To understand the physical properties of nano materials.

UNIT	Course contents	Contact Hours
Unit-I	**: INTRODUCTION TO NANO-MATERIALS** Introduction to nano-sized materials and structures, Brief history of nanomaterials and challenges in nanotechnology, Significance of nano-size and properties, classification of nanostructured materials	9
Unit-II	**METHODS OF SYNTHESIS OF NANO-MATERIALS** Bottom-up and Top-down approaches, Physical methods: High energy ball milling, Physical vapour deposition, sputter deposition. Chemical methods: colloidal method, co-precipitation and sol-gel method	9
Unit-III	**CHARACTERIZATION TECHNIQUES:** UV-Visible spectroscopy, X-ray diffraction, Scanning electron microscopy, Transmission electron microscopy, X –ray Photon Spectroscopy (XPS), Raman Spectroscopy	9
Unit-IV	**PROPERTIES AND APPLICATIONS OF NANO-MATERIALS** Mechanical, Electrical, Thermal, Optical, solubility, melting point and Magnetic properties. Applications: Nanoelectronics, Medical, Biological, Automobiles, Space, Defence, Sports, Cosmetics, Cloth industry etc.	9
Unit-V	**SPECIAL NANO-MATERIALS:** Carbon nano-tubes (CNTs)-Single and Multiwalled, Graphene, Quantum dots-Emission wavelength dependency of QD size,Brus Equation, Nanocrystalline ZnO and TiO2	9

LEARNING OUTCOME:

1. Understand about nano physics.
2. Become familiar to various instrumentation used in Nano technology.
3. Understand the quantum confinement and surface to volume ratio effect.
4. Understand the physical properties of nano materials

Learning Resources	
Text Book	1. Nanotechnology: Principles and Practices, Sulbha Kulkarni, Capital Publishing Co. New Delhi. 2. Introduction to nanotechnology, C. P. Poole Jr. and F. J. Ownes, Willey Publications. 3. Origin and development of nanotechnology, P. K. Sharma, Vista International Publishing house. 4. Nanostructure and nanomaterials synthesis, Properties and applications, G. Cao, Imperials College Press, London.

		L	T	P	C
20DEPH604	**RADIATION PHYSICS**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired basic knowledge of Radiation Physics.
2. To introduce X-ray, Gamma ray etc.
3. To acquired knowledge of low and high energy radiation.
4. To understand the radioactive isotopes.

UNIT	Course contents	Contact Hours
Unit-I	**LOW AND HIGH ENERGY RADIATION** Introduction to Microwave and Radio waves covering spectrum, power levels anddetection methods. Laboratory sources of infrared, visible and ultra- violet radiation withdetails of energy spectrum. Introduction to Cosmic radiation .Types of particles and their energies in cosmic rays. Basiclaboratory sources of electrons and ions up to 50 keV	9
Unit-II	**X-RAY RADIOGRAPHY** Principle and methods of generation of characteristics X-Rays. Interaction of X-Rays withmatter, attenuation coefficient.Methods for recording X-Ray radiograph using photographicplate. Modern digital methods for recording X-ray radiograph. Medical applications of X-rays	9
Unit-III	**RADIATION DETECTORS AND DOSIMETRY:** Working principle of ionization chamber and Scintillator detector, Units for radiationexposure, absorbed dose, Relative biological effective dose and dose equivalent. FrickeDosimeter.Personal dosimeters, Film badge dosimeters, thermo-luminescent dosimeter	9
Unit-IV	**RADIATION PROTECTION** Interaction of MeV energy electrons ,ions and gamma-rays with matter. Materials forradiation shielding. Radiation Protection and Safety rules as per the regulatory guidelines ofthe Government of India, Safety codes for handling radioactive sources.	9
Unit-V	**RADIOACTIVE ISOTOPES AND APPLICATIONS** Naturally occurring radioactive isotopes. Production of radioactive nuclides in nuclearreactors and by charged particle beams from accelerators. Measurement of radioactivity andlifetime of radioactive sources.Radioactive nuclei used in diagnostic applications. Applications of gamma-rays insterilization of medical instruments, Medication items and preservation of food.	9

LEARNING OUTCOME:

5. Understand about various kind of radiation Physics.

6. Become familiar to various instrumentation used in radiation detection.
7. Become familiar to various applications of radioactive materials.
5. Learn about radiation protection.

Learning Resources						
Text Book	1. Nuclear and Radiation Physics in Medicine. 2. Tony Key . World Scientific.2014 3. Radiation Protection and Health Science. 4. Marilyn E. Noz .World Scientific. 2007. 5. Introduction to radiation Protection: Grupen C. Springer. 2008.					
		L	**T**	**P**	**C**	
20DEPH604	**RADIATION PHYSICS**	**4**	**0**	**0**	**4**	
Discipline Specific Elective course	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To acquired basic knowledge of Radiation Physics.
2. To introduce X-ray, Gamma ray etc.
3. To acquired knowledge of low and high energy radiation.
4. To understand the radioactive isotopes.

UNIT	Course contents	Contact Hours
Unit-I	**LOW AND HIGH ENERGY RADIATION** Introduction to Microwave and Radio waves covering spectrum, power levels anddetection methods. Laboratory sources of infrared, visible and ultra- violet radiation withdetails of energy spectrum. Introduction to Cosmic radiation .Types of particles and their energies in cosmic rays. Basiclaboratory sources of electrons and ions up to 50 keV	9
Unit-II	**X-RAY RADIOGRAPHY** Principle and methods of generation of characteristics X-Rays. Interaction of X-Rays withmatter, attenuation coefficient.Methods for recording X-Ray radiograph using photographicplate. Modern digital methods for recording X-ray radiograph. Medical applications of X-rays	9
Unit-III	**RADIATION DETECTORS AND DOSIMETRY** Working principle of ionization chamber and Scintillator detector, Units for radiationexposure, absorbed dose, Relative biological effective dose and dose equivalent. FrickeDosimeter.Personal dosimeters, Film badge dosimeters, thermo-luminescent dosimeter	9
Unit-IV	**RADIATION PROTECTION** Interaction of MeV energy electrons ,ions and gamma-rays with matter. Materials forradiation shielding. Radiation Protection and Safety rules as per the regulatory guidelines ofthe Government of India, Safety codes for handling radioactive sources.	9
Unit-V	**RADIOACTIVE ISOTOPES AND APPLICATIONS** Naturally occurring radioactive isotopes. Production of radioactive nuclides in nuclearreactors and by charged particle beams from accelerators. Measurement of radioactivity andlifetime of radioactive sources.Radioactive nuclei used in diagnostic applications. Applications of gamma-rays insterilization of medical instruments, Medication items and preservation of food.	9

LEARNING OUTCOME:

1. Understand about various kind of radiation Physics.

2. Become familiar to various instrumentation used in radiation detection.
3. Become familiar to various applications of radioactive materials.
4. Learn about radiation protection.

Learning Resources						
Text Book	1. Nuclear and Radiation Physics in Medicine. 2. Tony Key . World Scientific.2014 3. Radiation Protection and Health Science. 4. Marilyn E. Noz .World Scientific. 2007. 5. Introduction to radiation Protection: Grupen C. Springer. 2008.					
		L	**T**	**P**	**C**	
20DEPH606	**RENEWABLE ENERGY PHYSICS**	**4**	**0**	**0**	**4**	
Discipline Specific Elective course	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To know about various sources of energy
2. To learn and appreciate the principles involved in non-conventional energy
3. To know the importance of Biomass for energy.

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION TO ENERGY SOURCES** Conventional and non-conventional sources of energy, Structure and characteristics of sun,Solar Constant, Electromagnetic energy spectrum, Solar radiations outside earth atmosphere, Solar radiation at the earth surface, problems	9
Unit-II	**PHOTOTHERMAL APPLICATIONS** Liquid flat plate collector, construction and working, Energy balance equation (without thermal analysis) ,Concentrating collectors, Advantage and disadvantage, Solar distillation, Solar drying, Solar cooker(box type), Solar water heating systems	9
Unit-III	**PHOTOVOLTAIC SYSTEMS** Introduction , Photovoltaic principle, Power output and conversion efficiency, Limitation to photovoltaic efficiency, Basic photovoltaic system for power Generation, Advantages and disadvantages, Types of solar cells, Application of solar photovoltaic systems	9
Unit-IV	**ENERGY FROM BIOMASS** Introduction , Bio -mass conversion technologies , Bio-gas generation Factors affecting bio-digestion (list of factors) , Working of biogas plant, Advantages and disadvantage of floating and fixed dome type plant, Bio-gas from plant wastes , Methods for obtaining energy from biomass , Thermal gasification of biomass, Working of downdraft gasifier , Advantages and disadvantages of biological conversion of solar energy.	9
Unit-V	**WIND ENERGY** Introduction, Classification and description of wind machines, Wind data	9

LEARNING OUTCOME:

1. Familiarity with various energy sources

2. To get an insight into the Physics involved in energy generations from natural resources
3. To relate principle of photoconductivity with Photovoltaic systems.

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

		L	**T**	**P**	**C**
20DEPH608	**SEMICONDUCTOR PHYSICS**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired deep knowledge in semiconductor physics.
2. To introduce concept of reciprocal space lattice.
3. To develop understanding of electrical and optical transport in semiconductors.
4. To understand band theory in solids.

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION AND ELECTRONIC STATES OF SEMICONDUCTORS** Introduction to solid state materials - crystal structure - Reciprocal lattice - Brillouin zone and rules for band (k - space) representation. Dynamics of electrons in periodic potential:Kronig - penny and nearly free electron models. Bandgaps in semiconductors - Holes and effective mass concept - Properties of conduction and valance bands	9
Unit-II	**FERMI DISTRIBUTION AND ENERGY** Fermi distribution and energy - Density of states - Valance and conduction band density of states - intrinsic carrier concentration - intrinsic Fermi level. Extrinsic semiconductors: n and p type doping - Densities of carriers in extrinsic semiconductors and their temperature dependence - extrinsic semiconductor Fermi energy level - Degenerate and non - degenerate semiconductors - Bandgap engineering.	9
Unit-III	**ELECTRICAL TRANSPORT** Scattering Mechanism: electron - electron and electron - phonon scattering. Macroscopic transport: Carrier transport by Diffusion - Carrier transport by Drift: Low field, High field and very high field (Impact ionization) - Einstein relation	9
Unit-IV	**OPTICAL TRANSPORT** Electron - hole pair generation and recombination: band to band (direct and indirect band gap transitions) and intra band (impurity related) transitions, free - carrier & phonon transitions. Excitons: Origin, electronic levels and properties Radiative and nonradiative recombination (Shockley - Read - Hall and Auger) processes. Carrier transport - continuity equations. Optical constants:Kramers - Kronig relations.	9
Unit-V	**RECENT ADVANCES** Processing of Semiconductor devices (Brief), p - n Semiconductor as device and Semiconductor junctions - Homo and hetero Junctions. Semiconductors Quantum structures, Density of states and excitons, Semiconductor photonic structures: 1D, 2D and 3D photonic crystals. Active and passive optoelectronic devices: performance and response enhancement (photo processes).	9

LEARNING OUTCOME:

1. Gains good knowledge on semiconductor physics.

2. Understand the reciprocal space and band theory.
3. Understand the concept of hole, effective mass and electronic transport
4. Appreciates the physics behind the p-n junction diode.

Learning Resources	
Text Book	The Physics of Semiconductors, K. F Brennan, Cambridge University Press. 2. Fundamentals of Semiconductors by Peter, Y Yu and Manuel Cardona,Springer. 3. Introduction to Solid State Physics, C. Kittel, 6th Ed., Willey. 4. Semiconductor Physics and Devices, D.A. Neamen, 3rdEd.,Tata McGraw-Hill. 5. Physics of Semiconductor Devices, S.M.Sze, John Willey, 2nd Ed., (1981).

		L	**T**	**P**	**C**
20DEPH610	**MEDICAL PHYSICS**	**4**	**0**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired basic knowledge of Medical Physics.
2. To learn basics of Medical Instrumentation.
3. To learn about elements of Radio Physics.

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION OF MEDICAL-PHYSICS** Definition and History of Medical-physics [Physical properties applied to biology- Surface tension, Viscosity, adsorption, diffusion, osmosis, dialysis and colloids] Protein structure (Primary, Secondary, Tertiary and Quaternary structure): Amino-acidsstructure (Specify types); Photosynthesis process; Genetic code- symmetry, DNA structure	9
Unit-II	**BIO-POTENTIALS** Bioelectric signals: structure of neuron, resting potential, action Potential, Nernst equation; Biopotntial amplifier: input impedance, frequency characteristics, gain, CMRR,Calibration, Noise, Temperature sensitive stability. Compaind action potentials of the human body ECG, EEG, ERG, EOG (in brief); Transducers: Definition, types- resistive, capacitive and inductive transducers, LVDT,Photo-diode	9
Unit-III	**MEDICAL-INSTRUMENTS& CHARACTERIZATION TECHNIQUES** Basic principle, Construction and working of colorimeters, spectrophotometer, ECGmachine, PH meter, Centrifuge measurement. Electron microscope: SEM, TEM	9
Unit-IV	**RADIATION PHYSICS** Definition, Units of Radioactivity and radiation doses, X-Ray Crystallography as a method for a structure determination of biomolecules NMR.Nuclear detector (G M Counter), radioimmunoassays (in brief)	9
Unit-V	**MEASUREMENTS OF PRESSURE AND VOLUME FLOW OF BLOOD** Direct measurements of blood pressure, Indirect measurements of BP. Heart sounds, Phonocardiography, Ultrasonic blood flow meter; Laser Doppler blood flow meter	9

LEARNING OUTCOME:

1. Students should get familiar with some of the useful concepts of Medical Physics

2. To have an understanding of the principles of Physics applied into Medical Instrumentation

Learning Resources					
Text Book	1. Introduction to Biophysics, P. Narayanan.New Age P. 2 Medical Instrumentation, by Khandpur, TMH 3 Laboratory Manuals of Biophysics Instruments, P.B. Vidyasagar 4. Biophysics,VatsalaPiramal, Dominant Publisher and Distributors, New Delhi-110002 5. Textbook of Biophysics, R.N. Roy 6. Photosynthesis, Hall and Rao. 7. Handbook of Biomedical Instrumentation, R.S. Khandpur.				
		L	**T**	**P**	**C**
20DEPH612	**Experimental Techniques**	**3**	**1**	**0**	**4**
Discipline Specific Elective course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To acquired understanding of measurements and errors.
2. To acquire knowledge of statistical analysis of data.
3. To introduce material characterization techniques.
4. To develop the understanding of vibrational spectroscopy.

UNIT	Course contents	Contact Hours
Unit-I	**MEASUREMENTS** Accuracy and precision. Significant figures. Error and uncertainty analysis.Types of errors: Gross error, systematic error, random error.	9
Unit-II	**STATISTICAL METHODS:** Statistical analysis of data(Arithmetic mean, deviation from mean, average deviation, standard deviation, chi-square)and curve fitting. Gaussian distribution	9
Unit-III	**MATERIAL CHARACTERIZATION TECHNIQUES (I)** X-ray diffraction (XRD)technique. Neutron diffraction, Fundamentals of electron microscopy (SEM, TEM, STEM). Atomic Force Microscopy (AFM), Thermal analysis –Differential Scanning Calorimetry (DSC)	9
Unit-IV	**MATERIAL CHARACTERIZATION TECHNIQUES (II)** Vibrational spectroscopy (Infra-red, Raman spectroscopy) Resonance techniques (NMR), Electron emission spectroscopies (XPS) Laser Induced Fluorescence (LIF), Ion scattering techniques and mass spectroscopy.	9
Unit-V	**TRANSDUCERS & SENSORS** Characteristics of Transducers. Transducers as electrical element and their signal conditioning. Linear Position transducer: Strain gauge, Piezoelectric. Spectroscopy based fiber optic sensors	9

LEARNING OUTCOME:

1. Gains good knowledge on Material characterization techniques
2. Become familiar to errors in the measurements.
3. Understand the transducers and sensors.

4. Understand the spectroscopy, fluorescence and scattering measurement techniques.

Learning Resources	
Text Book	1. Methods of Experimental Physics, M. I. Pergament. 2. Experimental Methods for Engineers, J.P. Holman 3. Introduction to Measurements and Instrumentation, A.K. Ghosh 4.Transducers and Instrumentation, D.V.S. Murty.

		L	**T**	**P**	**C**
20BSPH105	**PHYSICS LABORATORY I (MECHANICS & GENERAL PROPERTIES OF MATTER AND MATHEMATICAL PHYSICS I)**	**0**	**0**	**4**	**2**
Core	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To know basic plotting method and presentation of data using software.
2. To know how to measure various physical parameters including rigidity modulus, moment of inertia, coefficient of viscosity, Young's modulus, elastic constants etc.
3. To learn and appreciate the principles involved in measuring above mentioned physical parameters.
4. To know the estimation of errors while measuring the physical parameters.

NOTE: Atleast eight experiments to be performed by the students. Experiments list may be amended as per the availability of experimental kits

LIST OF EXPERIMENTS

1. Introduction to plotting graphs with Gnuplot:
   (a) Plotting 2D graphs: both functions and data files. Changing plot range, plot style: the options- with points (w p), with dots (w d), with lines (w l), with lines-points (w lp), line-type (lt), line-width (lw). Using the set command for samples, x-range, y-range, x-label, y-label, title etc. The *using* and *every* option.
   (b) User defined functions [Including the use of ternary operator (? :) for piece-wise defined functions.]
   (c) Fitting data files using Gnuplot.
   (d) Polar and parametric plots[Graphs to be saved by using GUI - The "export" protocol is not needed.]
2. Measurements of length (or diameter) using Vernier caliper, screw gauge and travelling microscope.
3. To study the random error in observations.
4. To determine the height of a building using a Sextant.
5. To determine the modulus of rigidity of a wire by Torsional Pendulum
6. To determine the Moment of Inertia of a Flywheel.
7. To determine g and velocity for a freely falling body using Digital Timing Technique.
8. To determine Coefficient of Viscosity of water by Capillary Flow method(Poiseuille's method).
9. To determine the Young's Modulus of the material of a beam by the method of uniform bending.
10. To determine the elastic Constants of a wire by Searle's method.
11. To determine the value of g using Bar Pendulum.

LEARNING OUTCOME:

1. Familiarity with graphical presentation techniques of measured data.
2. Get an insight into the principle involved in measuring the various physical parameters.

3. Understand how to measure various physical parameters including rigidity modulus, moment of inertia, coefficient of viscosity, Young's modulus, elastic constants etc

Learning Resources	
Text Book	1. "LABORATORY MANUAL IN APPLIED PHYSICS"-Second editionH.Sathyaseelam-New age International 2. LABORATORY EXPERIMENTS IN COLLEGE PHYSICS",C.H.Bernard and C.D.Epp.John Wiley and Sons Inc.,New York 1995 3. "EXPERIMENTS IN MODERN PHYSICS",A.C.Melisson,Academic Press,N.Y. 1966. 4. PRACTICAL PHYSICS",G.L.Squires,Cambridge University Press,1985

		L	**T**	**P**	**C**
20BSPH206	**PHYSICS LABORATORY II (ELECTRICITY & MAGNETISM)**	**0**	**0**	**4**	**2**
Core	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

1. To give practical knowledge on various circuit theorems including Thevenin, Norton, superposition, maximum power transfer theorem etc.
2. To learn and appreciate the principles involved in measuring various parameters.
3. To get practical knowledge on the core losses in transformer, self inductance of a coli, understanding LCR circuit etc.

NOTE: Atleast eight experiments to be performed by the students. Experiments list may be amended as per the availability of experimental kits

LIST OF EXPERIMENTS

1. To study core losses in transformers
2. To determine Inductance by Maxwell's bridge.
3. To verify the Thevenin and Norton theorems.
4. To verify the Superposition, and Maximum power transfer theorems.
5. To determine self inductance of a coil by Anderson's bridge.
6. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
7. To study the response curve of a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q.
8. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
9. Determine a high resistance by leakage method using Ballistic Galvanometer.
10. To determine self-inductance of a coil by Rayleigh's method.

    To determine the mutual inductance of two coils by Absolute method

LEARNING OUTCOME:

1. Familiarity with various circuit theorems including Thevenin, Norton, superposition, maximum power transfer theorem etc
2. Familiar with knowledge on the core losses in transformer, self inductance of a coli, understanding LCR circuit etc.

Learning Resources						
Text Book	1. "LABORATORY MANUAL IN APPLIED PHYSICS"-Second editionH.Sathyaseelam-New age International 2. LABORATORY EXPERIMENTS IN COLLEGE PHYSICS",C.H.Bernard and C.D.Epp.John Wiley and Sons Inc.,New York 1995 3. "EXPERIMENTS IN MODERN PHYSICS",A.C.Melisson,Academic Press,N.Y. 1966. 4. PRACTICAL PHYSICS",G.L.Squires,Cambridge University Press,1985					
		L	**T**	**P**	**C**	
20BSPH317	**PHYSICS LABORATORY III (OPTICS & ANALOG ELECTRONICS)**	**0**	**0**	**4**	**2**	
Core	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To give practical knowledge on optical concepts.
2. To learn and appreciate the principles behind the optics and electronic experiments
3. To give practical knowledge on electronic concepts.

NOTE: Atleast eight experiments to be performed by the students. Experiments list may be amended as per the availability of experimental kits

LIST OF EXPERIMENTS

1. Determination of dispersive power of material of a prism
2. Determination of specific rotation of cane sugar by polarimeter.
3. Determination of wavelength of mercury lines by diffraction grating
4. Determination of wavelength of sodium yellow line by Newton's rings
5. To determine diameter/thickness of a thin wire by diffraction method
6. Determination of Resolving Power of grating
7. Determination of wavelength by Constant deviation spectrometer
8. Determination of refractive index of liquid using hollow prism.
9. Study of the characteristics of a laser beam.
10. Measurement of energy band gap of Si using a p-n junction diode
11. To study charging and discharging of capacitor and determination of RC time constant
12. To study V-I characteristics of PN junction diode, and Light emitting diode
13. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
14. Study of V-I & power curves of solar cells and find maximum power point & efficiency.
15. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
16. To study the various biasing configurations of BJT for normal class A operation.
17. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
18. To study the frequency response of voltage gain of a RC-coupled transistor amplifier.
19. To design a Wien bridge oscillator for given frequency using an op-amp.
20. To design a phase shift oscillator of given specifications using BJT.
21. To study the Colpitt`s oscillator.
13. To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
14. To design inverting amplifier using Op-amp (741,351) and study its frequency response
15. To design non-inverting amplifier using Op-amp (741,351), study its frequency response
16. To study the zero-crossing detector and comparator
17. To add two dc voltages using Op-amp in inverting and non-inverting mode
18. To design a precision Differential amplifier of given I/O specification using Op-amp.

19. To investigate the use of an op-amp as an Integrator.
20. To investigate the use of an op-amp as a Differentiator.
21. To design a circuit to simulate the solution of a 1st/2nd order differential equation

LEARNING OUTCOME:

1. Become familiar with experimental knowledge of various optical and electronic concepts.
2. To get an insight into the Physics involved in the experiments.

Learning Resources						
Text Book	1. "LABORATORY MANUAL IN APPLIED PHYSICS"-Second editionH.Sathyaseelam-New age International 2. LABORATORY EXPERIMENTS IN COLLEGE PHYSICS",C.H.Bernard and C.D.Epp.John Wiley and Sons Inc.,New York 1995 3. "EXPERIMENTS IN MODERN PHYSICS",A.C.Melisson,Academic Press,N.Y. 1966. 5. PRACTICAL PHYSICS",G.L.Squires,Cambridge University Press,1985					
		L	**T**	**P**	**C**	
20BSPH418	**PHYSICS LABORATORY IV (DIGITAL ELECTROINCS)**	**0**	**0**	**4**	**2**	
Core	**Pre-requisite**					
	Co-requisite					
	Designed by department of PHYSICS					

COURSE OBJECTIVE

1. To give knowledge on digital electronics experiments.
2. To learn and appreciate the principles behind digital electronic concepts.
3. To introduce programming in microprocessor 8085

NOTE: Atleast eight experiments to be performed by the students. Experiments list may be amended as per the availability of experimental kits

LIST OF EXPERIMENTS

1. To measure (a) Voltage, and (b) Time period of a periodic waveform using CRO.
2. To design a switch (NOT gate) using a transistor.
3. To verify and design AND, OR, NOT and XOR gates using NAND gates.
4. To design a combinational logic system for a specified Truth Table.
5. To convert a Boolean expression into logic circuit and design it using logic gate ICs.
6. Half Adder, Full Adder and 4-bit binary Adder.
7. Half Subtractor, Full Subtractor, Adder-Subtractor using Full Adder I.C.
8. To build Flip-Flop (RS, Clocked RS, D-type and JK) circuits using NAND gates.
9. To build JK Master-slave flip-flop using Flip-Flop ICs
10. To build a 4-bit Counter using D-type/JK Flip-Flop ICs and study timing diagram.
11. To make a 4-bit Shift Register (serial and parallel) using D-type/JK Flip-Flop ICs.
12. To design an astablemultivibrator of given specifications using 555 Timer.
13. To design a monostable multivibrator of given specifications using 555 Timer.
14. Write the following programs using 8085 Microprocessor
    a. Addition and subtraction of numbers using direct addressing mode
    b. Addition and subtraction of numbers using indirect addressing mode
    c. Multiplication by repeated addition.
    d. Division by repeated subtraction.
    e. Handling of 16-bit Numbers.
    f. Use of CALL and RETURN Instruction.
    g. Block data handling.

Other programs (e.g. Parity Check, using interrupts, etc.).

LEARNING OUTCOME:

1. Becomes familiar with various digital electronic experiments.
2. Get an insight into the Physics involved in digital electronic experiments.
3. Will learn programming in microprocessor 8085

Learning Resources	
Text Book	1. ”LABORATORY MANUAL IN APPLIED PHYSICS”-Second editionH.Sathyaseelam-New age International 2. LABORATORY EXPERIMENTS IN COLLEGE PHYSICS”,C.H.Bernard and C.D.Epp.John Wiley and Sons Inc.,New York 1995 3. “EXPERIMENTS IN MODERN PHYSICS”,A.C.Melisson,Academic Press,N.Y. 1966. 4. PRACTICAL PHYSICS”,G.L.Squires,Cambridge University Press,1985

		L	**T**	**P**	**C**
20BSPH525	**PHYSICS LABORATORY V (DIGITAL ELECTROINCS)**	**0**	**0**	**4**	**2**
Core	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

4. To know about various atomic and nuclear physics related experiments
5. To learn and appreciate the principles involved in atomic and nuclear physics related experiments.

NOTE: Atleast eight experiments to be performed by the students. Experiments list may be amended as per the availability of experimental kits

LIST OF EXPERIMENTS

1. Determination of Rydberg’s constant
2. Zeeman Effect
3. Grating spectrograph.
4. GM Counter experiments and study characteristics of G.M. tube.
5. To study B-H curve and hysteresis loss of ferro-magnetic materials.
6. Experiment on fiber optics.
7. Wedge angle and refractive index of water using laser.
8. To verify Inverse square law using γ-rays

To determine e/m of electron by using J.J. Thomson method

LEARNING OUTCOME:

1. Gets Familiar with various atomic and nuclear physics related experiments.

Learning Resources	
Text Book	1. ”LABORATORY MANUAL IN APPLIED PHYSICS”-Second editionH.Sathyaseelam-New age International 2. LABORATORY EXPERIMENTS IN COLLEGE PHYSICS”,C.H.Bernard and C.D.Epp.John Wiley and Sons Inc.,New York 1995 3. “EXPERIMENTS IN MODERN PHYSICS”,A.C.Melisson,Academic Press,N.Y. 1966.

	4. PRACTICAL PHYSICS",G.L.Squires,Cambridge University Press,1985

Generic Elective (GE) Theory Courses

- Physical Chemistry (20GECH101)
- Inorganic and General Organic Chemistry(20GECH103)
- Mathematics (20GEMH101)
- Numerical Techniques (20GEMH203)
- Introduction to C++ Programming (20GECS202)
- Introduction to FOTRAN (20GEPH104)
- Computational Physics (20GEPH202)
- Introduction to Matlab (20GEMH206)

		L	T	P	C
20GECH101	**PHYSICAL CHEMISTRY**	**4**	**0**	**0**	**4**
Generic Elective	**Pre-requisite**				
	Co-requisite				
	Designed by department of CHEMISTRY				

COURSE OBJECTIVE

UNIT	Course contents	Contact Hours
Unit-I	**THERMODYNAMICS:** Intensive and extensive variables; state and path functions; isolated, closed and open systems. Concept of heat Q, work W, internal energy U, and statement of first law; enthalpy H, relation between heat capacities, calculations of Q, W, ΔU and ΔH for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Concept of entropy; Calculation of entropy change for reversible and irreversible processes, Statement of third law.	9
Unit-II	**KINETIC THEORY OF GASES:** Kinetic theory of gases, deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases, boyle's temperature, critical constants and their calculation from van der Waals equation, critical phenomenon, Andrews isotherms of CO_2, maxwellboltzmann distribution laws of molecular velocities and molecular energies and their importance,most probable, average and root mean square velocities	9
Unit-III	**NUCLEAR CHEMISTRY:**Fundamentals of radioactivity and decay, preparation of radioisotopes for tracers, applications with radiotracers, radiometric titration, radioactivity measurements by gas filled and scintillation detectors. Radioactive decay, decay kinetics, parent daughter decay growth relationship, concepts of transient and secular equilibrium, alpha, beta and gamma decay, artificial radioactivity	9
Unit-IV	**SOLID CHEMISTRY** Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method	9

LEARNING OUTCOME:

Learning Resources	
Text Book	1. Kapoor, K. L. (Vol. 1 to 5) *Physical Chemistry*, Macmillan. 2. Atkins, P.; Paula, J.P. *Physical Chemistry*, Oxford 3. R. West, Solid state chemistry and its applications, John Wiley & Sons, 1989. 4. L. Smart and E. Moore, Solid state chemistry, Chapman and Hall , 1992. 5. K. Cheetham and P. Day, Solid state chemistry compounds, Clarendon Press, Oxford 1992. 6. N. R. Rao and J. Gopalkrishanan, New directions in solid state chemistry, Cambridge Univ. Press 1997.

		L	**T**	**P**	**C**
20GECH103	**INORGANIC & GENERAL ORGANIC CHEMISTRY**	**4**	**0**	**0**	**4**
Generic Elective	**Pre-requisite**				
	Co-requisite				
	Designed by department of CHEMISTRY				

COURSE OBJECTIVE

UNIT	Course contents	Contact Hours
Unit-I	**ATOMIC STRUCTURE** Bohr's theory and its limitations, Heisenberg uncertainty principle, dual behaviour of matter and radiation, de-Broglie's relation,hydrogen atom spectra,quantummechanics,schrodinger equation and meaning,significance of ψ and ψ^2, Schrödinger equation for hydrogen atom,radial and angular parts (atomic orbitals) and their graphical representation,nodes and their significance, nodal planes, radial distribution functions, quantum numbers and their significance, shapes of various orbitals (s, p, d and f atomic orbitals),rules for filling electrons in various orbitals	9
Unit-II	**CHEMICAL BONDING** General characteristics of ionic bonding,energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds,statement of born-landé equation for calculation of lattice energy, born-haber cycle and its applications, polarizing power and polarizability,fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. Covalent bonding: valence band theory	9
Unit-III	**GENERAL ORGANIC CHEMISTRY** 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.curlyarrow rules, formal charges; electrophiles and nucleophiles; nucleophlicity and basicity; types, shape and their relative stability of carbocations, carbanions, free radicals and carbenes, benzyne, aromaticity: benzenoids and hückel's rule.	9
Unit-IV	**STEREOCHEMISTRY** Nomenclature systems D & L, R & S and E & Z, CIP rules. fischer projection, newmann and sawhorse projection formulae and their interconversions; conformational analysis of ethane, butane, cyclohexane. Interconversion of wedge formula, newmann, sawhorse and fischerrepresentations,elements of symmetry, chirality, molecules with more than one chiral center, enantiomerism, diastereomerism and meso compounds threo and erythro isomers	9

LEARNING OUTCOME:

Learning Resources	
Text Book	1. Lee, J.D. *Concise Inorganic Chemistry.* 2. Cotton, F.A., Wilkinson, G. &Gaus, P.L. *Basic Inorganic Chemistry*, Wiley. 3. Douglas, B.E., McDaniel, D.H. & Alexander, J. J. *Concepts and Models in Inorganic Chemistry*, John

Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India.
5. Ajai Kumar, *Basic Inorganic Chemistry.*
6. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi.
7. Finar, I.L. *Organic Chemistry* (Vol. I & II).
8. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson.
9. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education.
10. Bahl, A. &Bahl, B.S. *Advanced Organic Chemistry*, S. Chand.

		L	T	P	C
20GEMH101	**MATHEMATICS**	**4**	**0**	**0**	**4**
Generic Elective	**Pre-requisite**				
	Co-requisite				
	Designed by department of MATHEMATICS				

COURSE OBJECTIVE

UNIT	Course contents	Contact Hours
Unit-I	**DIFFERENTIAL CALCULUS** The tangent line and the derivative of a function, numerical differentiation, differentials, higher order derivatives, discontinuities, stationary points, maximum minimum problems, inflexion points, limiting values of functions: L'Hôpital's rule, combining limits. Leibnitz theorem and its applications	9
Unit-II	**INTEGRAL CALCULUS** The process of integration, odd and even functions, indefinite integrals, standard integrals, methods of integration, numerical integration (Trapezoidal and Simpson's rule, e.g. entropy/enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values. The calculus of trigonometric functions and reduction methods. Differentiation under the integral sign	9
Unit-III	**CALCULUS OF INDEPENDENT VARIABLES** Functions of several independent variables, change of variables, relations between partial derivatives (e.g. change in pressure for small changes in volume and temperature), total differentials, chain rules for partial differentiation, Euler's theorem, exact and inexact differentials (thermodynamics), line integrals.	9
Unit-IV	**DIFFERENTIAL EQUATIONS** Differential equations: differential equations with separable variables, series solution, numerical solutions of differential equations. Newton' laws of motion. The linear harmonic oscillator: Linear differential equations with constant coefficients. Partial differential equations: separation of variables. Application to Schrödinger's wave equation	9
Unit-V	**VECTORS & DETERMINANTS** Vectors and coordinate systems: Unit vectors (application in solid state), addition and subtraction of vectors, multiplication of vectors. Vector calculus. Vectors and coordinate systems in three dimensions (Cartesian, spherical polar and their interconversion). Determinants: Matrix algebra, Cramer's rule, matrix inversion, orthogonal and unitary matrices, matrix eigenvalues and eigenvectors, diagonalization	9

	of a matrix.	

LEARNING OUTCOME:

Learning Resources	
Text Book	1. McQuarrie, D. A. Mathematics for Physical Chemistry University Science Books (2008). 2. 2. Mortimer, R. Mathematics for Physical Chemistry. 3 rd Ed. Elsevier (2005). 3. 3. Steiner, E. The Chemical Maths Book Oxford University Press (1996). 4. 4. Yates, P. Chemical calculations. 2 nd Ed. CRC Press (2007).

		L	**T**	**P**	**C**
20GEMH203	**NUMERICAL TECHNIQUES**	**4**	**0**	**0**	**4**
Generic Elective	**Pre-requisite**				
	Co-requisite				
	Designed by department of MATHEMATICS				

COURSE OBJECTIVE

1. To be familiar with numerical solution of equations
2. To get exposed to finite differences and interpolation
3. To be familiar with the numerical Differentiation and integration
4. To find numerical solutions of ordinary differential equations
5. To find numerical solutions of partial differential equations.

UNIT	Course contents	Contact Hours
Unit-I	**ERRORS AND CURVE FITTING** Error in computation, types of error, rules for estimating errors, Method of Least Squares: Fitting a straight line, fitting a parabola.	9
Unit-II	**NUMERICAL SOLUTION OF ALGEBRAIC, TRANSCENDENTIAL AND SIMULTANEOUS EQUATION** Introduction-properties of equations, Graphical Methods, Bisection method, Regula Falsi method, Newton Raphson method. Guass elimination, Guass Jordan, factorization methods and GuassSiedel Method for solution of simultaneous equations	9
Unit-III	**FINITE DIFFERENCES AND INTERPOLATION** First and Higher order differences: Forward differences and backward differences, Shift operators and their relations, Interpolation with equal interval – Newton-Gregory Forward and Backward Interpolation formulae. Interpolation with unequal interval - Divided differences – Newton's Divided difference formula – Lagrange's Interpolation formula	9
Unit-IV	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Numerical Differentiation and Integration: Newton's forward and backward differences formulae to compute first and higher order derivatives – The Trapezoidal rule – Simpson's one third rule and three eighth rule.	9
Unit-V	**NUMERICAL SOLUTIONS OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Solution by Taylor's series – Euler's method – Runge-Kutta methods of fourth order (No proof). Classification of Partial differential equations of the second order –	9

	Difference quotients – Laplace's equation and its solution by Liebmann's process.	

LEARNING OUTCOME:

Learning Resources						
Text Book	1. B.S. Grewal, "*Numerical Methods in engineering and science"*, Khanna Publishers, 42nd edition,2012. 2. Venkataraman M.K, "*Numerical Methods in Science and Engineering",* National Publishing Co., 2005. 3. S.S. Sastry, "*Introductory Methods of Numerical Analysis"*, 4th edition,2005. 4. Balagurusamy E, "*Computer Oriented Statistical and Numerical Methods"* – Tata McGraw Hill., 2000. 5. Jain M.K, Iyengar SRK and Jain RL, "*Numerical Methods for Scientific and Engineering Computation*," Wiley Eastern Ltd., 4th edition,2003.					
		L	**T**	**P**	**C**	
20GECS202	**INTRODUCTION TO C++ PROGRAMMING (OOP)**	**4**	**0**	**0**	**4**	
Generic Elective	**Pre-requisite**					
	Co-requisite					
	Designed by department of COMPUTER SCIENCE					

COURSE OBJECTIVE

1. To impart a sound knowledge on working of the computer involving the different basic concepts of programming oriented topics required for developing computer software.

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION:** Principles of Object Oriented Programming (OOP) : Evolution of C++ - Programming Paradigms - Key Concepts of OOP - Advantages of OOP - Usage of OOP and C++ .Input and Output in C++-Streams-Stream classes Unformatted console I/O operations-Member functions of iostream class-manipulators-manipulators with parameters .	9
Unit-II	**DATA TYPES:** Declaring, Defining & Initializing Variables, Scope of Variables, Using Named Constants, Keywords, Data Types, Casting of Data Types, Operators (Arithmetic, Logical and Bitwise), Using Comments in programs, Character I/O (getc, getchar, putc, putcharetc), Formatted and Console I/O (printf(), scanf(), cin, cout), Using Basic Header Files (stdio.h, iostream.h, conio.hetc).	9
Unit-III	**CLASSES:** Principles of Object-Oriented Programming, Defining & Using Classes, Class Constructors, Constructor Overloading, Function overloading in classes, Class Variables &Functions, Objects as parameters, Specifying the Protected and Private Access, Copy Constructors, Overview of Template classes and their use	9
Unit-IV	**INHERITANCE AND POLYMORPHISM:** Introduction to Inheritance (Multi-Level Inheritance, Multiple Inheritance), Polymorphism (Virtual Functions, Pure Virtual Functions), Need of Overloading functions and operators, Overloading functions by number and type of arguments, Overloading Operators (including assignment operators, unary operators).	9
Unit-V	**FILE HANDLING :**Byte Stream, Character Stream, File IO Basics, File Operations, Creating file, Reading file, Writing File.	9

LEARNING OUTCOME:

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

1. Write, compile and debug programs in C++, use different data types, operators and I/O function in a

computer program.

2. Comprehend the concepts of classes, objects and apply basics of object oriented programming, polymorphism and inheritance.
3. Demonstrate use of file handling.
4. Demonstrate use of templates and exception handling.
5. Demonstrate use of windows programming concepts using C++.

Learning Resources	
Text Book	1. Object Oriented Programming in Turbo C++ by Robert Lafore, 1994, The WAITE Group Press. 2. Programming with C++ By D Ravichandran, 2003, T.M.H 3. Object oriented Programming with C++ by E Balagurusamy, 2001, Tata McGrawHill 4. C++ How to Program by H M Deitel and P J Deitel, 1998, Prentice Hall 5. Computing Concepts with C++ Essentials by Horstmann, 2003, John Wiley, 6. The Complete Reference in C++ By Herbert Schildt, 2002, TMH. 7. 7. C++ Programming Fundamentals by Chuck Easttom, Firewall Media.

		L	**T**	**P**	**C**
20GEPH202	**COMPUTATIONAL PHYSICS**	**4**	**0**	**2**	**6**
Generic Elective	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

2. To know about various sources of energy
3. To learn and appreciate the principles involved in non-conventional energy
4. To know the importance of Biomass for energy .

UNIT	Course contents	Contact Hours
Unit-I	**ERROR & CURVE FITTING** Errors: Round off errors, truncation error, machine error, random error. Solution of algebraic equation: Bisection method, iteration method, Newton Raphson method.CurveFitting:Least-square curve fitting, straight line and polynomial fits.	9
Unit-II	**INTERPOLATION &VEXTRAPOLATION** Finite difference, forward difference, backward difference, central differences, Lagrange method	9
Unit-III	**NUMERICAL DIFFERENTIATION METHODS** Differentiation: Taylor series method, numerical differention using Newton's forward difference formula, Newton's backward difference formula, strilling formula	9
Unit-IV	**NUMERICAL INTEGRATION METHODS** Integration: Trapezoidal rule, Simpson 1/3 rule, Simpson 3/4 rule, Gaussian Quadrature, Legendre-Gauss Quadrature, Numerical double integration	9
Unit-V	**NUMERICAL SOLUTION OF DIFFERENTIAL EQUATION** Numerical solution of ordinary differential equation: Taylor series method, Eulers methods, forth order RungaKutta method. Second order differential equation: Initial and boundary value problem	9

LEARNING OUTCOME:

1. Familiarity with various energy sources
2. To ge an insight into the Physics involvd in energy generations from natural resources

3. To relate principle of photoconductivity with Photovoltaic systems

Learning Resources	
Text Book	1. Numerical Mathematical Analysis, J.B. Scarborough (Oxford Book Co.) 2. Computational: Physics an introduction by RC Verma, PK Ahulawalia and K C Sharma (New Age International Publisher) 3. Introduction to Numerical Analysis by F b Hilderbrand(Tata McGraw Hill, New Delhi) 4. Programming with Fortran 77, Schaum's outline seriios by William E. Mayo and Martin Cwiakala(McGrawHill,Inc). 5. Fortran Programming and Numerical methods by R C Desai (Tata McGraw Hill, N Delhi). 6. Computer Applications in Physics Suresh Chandra (Narosa Publishing House). 7. Introductory methods of numerical methods of numerical Analysis by S S Sastry(P H of India). 8. Computer oriented Numerical Method by V Rajaraman (Prentice Hall of India).

		L	T	P	C
20GEMH206	**INTRODUCTION TO MATLAB**	**4**	**0**	**0**	**4**
Generic Elective	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

The course provides a gentle introduction to the MATLAB computing environment, and is intended for beginning users and those looking for a review. It is designed to give students a basic understanding of MATLAB, including popular toolboxes

UNIT	Course contents	Contact Hours
Unit-I	Practicing MATLAB environment with simple exercises to familiarize Command Window, History, Workspace, Current Directory, Figure window, Edit window, Shortcuts, Help files.	9
Unit-II	Data types, Constants and Variables, Character constants, operators, Assignment statements. Control Structures: For loops, While, If control structures, Switch, Break, Continue statements	9
Unit-III	Input-Output functions, Reading and Storing Data, Vectors and Matrices, commands to operate on vectors and matrices, matrix Manipulations	9
Unit-IV	Arithmetic operations on Matrices, Relational operations on Matrices, Logical operations on Matrices	9
Unit-V	Polynomial Evaluation, Roots of Polynomial, Arithmetic operations on Polynomials, Graphics, 2D plots, Printing labels, Grid & Axes box, Text in plot, Bar and Pie chart. Linear Equations	9

LEARNING OUTCOME:

Upon completion of this course, the student will be able to:

1. Find importance of this software for Lab Experimentation.
2. Write basic mathematical problems in Matlab.
3. Design and conduct experiments, as well as to analyze and interpret data

Learning Resources	
Text Book	1. Bansal R.K, Goel A.K., Sharma M.K., "MATLAB and its Applications in Engineering", Pearson Education, 2012. 2. Amos Gilat, "MATLAB-An Introduction with Applications", Wiley India, 2009. 3. Stephen.J.Chapman, "Programming in MATLAB for Engineers", Cengage Learning, 2011. 4. Pratap R., Getting started with MATLAB: A Quick introduction for Scientists &Engineers, Oxford University Press, 2010

(I) Ability Enhancement Compulsory (AEC) Courses

- COMMUNICATIVE English (20AEC101)
- Environmental Studies (20AEC202)

(II) Skill Enhancement Compulsory (SEC) Courses

- Soft Skills (20SEC101)
- Progressive English (20SEC202)

		L	T	P	C
20AEC101	**COMMUNICATIVE ENGLISH**	**2**	**0**	**0**	**2**
Ability Enhancement Course	**Pre-requisite**				
	Co-requisite				
	Designed by department of ENGLISH				

COURSE OBJECTIVE

- To enhance and strengthen communication skills in English in relation to the requirements of the students of Engineering and Technology.
- To facilitate the holistic, integrated development of LSRW involved in language learning through a series of intensely practical tasks and activities.
- To offer professionally sustainable language content to address the special needs of the target learners to ensure that they are adequately equipped with discoursal and grammatical competencies.
- To encourage language acquisition through the electronic media and to enable the learners to deal effectively with E-materials.
- To expose the learners to a wide range of lexical and grammatical skills needed for their special professional demands.

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION** This course enhances and strengthens communication skills in English languagefacilitating the holistic and integrated development of LSRW skills – Listening, Speaking, Reading Writing. The course will expose the learners to a wide range of lexical and grammatical skills, critical reading and writing and professional communicative skills to meet the demands at workplace. **GRAMMAR & VOCABULARY BUILDING** Introduction - Basic English Grammar – Tenses – Active Voice - Passive Voice Phrasal verbs – Prepositions - Building Vocabulary - Prefixes and Suffixes – Simple and complex sentences	9
Unit-II	**TECHNICAL WRITING SKILLS** Report Writing: Scientific documents/observations/experiments Discipline specific writing techniques, vocabulary and practices Curriculum Vitae – Resume Writing Abstract and Synopsis Writing Reviewing – Editing Effective Language - Formal Letters, Memos & Email letters to the editor - Writing letters, informal and official on –Article Writing - Writing Proposals - Research Papers – Preparing Minutes of Meeting.	9
Unit-III	**COMMUNICATION** English Communication - Aims & Objectives - Basics of Communication - Barriers to Communication - Non-Verbal Communication – Listening Skills - Active Listening - Effective Speaking – Speech - Art of Public Speaking – Pronunciation - Stress & Intonation in English – Debate – Conversations	9

Unit-IV	**EFFECTIVE READING** Reading strategies (Skimming, Scanning, Inferring) –Predicting and responding to content – Speed Reading – Note Making – Use of Extensive reading texts – Vocabulary Extension - Guessing from Context - Use of Extensive Reading Texts	9
Unit-V	**LANGUAGE THROUGH LITERATURE** The Overcoat (Nikolai Gogol) The Open Window (H.H. Munro) To a Skylark (P.B. Shelley) The Raven (Edgar Allan Poe)	9

LEARNING OUTCOME:

Learning Resources	
Text Book	1. Koneru, Aruna. *Professional Speaking Skills*. New Delhi: Oxford University Press, 2015. 2. Sanjay Kumar and Pushp Lata. *Technical Communication*, New Delhi: Oxford University Press, 2008. 3. Koneru, Anuna. *Professional Communication*, New Delhi: McGraw Hill Pvt. Ltd, 2008. 4. Murphy, Herta A. *Effective Business Communication*, New Delhi: McGraw Hill, 2008. 5. Swan, Michael. *Practical English Usage*. New Delhi: Oxford University Press, 2005. 6. Rizvi, M. Ashraf. *Effective Technical Communication*, New Delhi: McGraw Hill, 2018. 7. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, New Delhi, 2011.

		L	**T**	**P**	**C**
20AEC202	**ENVIRONMENTAL STUDIES**	**2**	**0**	**0**	**2**
Ability Enhancement Course	**Pre-requisite**				
	Co-requisite				
	Designed by department of ENGLISH				

COURSE OBJECTIVE

UNIT	Course contents	Contact Hours
Unit-I	**INTRODUCTION** • Introduction to environmental studies • Multidisciplinary nature of environmental studies • Scope and importance • Need for public awareness.	9
Unit-II	**ECOSYSTEMS** • Concept of an ecosystem. • Structure and function of an ecosystem. • Energy flow in an ecosystem: food chains, food webs and ecological pyramids. • Ecological succession. • Case studies of the following ecosystems : a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	9
Unit-III	**NATURAL RESOURCES: RENEWABLE & NON-RENEWABLE RESOURCES** • Land resources and land use change : Land as a resource, land degradation, landslides (natural & man-induced), soil erosion and desertification. • Forests & forest resources: Use and over-exploitation, deforestation, case studies. • Impacts of deforestation, mining, dam building on environment, forests, biodiversity and tribal populations. • Resettlement and rehabilitation of project affected persons; problems and concerns, case	9

	studies • Water resources: Use and over-exploitation of surface and ground water, floods, drought, conflicts over water (international & inter-state). • Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies	
Unit-IV	**BIODIVERSITY & CONSERVATION** • Levels of biological diversity: genetic, species and ecosystem diversity. • Biogeographic zones of India • Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational values • Biodiversity patterns and global biodiversity hot spots • India as a mega-biodiversity nation; Endangered and endemic species of India • Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity	9
Unit-V	**ENVIRONMENTAL POLLUTION** * Definition * Types of pollutants * Causes, effects and control measures of (a) Air pollution (b) Water pollution * Solid waste management	9

LEARNING OUTCOME:

Learning Resources	
Text Book	Environmental Studies from crisis to cure, by R. Rajagopalan, 3rd edition, Oxford Higher Education 2. Kurian Joseph & R. Nagendran, "Essential of Environmental Studies"" PearsonEducation, 2004. 3. Dara S.S., A Text Book of Environmental Chemistry and pollution control,S.Chand& Company Ltd., New Delhi, 2004. 4. Jeyalakshmi.R, Principles of Environmental Science, 1st Edition, DeviPublications, Chennai 2006. 5. Kamaraj.P&Arthanareeswari.M, Environmental Science – Challenges andChanges, 1st Edition, Sudhandhira Publications, 2007. 6. Arivalagan.K, Ramar.P&Kamatchi.P, Principles of Environmental Science, 1st Edition, Suji Publications, 2007.

		L	T	P	C
20SEC101	**SOFT SKILLS**	**2**	**0**	**0**	**2**
SKILL ENHANCEMENT COURSE	**Pre-requisite**				
	Co-requisite				
	Designed by department of Personality Development				

COURSE OBJECTIVE

UNIT	Course contents	Contact Hours
Unit-I	**SOFT SKILLS AND KNOW THYSELF/ SELF- DISCOVERY** Introduction – what are soft skills? – Importance of Soft skills – Selling your soft skills – Attribute regarded as soft skills – Soft skills – Social – Soft skills – Thinking – Soft skills – Negotiating – Exhibiting your soft skills – Identifying your soft skills – Improving your soft skills – Will formal training enhance your soft skills – Soft skills training – Train yourself	9
Unit-II	**DEVELOPING POSITIVE ATTITUDE & FORMING VALUES** Introduction – Meaning – Features of attitudes – Attitude and behavior – Formation of attitudes – Change of attitudes – Attitude and behavior – Formation of attitudes – Change of attitudes – What can you do to change attitudes? – Ways of changing attitude in person – Attitude in a workplace – The power of positive attitude.	9
Unit-III	**IMPROVING PERCEPTION AND CAREER PLANNING** Introduction – Meaning – Factors influencing perception – Perceptual process – Improving perception – Perception and its application in organisations. Introduction – Benefits of career planning – Guidelines for choosing a career – Myths about choosing a career – Tip for successful career planning.	9
Unit-IV	**ART OF LISTENING AND READING** Introduction – What is listening? – Two ears, one mouth – Benefits of active listening – Kinds of listening – Factors that hamper listening – Common poor listening habits – Advantages of active listening – Listening tips. Introduction – Reading is a cognitive process – Good readers are what they read – Benefits of reading – Different types of reading – Tips for effective reading – The SQ3R	9

Unit-V	**ART OF SPEAKING AND WRITING** Introduction – What makes communication important? – Defining Communication – Special features of communication – Communication process – Channels of communication – Formal communication network – Informal communication network (grapevine communication) – Importance of communication – Barriers to communication	9

LEARNING OUTCOME:

Learning Resources	
Text Book	Dr. K. Alex," Soft Skills: Know Yourself and Know the World", 3 rd Edition, S. Chand & Company. Pvt.Ltd.

Generic Elective Courses (Laboratory)

1. Physical Chemistry Lab I (20GECH105)
2. Inorganic & General Organic Chemistry Lab (20GECH107)
3. C++ Programming Lab (20GECS104)
4. FOTRAN Programming Lab (20GEPH106)
5. MatLab Programming Lab (20GEMH108)

		L	T	P	C
20GECH105	**PHYSICAL CHEMISTRY LABORATORY**	**0**	**0**	**4**	**2**
Generic Elective Course	**Pre-requisite**				
	Co-requisite				
	Designed by department of CHEMISTRY				

COURSE OBJECTIVE

List of experiments

1. Conductometric titrations: Strong acid vs. strong base; Weak acid vs. strong base.
2. Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.
3. Study the kinetics of the following reactions.

   (i) Saponification of ethyl acetate.

   (ii) Comparison of the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate.
4. Interpretation of a given powder diffraction pattern of a cubic crystalline system.

   (a) Determination of heat capacity of a calorimeter for different volumes using

   (i) Change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution of sulfuric acid or enthalpy of neutralization)

   (b) (ii) Verification of heat law.
5. Study the effect of addition of HCl/NaOH on pH to the solutions of acetic acid, sodium acetate and their mixtures.
6. Preparation of buffer solutions of different pH values i.e. Sodium acetate-acetic acid.

LEARNING OUTCOME:

Learning Resources	
Text Book	• Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi. • Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. McGraw-Hill: New York. • A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall. • Kapoor, K.L. (Vol. 1 to 5) *Physical Chemistry*, Macmillan. • Atkins, P.; Paula, J.P. *Physical Chemistry*, Oxford.

		L	T	P	C
20GECH107	**INORGANIC & GENERAL ORGANIC CHEMISTRY LABORATORY**	**0**	**0**	**4**	**2**
Generic Elective Course	**Pre-requisite**				
	Co-requisite				
	Designed by department of CHEMISTRY				

COURSE OBJECTIVE

PRACTICAL INORGANIC CHEMISTRY

1. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
2. Estimation of oxalic acid by titrating it with $KMnO_4$.
3. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.

PRACTICAL ORGANIC CHEMISTRY

4. Determination of Melting point and Boiling point of an organic compound
5. Detection of extra elements (N, S, Cl, Br, I) in organic compounds
6. Separation of mixtures by Chromatography: Measure the R_f value in each case (a) Identify and separate the components of a given mixture on the basis of polarity by paper chromatography (b) Role of eluting solvent (mobile phase) on R_f.

LEARNING OUTCOME:

Learning Resources	
Text Book	• Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman. • Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education. • Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson.

	• Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall. • Ahluwalia, V. K.; Dhingra, S.; Dhingra, S. *College Practical Chemistry*, Universities Press. Pandey, O.P.; Bajpai, D. N.; Giri, S. *Practical Chemistry*, S. Chand Limited.

		L	T	P	C
20GECS104	**C++ Programming Lab**	**0**	**0**	**4**	**2**
Generic Elective Course	**Pre-requisite**				
	Co-requisite				
	Designed by department of Computer Science				

COURSE OBJECTIVE

To impart a sound knowledge on working of the computer involving the different basic concepts of programming oriented topics required for developing computer software

1. WAP to print the sum and product of digits of an integer.
2. WAP to reverse a number.
3. WAP to compute the sum of the first n terms of the following series S = 1+1/2+1/3+1/4+……
4. WAP to compute the sum of the first n terms of the following series S =1-2+3-4+5…….
5. Write a function that checks whether a given string is Palindrome or not. Use this function to find whether the string entered by user is Palindrome or not.
6. Write a function to find whether a given no. is prime or not. Use the same to generate 7 the prime numbers less than 100.
7. WAP to compute the factors of a given number.
8. Write a macro that swaps two numbers. WAP to use it.
9. Create a class ‘staff ’, to create different objects and to test the functioning of member functions, constructors and Destructors.
10. write a C++ program to implement the concept Arrays of Objects
11. Create Class ‘student’, create an array of students, find out the student who get the first rank
12. Write a C++ program to implement operator overloading to perform complex arithmetic

LEARNING OUTCOME:

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

1. The working of OOPS programming approach.
2. The knowledge of object oriented programming style.
3. The basic concepts involved in computer programming.
4. Important programming aspects i.e object, class, inheritance and polymorphism.
   Knowledge with respect to the software development phase of OOPS

Learning Resources	
Text Book	1. Object oriented Programming with C++ by E Balagurusamy, 2001, Tata McGraw-Hill

		L	**T**	**P**	**C**
20GEPH106	**FOTRAN PROGRAMMING LAB**	**0**	**0**	**4**	**2**
	Pre-requisite				
	Co-requisite				
	Designed by department of PHYSICS				

LIST OF EXPERIMENTS/ PROGRAMS
(FORTRAN)

1. To print out all natural (even/odd) numbers between given limits using computer.
2. To find maximum, minimum and range of a given set of numbers using computer.
3. To evaluate sum of finite series.
4. Find the roots of a quadratic equation.
5. To find integration of a definite integral by trapezoidal rule.
6. To find the area of a triangle, sphere and cylinder.
7. Given values for a, b, c and d and a set of values for the variable x evaluate the function defined by.

   $f(x) = ax^2 + bx + c$ if $x < d$

   $f(x) = 0$ if $x = d$

   $f(x) = ax^2 + bx - c$ if $x > d$

   For each value of x and print the value of x and f(x). Write a program for an arbitrary number of x values

		L	T	P	C
20GEMH108	**MATLAB PROGRAMMING LAB**	**0**	**0**	**4**	**2**
Generic Elective Course	**Pre-requisite**				
	Co-requisite				
	Designed by department of PHYSICS				

COURSE OBJECTIVE

- To learn and Practice the basics of MATAB

INSTRUCTIONAL OBJECTIVES
To learn & practice the MATLAB.

PRACTICAL
Programs based on MATLAB.

Learning Resources	
Text Book	**TEXT AND REFERENCE BOOKS:** 1. Laboratory Manual