DEPARTMENT OF PHYSICS

H.H. THE RAJAH'S COLLEGE(AUTO)

PUDUKKOTTAI – 622 001

COURSE STRUCTURE

AND

SYLLABI

FOR PG PROGRAMME

CHOICE BASED CREDIT SYSTEM

(2023 – 2024 ONWARDS)

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF)
Guideline Based Credits and Hours Distribution System
M.Sc. Physics Programme 2023-2024 Onwards

Sem	Paper	Sub Code	Hrs/ week	Credit	Exam hrs.	Marks		
						Internal	External	Total
	I - SEMESTER							
1.1	CC 1- Mathematical Physics	23PPH1	7	5	3	25	75	100
1.2	CC 2-Classical Mechanics and Relativity	23PPH2	7	5	3	25	75	100
1.3	CC 3-General Physics Laboratory	23PPH3P	6	4	3	40	60	100
1.4	Elective 1-Linear and Digital ICs and Applications	23PPHEIA	5	3	3	25	75	100
1.5	Elective 2-Crystal Growth and Thin films	23PPHE2A	5	3	3	25	75	100
	II - SEMESTER							
2.1	CC 4- Statistical Mechanics	23PPH4	6	5	3	25	75	100
2.2	CC 5-Quantum Mechanics –I	23PPH5	6	5	3	25	75	100
2.3	CC 6-Electronics Laboratory	23PPH6P	6	4	4	40	60	100
2.4	Elective 3-Advanced Mathematical Physics	23PPHE3A	4	3	3	25	75	100
2.5	Elective 4-Microprocessor and Microcontroller	23PPHE4B	4	3	3	25	75	100
2.6	Skill Enhancement Course 1-Physics for Skill Enhancement -I	23PPHSE1	4	2	3	25	75	100
	III - SEMESTER							
3.1	CC 7-Quantum Mechanics – II	23PPH7	6	5	3	25	75	100
3.2	CC 8- Atomic Physics and Molecular Spectroscopy	23PPH8	6	5	3	25	75	100
3.3	CC 9-Electromagnetic Theory	23PPH9	6	5	3	25	75	100
3.4	CC 10-Micro Processor, Micro Controller & Python Programming Laboratory	23PPH10P	6	4	4	40	60	100
3.5	Elective 5-Physics of Nanoscience and Nanotechnology	23PPHE5A	3	3	3	25	75	100
	Elective 5-Numerical Methods & python Programming	23PPHE5B						
3.6	Skill Enhancement Course II-Physics for Competitive	23PPHSE2	3	2	3	25	75	100

	Examinations							
3.7	**Internship/Industrial Visit (30 Hours)**	**23PIT**		**2**				
	IV - SEMESTER							
4.1	**CC 11- Nuclear and Particle Physics**	**23PPH11**	**6**	**5**	**3**	**25**	**75**	**100**
4.2	**CC 12- Condensed Matter Physics**	**23PPH12**	**6**	**5**	**3**	**25**	**75**	**100**
4.3	**CC 13-Project with viva-voce**	**23PPH3PW**	**10**	**7**		**20**	**80**	**100**
4.4	**Elective 6- Energy Physics**	**23PPHE6A**	**4**	**3**	**3**	**25**	**75**	**100**
	Elective 6- Medical Physics	**23PPHE6B**						
4.5	**Skill Enhancement Course III-Electronics and Communication Systems**	**23PPHSE3**	**4**	**2**	**3**	**25**	**75**	**100**
4.6	**Extension Activity**	**22PEA**		**1**				
		91						**2200**
Total Credit: 91								

Consolidation:

Part	**Subject**	**Credits Distribution**	**Total**
A	Core	12x4	48
A	Core Practical	4x3	12
A	Elective	4x3	12
B1	Skill Enhancement Course(SEC)	4x2	08
B2	Soft Skill& Internship	5x2	10
C	Extension Activity	1x1	01
	TOTAL		**91**

M.Sc. PHYSICS

Preamble:

The curriculum for the P.G. Physics for universities and colleges is revised as per Learning Outcomes-based Curriculum Framework (LOCF). The learner centric courses are designed to enable the students to progressively develop a good understanding of the concepts of various domains in physics. Significant modification is the inclusion of the courses to equip students to face challenges in industries and make them employable. Skill development in different spheres and confidence building are given a special focus.

TANSCHE REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M. Sc., Physics**
Programme Code	
Duration	**PG – 2YEARS**
Programme Outcomes (POs)	**PO1: Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. **PO2: Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision-making. **PO3: Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. **PO4: Communication Skill** Ability to develop communication, managerial and interpersonal skills. **PO5: Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals. **PO6: Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment. **PO7: Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur. **PO8: Contribution to Society** Succeed in career endeavors and contribute significantly to society. **PO 9 Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective. **PO 10: Moral and ethical awareness/reasoning** Ability to embrace moral/ethical values in conducting one's life.

Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.

	PSO3 – Research and Development Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit. **PSO 6** Students will utilize e-resources, digital tools and techniques for widening their knowledge base. **PSO 7** Students gain exposure to programming language and skills. **PSO 8** Student will appreciate the interplay of mathematics, physics and technology. **PSO 9** Students will develop adequate knowledge and skills for employment and entrepreneurship. **PSO 10** An awareness of civic and ecological duties as good citizens and importance of human values will be inculcated in students

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	**25 Marks**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	**75 Marks**
Total		**100 Marks**

METHODS OF ASSESSMENT	
Remembering (K1)	• The lowest level of questions require students to recall information from the course content. • Knowledge questions usually require students to identify information in the text book.
Understanding (K2)	• Understanding off acts and ideas by comprehending organizing, comparing,translating,interpolating and interpreting in their own words. • The questions go beyond simple recal land require students to combined at a together
Application (K3)	• Students have to solve problems by using/applying a concept learned in the classroom. • Students must use their knowledge to determine a exact response.
Analyze (K4)	• Analyzing the question is one that asks the students to break down some thing into its component parts. • Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.
Evaluate (K5)	• Evaluation requires an individual to make judgment on something. • Questions to be asked to judge the value of an idea, a character,a work of art,or a solution to a problem. • Students are engaged in decision-making and problem–solving.

	• Evaluation questions do not have single right answers.
Create (K6)	• The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem solving skills.

ELECTIVE PAPERS

LIST 1

1. **Crystal Growth and Thin films**
2. **Physics of Nano Science and Technology**
3. **Communication Electronics**
4. **Energy Physics**

LIST 2

1. **Advanced Mathematical Physics**
2. Advanced Optics
3. Plasma Physics
4. Bio Physics

LIST 3

INDUSTRY ORIENTED ELECTIVE (IOE)

1. **Microprocessor 8086 and Microcontroller 8051**
2. **Medical Physics**
3. Characterization of Materials
4. Digital Communication

(**Note:** Institutions can also frame such IOE courses more suitable for their locality.)

Core -1 - MATHEMATICAL PHYSICS	**I YEAR - FIRST SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPH1	**MATHEMATICAL PHYSICS**	**Core**				**5**	**7**	**75**

Pre-Requisites
Knowledge of Matrices, vectors, differentiation, integration, fourier and laplace transform,differential equations,complex analysis and special function.
Learning Objectives
➢ To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program ➢ To extend their manipulative skills to apply mathematical techniques in their fields ➢ To help students apply Mathematics in solving problems of Physics ➢ To study the connection between differential equations and their contribution in the study of dynamics. ➢ To enhance the physically relevant problem solving techniques skills using special function

UNITS	Course Details
UNITI: VECTOR ANALYSIS AND LINEAR VECTOR SPACE	The Scalar and Vector fields - Integration of Vector - Line integrals, Surface integrals and Volume integrals - Gauss Divergence theorem - Stokes theorem - Green's theorem. Basic concepts – Definitions- examples of vector space – Linear dependence and independence - Scalar product- Orthogonality – Schwartz inequality- Gram-Schmidt orthogonalization process –Linear operators - Orthogonal basis – Change of basis – Isomorphism of vector space - Projection operator.
UNITII: COMPLEX ANALYSIS	Functions of a Complex Variable- Differentiability - Analytic functions- Line integrals complex Function- Complex Integration- Contour Integration, Cauchy – Riemann conditions – Poles and Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Series - Zeros and poles – Cauchy's Residue theorem and its Application Evaluation of integrals using residues: Evaluation of Definite integral and contour integrals.
UNITIII: MATRICES	Types of Matrices and their properties, Rank of a Matrix -Conjugate of a matrix - Adjoint of a matrix - Inverse of a matrix - Hermitian and Unitary Matrices -Trace of a matrix- Transformation of matrices - Characteristic equation - Eigen values and Eigen vectors - Cayley–Hamilton theorem –Diagonalization.
UNITIV: FOURIER TRANSFORMS & LAPLACE	Definitions -Fourier transform and its inverse - Transform of Gaussian function and Dirac delta function -Fourier transform of derivatives - Cosine and sine transforms - Convolution theorem. Application: Diffusion equation: Flow of heat in an infinite and in a semi - infinite medium - Wave equation: Vibration of an infinite string and of a semi - infinite string. Laplace transform and its inverse - Transforms of derivatives and integrals –

TRANSFORMS	Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi - infinite strip.

UNITV: **SPECIAL FUNCTIONS**	Definition of Gamma and Beta functions - Fundamental property, Transformation, Different form of Beta function and Relation between the Beta,Gamma function - Legendre differential equations - Associated Legendre polynomials - Bessel and Hermite differential equations and polynomials -Generating function - Orthogonality properties - Recurrence relations - Generating function – Rodrigue's formula - Dirac delta function.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. P.K. Chattopadhyay, 2013, *Mathematical Physics* (2nd edition), New Age, New Delhi 2. A W Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt.Ltd., India 3. B. D. Gupta, 2010, *Mathematical Physics* (5th edition), VikasPublishing House, New Delhi. 4. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi. 5. Sathyaprakash, Mathematical Physics, Sultan Chand & Sons, New Delhi. 6th edition, 2012.
REFERENCE BOOKS	1. E. Kreyszig, Advanced Engineering Mathematics (Wiley Itel. Student Version, 10th edition, 2015). 2. V. Balakrishnan, Mathematical Physics with Applications, Problems and Solutions (Ane Books Pvt. Ltd. 1st edition, 2018). 3. D. G. Zill, Advanced Engineering Mathematics (Jones & Bartlett, 6th edition, 2017). 4. M. T. Vaughn, Introduction to Mathematical Physics (Wiley India, 1st edition, 2013).
WEB SOURCES	1. www.khanacademy.org 2. https://youtu.be/LZnRlOA1_2I 3. http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath 4. https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SlED56gNjVJGO2qaZ 5. https://archive.nptel.ac.in/courses/115/106/115106086/

COURSEOUTCOMES:

At the end of the course the students will be able to:

CO1	Understand use of bra-ket vector notation and explain the meaning of complete	**K1, K2**

	orthonormal set of basis vectors, and transformations and be able to apply them.	
CO2	Able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration.	**K2, K3**
CO3	Analyze characteristics of matrices and its different types, and the process of diagonalization.	**K4**
CO4	Solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology	**K4, K5**
CO5	To find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems	**K2, K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)**in the 3-point scale of STRONG(3),MEDIUM(2) and LOW (1)**.**

23PPH1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	3

23PPH1	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Core -2 - CLASSICAL MECHANICS AND RELATIVITY	**I YEAR - FIRST SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPH2	CLASSICAL MECHANICS AND RELATIVITY	Core				5	7	75

Pre-Requisites
Knowledge of fundamentals of mechanics, Foundation in mathematical methods.
Learning Objectives
➢ To understand fundamentals of classical mechanics. ➢ To understand Lagrangian formulation of mechanics and apply it to solve equation of motion. ➢ To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion. ➢ To discuss the theory of small oscillations of a system. ➢ To learn the relativistic formulation of mechanics of a system.

UNITS	Course Details
UNIT I: PRINCIPLES OF CLASSICAL MECHANICS	Mechanics of a single particle – mechanics of a system of particles – conservation laws for a system of particles – constraints – holonomic & non-holonomic constraints – generalized coordinates – configuration space – transformation equations – principle of virtual work.
UNIT II: LAGRANGIAN FORMULATION	D'Alembert's principle - Principle of least action -Derivation of Lagrange's equation from it – Lagrangian equations of motion for conservative and Dissipative system – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.
UNIT III: HAMILTONIAN FORMULATION	Phase space – cyclic coordinates – conjugate momentum – Hamiltonian function – Hamilton's canonical equations of motion – applications: (i) simple pendulum (ii) one dimensional simple harmonic oscillator (iii) motion of particle in a central force field.
UNIT IV: SMALL OSCILLATIONS	Formulation of the problem – transformation to normal coordinates – frequencies of free vibrations and normal modes – Free vibrations of a linear triatomic molecule- Damped driven pendulum.
UNIT V: RELATIVITY	Inertial and non-inertial frames – Lorentz transformation equations – length contraction and time dilation – relativistic addition of velocities – Einstein's mass-energy relation – Minkowski's space – four vectors – position, velocity, momentum, acceleration and force in for vector notation and their transformations.

UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001 2. H. Goldstein, C. Poole and J. Sofko, Classical Mechanics (Pearson Education, New Delhi,2013). 3. N.C.Rana and P.S.Joag, Classical Mechanics, (Tata Mc-Graw Hill, New Delhi, 2001). 4 G. K. Sharma, Classical Mechanics, (Pragati Prakashan, New Delhi, 2012) 5 S. T.Thornton and J. B. Marion, Classical Dynamics of Particles and Systems.(Cengage Learning, 2003)..
REFERENCE BOOKS	1. Classical Mechanics – J. C. Upadhyaya, Himalaya Publishing House, 2012. 2. G. K. Sharma, Classical Mechanics, (Pragati Prakashan, New Delhi, 2012) 3. T. L. Chow, Classical Mechanics (John Wiley, New York, 1995) 4. S. N. Biswas, 1999, *Classical Mechanics*, Books & Allied, Kolkata. 5. Gupta and Kumar, *Classical Mechanics*, KedarNath. 6. T.W.B. Kibble, *Classical Mechanics*, ELBS.
WEB SOURCES	1. http://poincare.matf.bg.ac.rs/~zarkom/Book_Mechanics_Goldstein_Classical_Mechanics_optimized.pdf 2. https://pdfcoffee.com/classical-mechanics-j-c-upadhyay-2014-editionpdf-pdf-free.html 3. https://nptel.ac.in/courses/122/106/122106027/ 4. https://ocw.mit.edu/courses/physics/8-09-classical-mechanics-iii-fall-2014/lecture-notes/ 5. https://www.britannica.com/science/relativistic-mechanics

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the fundamentals of classical mechanics.	**K2**
CO2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	**K3**
CO3	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.	**K3, K5**

CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.	**K4, K5**
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.	**K2, K3**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH2	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	2	2	2	3	2	2
CO2	2	3	3	3	2	2	2	3	2	2
CO3	2	3	3	3	2	2	2	3	2	2
CO4	2	3	3	3	2	2	2	3	2	2
CO5	2	3	3	3	2	2	2	3	2	2

23PPH2	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	3	3	2	3	2
CO2	2	3	3	3	3	3	3	2	2	2
CO3	3	3	3	2	2	3	3	2	3	2
CO4	3	3	3	3	2	3	3	2	2	2
CO5	3	2	3	3	2	3	3	2	2	2

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Core 3 – GENERAL PHYSICS LABORATORY	**I YEAR - FIRST SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks

23PPH3P	**GENERAL PHYSICS LABORATORY**	**Core**				**4**	**6**	**100**

Pre-Requisites
Knowledge and hands on experience of basic general experiments of Physics
Learning **Objectives**
➢ To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations. ➢ To calculate the thermodynamic quantities and physical properties of materials. ➢ To analyze the optical and electrical properties of materials. ➢ To give hands on training to do advanced physics experiments. ➢ To make the students understand the concepts behind various physical experiments such as polarizablity of liquids refractive index of glass.

Course Details

(Any Twelve Experiments from the list)

1. Determination of Young's modulus and Poisson's ratio,Rigidity modulus by Hyperbolic fringes - Cornu's Method.
2. Determination of Young's modulus and Poisson's ratio, Rigidity modulus by Elliptic fringes - Cornu's Method.
3. Identification of Prominent lines by spectrum photograph- Iron Spectrum.
4. Identification of Prominent lines by spectrum photograph- Copper Spectrum.
5. Determination of Specific charge of an electron – e/m Thomson's method.
6. Measurement of Conductivity - Four probe method.
7. Determination of polarization of liquid (benzene) using spectrometer.
8. Determination of Stefan's constant of radiation from a hot body
9. Measurement of Susceptibility of liquid - Quincke's method.
10. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility.
11. Determination of Planck constant by Photo electric effect.
12. Determination of Charge of an electron by spectrometer.
13. Compressibility of a Liquid using Ultrasonic interferometer.
14. Determination of Specific rotatory power of a liquid using Polarimeter.
15. Determination of Magnetic susceptibility of a thin rod by Guoy method.
16. He-Ne Laser experiments (particle size, diameter of thin wire determination).
17. Determination of wavelength and thickness of a film using Michelson interferometer
18. .Determination of Magnetic susceptibility of a liquid by Guoy method.
19. Determination of Magnetic susceptibility of a powder Guoy method.
20. Determination of Rydberg constant using spectrometer.

TEXT BOOKS	1. Kit Developed for doing experiments in Physics- Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences. 2. General Physics Laboratory Manual,Department of Physics,

	ST.Joesph College,Trichy.(2000) 3. Practical Physics and Electronics,C.C.Ouseph,U.J.Rao, V.Vijayendran,S.Viswanathan Publishers(2007). 4. A text book of Practical Physics,M.N.Srinivasan, S.Balasubramanian,R.Ranganathan,sultan Chand&Sons(2017). 5. D.Malacara (ed.),Methods of Experimental Physics,Series of volume,Acadamic Press Inc.(1988) 6. An advanced course in Practical Physics,D.Chattopadhayay, C.RRakshit, New Central Book Agency Pvt. Ltd
REFERENCE BOOKS	1. Advanced Practical Physics, S.P Singh, PragatiPrakasan. 2. An advanced course in Practical Physics, D.Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd 3. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd. 4. Practical Physics, Gupta and Kumar, Pragati Prakasan

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the strength of material using Young's modulus.	**K2**
CO2	Acquire knowledge of thermal behaviour of the matetials.	**K1**
CO3	Understand theoretical principles of magnetism through the experiments.	**K2**
CO4	Acquire knowledge about arc spectrum and applications of laser	**K1, K3**
CO5	Improve the analytical and observation ability in Physics Experiments	**K3, K5**
CO6	Conduct experiments on applications of FET and UJT	**K4**
CO7	Analyze various parameters related to operational amplifiers.	**K4**
CO8	Understand the concepts involved in arithmatic and logical circuits using IC's	**K2**
CO9	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits	**K1**
CO10	Analyze the applications of counters and registers	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH3P	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3

CO5	3	3	3	3	3	3	2	2	2	2
CO6	2	2	2	3	3	1	1	1	3	3
CO7	2	2	3	3	3	1	1	1	3	3
CO8	3	3	3	3	3	3	2	2	3	3
CO9	3	3	3	3	3	3	1	1	1	1
CO10	3	3	3	3	3	3	1	1	1	1

23PPH3P	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	2	2	3	2	2	2	1	2	3
CO2	2	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	2	2
CO6	2	2	2	3	3	1	1	1	3	3
CO7	2	2	3	3	3	1	1	1	3	3
CO8	3	3	3	3	3	3	2	2	3	3
CO9	3	3	3	3	3	3	1	1	1	1
CO10	3	3	3	3	3	3	1	1	1	1

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
40	60	**100**	

Elective 1 - LINEAR AND DIGITAL ICs AND APPLICATIONS	**I YEAR - FIRST SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**

23PPHE1A	**LINEAR AND DIGITAL ICs AND APPLICATIONS**	**Elective**				**3**	**5**	**75**

Pre-Requisites
Knowledge of semiconductor devices, basic concepts of digital and analog electronics
Learning Objectives
➢ To introduce the basic building blocks of linear integrated circuits. ➢ To teach the linear and non-linear applications of operational amplifiers. ➢ To introduce the theory and applications of PLL. ➢ To introduce the concepts of waveform generation and introduce one special function ICs. ➢ Exposure to digital IC‘s.

UNITS	**Course Details**
UNIT I: INTEGRATED CIRCUITS AND OPERATIONAL AMPLIFIER	Introduction, Classification of IC‘s, basic information of Op-Amp 741 and its features - The ideal Operational amplifier - Op-Amp internal circuit and Op-Amp.Characteristics
UNIT II: APPLICATIONS OF OP-AMP	LINEAR APPLICATIONS OF OP-AMP: Solving simultaneous equations - Solving differential equations - V to I and I to V converters.. NON-LINEAR APPLICATIONS OF OP-AMP: Log and Antilog amplifier - Multiplier and Divider – Comparators - Schmitt trigger - Triangular and Square waveform generators.
UNIT III: ACTIVE FILTERS & TIMER AND PHASE LOCKED LOOPS	ACTIVE FILTERS: Introduction, Butterworth filters – 1st order, 2nd order low pass and high pass filters - band pass - band reject and all pass filters. TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer- Description of functional diagram of Monostable and Astable operations and applications - Schmitt trigger - PLL – introduction - basic principle - phase detector/comparator - voltage controlled oscillator (IC 566)
UNIT IV: VOLTAGE REGULATOR & D to A AND A to D CONVERTERS	VOLTAGE REGULATOR: Introduction - IC Voltage Regulators - Types of Voltage Regulator - Series Op-Amp regulator - Shunt Op-Amp Regulator IC 723 general purpose regulators, Switching Regulator . D to A AND A to D CONVERTERS: Introduction, basic DAC techniques – Binary weighted resistor DAC R-2R ladder DAC - Inverted R-2R ladder DAC - ADC Techniques - counter type ADC - Successive approximation ADC - Dual slope ADC
UNIT V: CMOS LOGIC, COMBINATIONAL CIRCUITS USING	CMOS LOGIC: CMOS logic levels - MOS transistors - Basic CMOS Inverter, NAND,NOR,AND,XOR gates

TTL 74XX ICs & SEQUENTIAL CIRCUITS USING TTL 74XX ICs	COMBINATIONAL CIRCUITS USING TTL 74XX ICs: Study of logic gates using 74XX ICs, Four-bit parallel adder (IC 7483) - Comparator (IC 7485) - Decoder (IC 74138, IC 74154). Multiplexer (IC74151), Demultiplexer (IC 74154). SEQUENTIAL CIRCUITS USING TTL 74XX ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194),
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd.,NewDelhi,India 2. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, NewDelhi. 3. B.L. Theraja and A.K. Theraja, 2004, A Textbook of Electrical technology, S. Chand & Co. 4. Jacob Millman.Christos Halkias.Chetan D Praikh (July 2017) Millman's Integrated Electronics Analog and Digital Circuits and system. Tata McGraw Hill, New Delhi,Second Edision. 5. V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition. 6. V. Vijayendran, 2008, Introduction to Integrated electronics (Digital & Analog), S.Viswanathan Printers & Publishers Private Ltd, Reprint. V.
REFERENCE BOOKS	1. Sergio Franco (1997), Design with operational amplifiers and analog integrated circuits, McGraw Hill, New Delhi. 2. Gray, Meyer (1995), Analysis and Design of Analog Integrated Circuits, Wiley International, New Delhi. 3. Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill, New Delhi 4. Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
WEB SOURCES	1. https://nptel.ac.in/course.html/digital circuits/ 2. https://nptel.ac.in/course.html/electronics/operational amplifier/ 3. https://www.allaboutcircuits.com/textbook/semiconductors/chpt-7/field-effect-controlled-thyristors/

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems	**K1, K5**
CO2	Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.	**K3**
CO3	Gain knowledge about PLL, and develop the skills to design the simple circuits using	**K1, K3**

	IC 555 timer and can solve problems related to it.	
CO4	Learn about various techniques to develop A/D and D/A converters.	**K2**
CO5	Acquire the knowledge about the CMOS logic, combinational and sequential circuits	**K1, K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPHE1A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	2	3	3	3	2
CO2	3	3	3	3	1	3	3	3	2	1
CO3	3	3	3	3	1	3	3	3	2	1
CO4	3	3	3	3	1	3	3	3	2	1
CO5	3	3	3	2	1	1	2	3	2	1

23PPHE1A	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	2	2	3	3	3	2
CO2	3	3	3	3	1	3	3	3	2	1
CO3	3	3	3	3	1	3	3	3	2	1
CO4	3	3	3	3	1	3	3	3	2	1
CO5	3	3	3	2	1	1	2	3	2	1

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Elective-2 . **CRYSTAL GROWTH AND THIN FILMS**	**I YEAR – FIRST SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks

23PPHE2A	**CRYSTAL GROWTH AND THIN FILMS**	**Elective**				**3**	**5**	**75**

Pre-Requisites
Fundamentals of Crystal Physics
Learning Objectives
➢ To acquire the knowledge on Nucleation and Kinetics of crystal growth ➢ To understand the Crystallization Principles and Growth techniques ➢ To study various methods of Crystal growth techniques ➢ To understand the thin film deposition methods ➢ To apply the techniques of Thin Film Formation and thickness Measurement

UNITS	**Course Details**
UNIT I: CRYSTAL GROWTH KINETICS	Basic Concepts, Nucleation and Kinetics of growth Ambient phase equilibrium - super saturation - equilibrium of finite phases equation of Thomson - Gibbs - Types of Nucleation - Formation of critical Nucleus - Classical theory of Nucleation - Homo and heterogeneous formation of 3D nuclei - rate of Nucleation - Growth from vapour phase solutions, solutions and melts - epitaxial growth - Growth mechanism and classification - Kinetics of growth of epitaxial films
UNIT II: CRYSTALLIZATION PRINCIPLES	Crystallization Principles and Growth techniques Classes of Crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram - Super solubility - expression for super saturation - Metastable zone and introduction period - Miers TC diagram - Solution growth - Low and high temperatures solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a Crystallizer.
UNIT III: GEL, MELT AND VAPOUR GROWTH	Gel, Melt and Vapour growth techniques Principle of Gel techniques - Various types of Gel - Structure and importance of Gel - Methods of Gel growth and advantages - Melt techniques - Czochralski growth - Floating zone - Bridgeman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - Physical vapour deposition - Chemical vapour deposition - Stoichiometry.
UNIT IV: THIN FILM DEPOSITION METHODS	Thin film deposition methods of thin film preparation, Thermal evaporation, Electron beam evaporation, pulsed LASER deposition, Cathodic sputtering, RF Magnetron sputtering, MBE, chemical vapour deposition methods, Sol Gel spin coating, Spray pyrolysis, Chemical bath deposition.
UNIT V: THIN FILM FORMATION	Thin Film Formation and thickness Measurement Nucleation, Film growth and structure - Various stages in Thin Film formation, Thermodynamics of Nucleation, Nucleation theories, Capillarity model

	and Atomistic model and their comparison. Structure of Thin Film, Roll of substrate, Roll of film thickness, Film thickness measurement - Interferometry, Ellipsometry, Micro balance, Quartz Crystal Oscillator techniques.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. V. Markov Crystal growth for beginners: Fundamentals of Nucleation, Crystal Growth and Epitaxy (2004) 2nd edition 2. A. Goswami, Thin Film Fundamentals (New Age, New Delhi, 2008) 3. P. SanthanaRaghavan and P. Ramasamy, "Crystal Growth Processes",KRU Publications. Kumbakonam, 2001) 4. 4. D. Elwell and H. J. Scheel, "Crystal Growth from High Temperature Solution" 5. Heinz K. Henish, 1973, "Crystal Growth in Gels", Cambridge University Press. USA.
REFERENCE BOOKS	1. J.C. Brice, Crystal Growth Process (John Wiley, New York, 1986) 2. P. Ramasamy and F. D. Gnanam, 1983, "UGC Summer School Notes". 3. M. Ohora and R. C. Reid, "Modeling of Crystal Growth Rates from Solution" 4. H.E. Buckley, 1986, Crystal Growth, John Wiley and Sons, New York 5. B.R. Pamplin, 1980, Crystal Growth, Pergman Press, London.
WEB SOURCES	1. https://www.youtube.com/playlist?list=PLbMVogVj5nJRjLrXp3kMtrIO8kZl1D1Jp 2. https://www.youtube.com/playlist?list=PLFW6lRTa1g83HGEihgwcy7KeTLUuBu3WF 3. https://www.youtube.com/playlist?list=PLADLRin7kNjG1Dlna9MDA53CMKFHPSi9m 4. https://www.youtube.com/playlist?list=PLXHedI-xbyr8xIl_KQFs_R_oky3Yd1Emw 5. https://www.electrical4u.com/thermal-conductivity-of-metals/

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Acquire the Basic Concepts, Nucleation and Kinetics of crystal growth	**K1**
CO2	Understand the Crystallization Principles and Growth techniques	**K2, K4**
CO3	Study various methods of Crystal growth techniques	**K3**
CO4	Understand the Thin film deposition methods	**K2**
CO5	Apply the techniques of Thin Film Formation and thickness Measurement	**K3, K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPHE2A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	2	1	3	2	2	2	2
CO2	3	3	1	3	1	2	3	2	2	1
CO3	3	2	1	3	1	2	3	3	3	1
CO4	3	2	1	2	1	2	3	3	3	1
CO5	2	3	3	3	1	3	3	3	3	2

23PPHE2A	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	1	2	1	3	2	2	2	2
CO2	3	3	1	3	1	2	3	2	2	1
CO3	3	2	1	3	1	2	3	3	3	1
CO4	3	2	1	2	1	2	3	3	3	1
CO5	2	3	3	3	1	3	3	3	3	2

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Core 4 - STATISTICAL MECHANICS	**I YEAR - SECOND SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPH4	**STATISTICAL MECHANICS**	**Core**				**5**	**6**	**75**

Pre-Requisites
Knowledge of Laws of thermodynamics, phase transition, entropy, ensembles, partition function, classical and quantum statistics, thermal equilibrium, Brownian motion
Learning Objectives
➢ To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics ➢ To identify the relationship between statistic and thermodynamic quantities ➢ To comprehend the concept of partition function, canonical and grand canonical ensembles ➢ To grasp the fundamental knowledge about the three types of statistics ➢ To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time

UNITS	Course Details
UNIT I: **PHASE TRANSITIONS**	Thermodynamic potentials - Phase Equilibrium - Gibb's phase rule - Phase transitions and Ehrenfest's classifications –Third law of Thermodynamics. Order parameters – Landau's theory of phase transition -.Gibb's Helmholtz relation – Nernst heat theorem of third law.
UNIT II: **STATISTICAL MECHANICS AND THERMODYNAMICS**	Foundations of statistical mechanics - Micro and Macro states – Statistical equilibrium - Micro canonical ensemble - Phase space –Entropy – Connection between statistics and Themodynamics – Entropy of an ideal gas using the micro canonical ensemble - Entropy of mixing and Gibb's paradox.
UNIT III: **CANONICAL AND GRAND CANONICAL ENSEMBLES**	Density distribution of phase space - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities -Thermodynamic properties of diatomic molecule
UNIT IV: **CLASSICAL AND QUANTUM STATISTICS**	Principles and Law of equipartition of energy Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.– Liquid Helium.
UNIT V: **REAL GAS, ISING MODEL AND FLUCTUATIOS**	Quantum theory of specific heat: Einstein's theory – Debye's theory - Ferromagnetism: Ising model - Mean-field theories of the Ising model in three, two and one dimensions - - Brownian motion - Langevin's theory -Fluctuations in energy, pressure, volume, and enthalpy- The Fokker-Planck equation
UNIT VI: **PROFESSIONAI COMPONENTS**	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

TEXT BOOKS	1. Singhal, Agarwal, Prakash, *Thermodynamics and Statistical Physics*(Prakashan, Meerut, 2003. 2. B. K. Agarwal and M. Eisner, *Statistical Mechanics,* Second Edition New Age International, New Delhi. 3rd edition, 2013). 3. F. Reif, 2010,*Fundamentals of Statistical and Thermal Physics,* McGraw - Hill, New York. 4. S. C. Garg, R. M. Bansal and C. K. Gosh, Thermal Physics: with Kinetic Theory,Thermodynamics and Statistical Mechanics (McGraw Hill Education,2nd edition, 2017). 5. R. K. Pathria and P. D. Beale, Statistical Mechanics (Academic Press, 3rd edition, 2011). 6. D. A. McQuarrie, Statistical Mechanics (Viva Books India, Viva Student Editi on, 2018).
REFERENCE BOOKS	1. L. D. Landau and E. M. Lifshitz, 1969, *Statistical Physics,* Pergamon Press, Oxford. 2. K. Huang, 2002, *Statistical Mechanics,* Taylor and Francis, London 3. W. Greiner, L. Neiseand H.Stoecker, *Thermodynamics and Statistical Mechanics,* Springer Verlang, New York. 1st edition, 1995 4. A. B. Gupta, H. Roy, 2002, *Thermal Physics,* Books and Allied, Kolkata. 5. J. K. Bhattacharjee, 1996, *Statistical Mechanics*: An Introductory Text, Allied Publication, New Delhi. 6.S. K. Sinha, 1990, Statistical *Mechanics,* Tata McGraw Hill, New Delhi
WEB SOURCES	1. https://byjus.com/chemistry/third-law-of-thermodynamics/ 2. https://web.stanford.edu/~peastman/statmech/thermodynamics.html 3. https://en.wikiversity.org/wiki/Statistical_mechanics_and_thermodynamics 4. https://en.wikipedia.org/wiki/Grand_canonical_ensemble 5. https://en.wikipedia.org/wiki/Ising_model

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition	**K5**
CO2	To analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. Describe the peculiar behaviour of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities	**K4**
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the	**K1**

	relation between thermodynamical quantities and partition function	
CO4	To recall and apply the different statistical concepts to analyze the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics.	**K4, K5**
CO5	To discuss and examine the thermodynamical behaviour of gases under fluctuation and also using Ising model	**K3**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH4	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	1	2	3	1	1	3
CO2	3	3	3	1	1	2	3	1	1	3
CO3	3	3	3	1	1	2	3	2	1	3
CO4	3	3	3	1	1	2	3	2	1	3
CO5	3	3	3	1	1	2	3	1	1	3

23PPH4	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	1	1	2	3	1	1	3
CO2	3	3	3	1	1	2	3	1	1	3
CO3	3	3	3	1	1	2	3	2	1	3
CO4	3	3	3	1	1	2	3	2	1	3
CO5	3	3	3	1	1	2	3	1	1	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Core 5 - **QUANTUM MECHANICS – I**	**I YEAR - SECOND SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPH5	**QUANTUM MECHANICS – I**	**Core**				**5**	**6**	**75**

Pre-Requisites
Knowledge of Newton's laws of motion, Schrodinger's equation, integration, differentiation.
Learning Objectives
➢ To develop the physical principles and the mathematical background important to quantum mechanical descriptions. ➢ To describe the propagation of a particle in a simple, one-dimensional potential. ➢ To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential. ➢ To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature ➢ To discuss the Approximation methods like perturbation theory, Variational and WKB methods for solving the Schrödinger equation.

UNITS	Course Details
UNIT I: **BASIC FORMALISM**	Interpretation of the wave function – Time dependent Schrodinger equation – Time independent Schrodinger equation – Stationary states – Ehrenfest's theorem – Linear vector space – Linear operator – Eigen functions and Eigen Values – Hermitian Operator – Postulates of Quantum Mechanics – Simultaneous measurability of observables – General Uncertainty relation
UNIT II: **ONE DIMENSIONAL AND THREE-DIMENSIONAL ENERGY EIGEN VALUE PROBLEMS**	Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – Bloch waves in a periodic potential – Kronig-penny square – well periodic potential – Linear harmonic oscillator: Operator method – Particle moving in a spherically symmetric potential – System of two interacting particles – Rigid rotator - Hydrogen atom
UNITIII: **GENERAL FORMALISM**	Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum representation – Symmetries and conservation laws – Unitary transformation – Parity and time reversal
UNIT IV: **APPROXIMATION METHODS**	Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – WKB approximation – Connection formulae (no derivation) – WKB quantization – Application to simple harmonic oscillator.

UNIT V: **ANGULAR MOMENTUM**	Eigenvalue spectrum of general angular momentum – Ladder operators and their algebra – Matrix representation – Spin angular momentum – Addition of angular momenta – CG Coefficients – Symmetry and anti – symmetry of wave functions – Construction of wave-functions and Pauli's exclusion principle.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. P.M. Mathews and K. Venkatesan, A Text book of Quantum mechanics TMH, New Delhi,. 6th edision, 2013 2. S. Rajasekar and R. Velusamy, Quantum Mechanics: The Fundamentals (CRC Press, Boca Raton, 2015). 3. Quantum Mechanics – Nouredine Zettili, John Wiley & Sons, Ltd, 2nd Edition, 2009. 4. Ajoy Ghatak and S.Loganathan, Quantum mechanics , TMH 6th edision 2015 5. G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009. 6. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011.
REFERENCE BOOKS	1. Leonard I Schiff, Quantum mechanics Fourth Edition, Mc Graw Hill Education 2016. 2. Introduction to Quantum mechanics Second Edition David J.Griffiths,Published by Pearson Education 2015. 3 K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985. 4. V.Devanathan, Quantum Mechanics, 2nd edition, Alpha Science 5. International Ltd, Oxford , 2011. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982.
WEB SOURCES	1. http://research.chem.psu.edu/lxjgroup/download_files/chem565-c7.pdf 2. http://www.feynmanlectures.caltech.edu/III_20.html 3. http://web.mit.edu/8.05/handouts/jaffe1.pdf 4. https://hepwww.pp.rl.ac.uk/users/haywood/Group_Theory_Lectures/Lecture_ 1.pdf 5. https://theory.physics.manchester.ac.uk/~xian/qm/chapter3.pdf

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics	**K1, K5**
CO2	Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems	**K3, K4**
CO3	Can discuss the various representations, space time symmetries and formulations of time evolution	**K1**

CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems	**K4, K5**
CO5	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.	**K3, K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

23PPH5	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	S	3	2	2	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	2	3	S	3	3	2	3

23PPH5	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	3	3	2	3	2	2	3
CO2	3	3	3	3	3	S	3	2	2	3
CO3	2	3	3	2	3	2	3	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	2	3	S	3	3	2	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Core 6 – ELECTRONICS LABORATORY	I YEAR - SECOND SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks

23PPH6P	**ELECTRONICS LABORATORY**	**Core**				**4**	**6**	**75**

Pre-Requisites
Knowledge and handling of basic electronics experiments of Physics
Learning Objectives
➢ To understand the concept of mechanical behavior of materials and calculation of same using appropriate equations. ➢ To calculate the thermodynamic quantities and physical properties of materials. ➢ To analyze the optical and electrical properties of materials. ➢ To observe the applications of SCR and UJT. ➢ To study the different applications of operational amplifier circuits. ➢ To learn about Combinational Logic Circuits and Sequential Logic Circuits

Course Details

(Any Twelve Experiments from the list)

1. Characteristics of UJT
2. Half and Full Subtractor
3. Half and Full Subtractor
4. Characteristics of SCR.
5. Construction of dual power supply using ICs (78XX and 79XX
6. K- Map.
7. Solving simultaneous equations – IC 741 / IC LM324
8. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter.
9. Operational amplifier - Digital to analog conversion by Binary weighted method.
10. Operational amplifier - Digital to analog conversion by R-2R ladder method
11. Design and study of Monostable multivibrator (IC 555).
12. Design and study of Bistable multivibrator (IC 555).
13. Design and study of Astable Multivibrator by 555 timer.
14. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
15. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
16. Study of R-S, clocked R-S,J-K and D-Flip flop using NAND gates
17. IC 7490 as scalar and seven segment display using IC7447
18. Multiplexer and Demultiplexer.
19. One bit comparator.
20. Frequency divider using IC 555.
21. Shift register.
22. Operational amplifier - Waveform generators.

TEXT BOOKS	1. Practical Physics, Gupta and Kumar, PragatiPrakasan. 2. Kit Developed for doing experiments in Physics- Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences. 3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition. 4. Electronics Laboratory Manual,Department of Physics,ST.Joesph College,Trichy.(2000). 5. B.K. Jones,Electronics for Experimentation and Research,Prentice-Hall(1986). 6. Electronic Laboratory Primer a design approach, S. Poornachandra, B.Sasikala, Wheeler Publishing, New Delhi. 7. Electronic lab manual Vol I, K ANavas, Rajath Publishing. 8. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition.
REFERENCE BOOKS	1. An advanced course in Practical Physics, D.Chattopadhayay, C.RRakshit, New Central Book Agency Pvt. Ltd. 2. Advanced Practical Physics, S.P Singh, PragatiPrakasan 3. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt.ltd 4. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing 5. Electronic Laboratory Primer a design approach, S. Poornachandra, B.Sasikala, Wheeler Publishing, New Delhi

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand the strength of material using Young's modulus.	**K2**
CO2	Acquire knowledge of thermal behaviour of the materials.	**K1**
CO3	Understand theoretical principles of magnetism through the experiments.	**K2**
CO4	Acquire knowledge about arc spectrum and applications of laser.	**K1**
CO5	Improve the analytical and observation ability in Physics Experiments.	**K4**
CO6	Conduct experiments on applications of FET and UJT.	**K5**
CO7	Analyze various parameters related to operational amplifiers.	**K4**
CO8	Understand the concepts involved in arithmetic and logical circuits using IC's.	**K2**
CO9	Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits	**K3**
CO10	Analyze the applications of counters and registers	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH6P	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	2	2	S	S	2	2	2	3	3

CO2	2	2	S	S	S	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3
CO6	2	2	2	3	3	2	2	2	3	3
CO7	2	2	3	3	3	2	2	3	3	3
CO8	3	3	3	3	3	3	3	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3
CO10	3	3	3	3	3	3	3	3	3	3

23PPH6P	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	2	2	3	3	2	2	2	3	3
CO2	2	2	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3
CO6	2	2	2	3	3	2	2	2	3	3
CO7	2	2	3	3	3	2	2	3	3	3
CO8	3	3	3	3	3	3	3	3	3	3
CO9	3	3	3	3	3	3	3	3	3	3
CO10	3	3	3	3	3	3	3	3	3	3

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
40	60	**100**	

Elective - 3. ADVANCED MATHEMATICAL PHYSICS	**I YEAR SECOND SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**

23PPHE3A	**ADVANCED MATHEMATICAL PHYSICS**	**Elective**				**3**	**4**	**75**

Pre-Requisites
Good knowledge in basic mathematics
Learning Objectives
➢ To educate and involve students in the higher level of mathematics and mathematical methods relevant and applicable to Physics.

UNITS	**Course Details**
UNIT I: DISCRETE GROUPS	Definition of a group, subgroup, class, Lagrange's theorem, invariant subgroup, Homomorphism and isomorphism between two groups. Representation of a group, unitary representations, reducible and irreducible representations Schur's lemmas, orthogonality theorem, character table, reduction of Kronecker product of representations.
UNIT II: PARTIAL DIFFERENTIAL EQUATIONS	Linear Partial differential equations - Separation of variables - Separation of Helmholtz equation in Cartesian coordinates - Solution of Laplace's equation in Cartesian, Spherical polar and Cylindrical, Circular and Cylindrical Harmonics coordinates - Symmetry and Separability - One dimensional and Two dimensional heat flow equation.
UNIT III: GREEN'S FUNCTIONS AND INTEGRAL EQUATIONS	Green's functions -Proof of symmetry- properties - Methods of solutions in one dimension – Applications : Green's function for poisson equation and Quantum mechanical scattering problem - Linear integral equations - Neumann series- Wronskian - Eigen function expansion of green's function - Applications.
UNIT IV: TENSORS	.Definition - Co-ordinate transformation Contravariant and covariant vectors and tensors, mixed tensors; tensor algebra, addition, subtraction, direct product of tensors, symmetric and antisymmetric tensors - Indicial and Summation conventions - Kronecker delta symbol - Tensors of higher Ranks - Conjugate tensors. Vectors and tensors under general co-ordinate transformations.
UNIT V: TENSOR CALCULUS	Covariant derivative, affine connection. Metric tensors : Spherical and Cylindrical co-ordinates - Riemannian Spaces - Christoffell's three index symbols – Relations between the two kinds - Transformation laws of Christofell's symbols.

UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. B.D.Gupta, Mathematical Physics, Vikas publishing ltd, India(2010). 2. H.K Dass & Dr.Ramavarma, Mathematical Physics, Sultan Chand & Sons, New Delhi.(2010) 3. M. T. Vaughn, Introduction to Mathematical Physics (Wiley India, 1st edition, 2013). 4. Sathya prakash, Mathematical Physics, Sultan Chand & Sons, New Delhi. 6th edition(2012). 5. P.K.Chattopadhyay, Mathematical Physics, New Age international,NewDelhi, 1992. 6. A.W.Joshi, Elements of Group theory for physicists, Wiley Eastern Ltd., New Delhi 1997.
REFERENCE BOOKS	1. V. Balakrishnan, Mathematical Physics with Applications, Problems and Solutions (Ane Books Pvt. Ltd. 1st edition, 2018). 2. G. Arfken, H. Weber and F. E. Harris, Mathematical Method for Physicists (Academic Press, 7th edition, 2012). 3. D. G. Zill, Advanced Engineering Mathematics (Jones & Bartlett, 6th edition, 2017). 4. E. Kreyszig, Advanced Engineering Mathematics(Wiley International Student Version,10th edition, 2016).
WEB SOURCES	1. https://vdoc.pub/documents/unitary-symmetry-and-elementary-particles-c4qsfejthkc0 2. https://physics.iith.ac.in/HEP_Physics/slides/poplawskitalk.pdf 3. https://www.hindawi.com/journals/amp/ 4. https://projecteuclid.org/journals/advances-in-theoretical-and-mathematical-physics 5. https://www.springer.com/journal/11232

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Gained knowledge of both discrete and continuous groups its apply various important theorems in group theory.	**K1**
CO2	Gained knowledge of linear Partial differential equations and One, Two dimensional	**K3**
CO3	Gained knowledge of Green's functions and eigen functions of application of physics	**K5**
CO4	Equipped to basic of tensors under general co-ordinate transformations	**K4, K5**
CO5	Developed skills to apply tensors to Christoffell's three index symbols.	**K2, K3**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPHE3A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	2	2	2	3	3
CO2	3	3	2	2	2	2	2	2	3	2
CO3	3	3	2	2	2	2	2	2	3	2
CO4	3	3	2	2	2	2	2	2	3	2
CO5	3	3	2	2	2	2	2	2	3	2

23PPHE3A	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	2	2	2	2	2	2	3	3
CO2	3	3	2	2	2	2	2	2	3	2
CO3	3	3	2	2	2	2	2	2	3	2
CO4	3	3	2	2	2	2	2	2	3	2
CO5	3	3	2	2	2	2	2	2	3	2

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Elective -4. MICROPROCESSOR AND MICROCONTROLLER	**I YEAR - SECOND SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHE4B	**MICROPROCESSOR AND MICROCONTROLLER**	**Elective**				**3**	**4**	**75**

Pre-Requisites
Knowledge of number systems and binary operations
Learning Objectives
➢ To provide an understanding of the architecture and functioning of microprocessor 8085A and to the methods of interfacing I/O devices and memory to microprocessor ➢ To introduce 8085A programming and applications and the architecture and instruction sets of microcontroller 8051 ➢ To acquire knowledge of microprocessor assembly language program ➢ Gain knowledge of microprocessor interrupts programming and interfacing. ➢ . To provide an understanding of the 8081 microcontroller hardware/.

UNITS	Course Details
UNIT I:8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING	Instruction set - Addressing modes - Programming techniques - Memory mapped I/O scheme- I/O mapped I/O scheme - Memory and I/O interfacing- Data transfer schemes - Interrupts of 8085 - Programmable peripheral interface (PPI) - Control group and control word- Programmable DMA controller - Programmable interrupt controller – Programmable communication interface - Programmable counter /interval timer.
UNIT II: 8085 INTERFACING APPLICATIONS	Seven segment display interface - Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities –Voltage and current) Measurement of physical quantities (Temperature an strain).
UNIT III: 8051 MICROCONTROLLER HARDWARE	Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/Output pins, Ports and Circuits – External data memory and program memory: External program memory, External data memory.
UNIT IV: 8051 INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING	Addressing modes – Data moving (Data transfer) instructions: Instructions to Access external data memory, external ROM / program memory, PUSH and POP instructions, Data exchange instructions – Logical instructions: byte and bit level logical operations, Rotate and swap operations – Arithmetic instructions: Flags, Incrementing and decrementing, Addition, Subtraction, Multiplication and division, Decimal arithmetic – Jump and CALL instructions: Jump and Call program range, Jump, Call and subroutines – Programming.
UNIT V: INTERRUPT PROGRAMMING AND INTERFACING TO	8051 Interrupts – Interrupt vector table – Enabling and disabling an interrupt – Timer interrupts and programming – Programming external hardware interrupts – Serial communication interrupts and programming – Interrupt priority in the 8051 : Nested interrupts ,

EXTERNAL WORLD	Software triggering of interrupt. LED Interface Seven segment display interface- Interfacing of Digital to Analog converter and Analog to Digital converter - Stepper motor interface - Measurement of electrical quantities – Voltage and current) Measurement of physical quantities(Temperature an strain).
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. A. NagoorKani, Microprocessors & Microcontrollers, RBA Publications (2009). 2. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013). 3. B. Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016). 4. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd. 5. Microprocessor and micro controller,(Krishna kant ,New Delh,i 2014.)
REFERENCE BOOKS	1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008) 2. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008). 3. Soumitra Kumar Mandal, Microprocessors and Microcontrollers Architecture, Programming and Interfacing using 8085, 8086, 8051, Mc Graw Hill Education (India) Private Limited, New Delhi (2015 4. W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Gain knowledge of architecture and working of 8085 microprocessor.	**K1**
CO2	Get knowledge of architecture and working of 8051 Microcontroller.	**K1**
CO3	Be able to write simple assembly language programs for 8085A microprocessor.	**K2, K3**
CO4	Able to write simple assembly language programs for 8051 Microcontroller.	**K3, K4**
CO5	Understand the different applications of microprocessor and microcontroller.	**K3,K 5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) **and** LOW (1)**.**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	3	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2
CO3	3	3	3	3	3	2	2	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2
CO5	3	3	3	3	3	2	2	2	2	2

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	3	2	2	2	2	2
CO2	2	2	2	2	1	2	2	2	2	2
CO3	3	3	3	3	3	2	2	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2
CO5	3	3	3	3	3	2	2	2	2	2

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Skill Enhancement Course-I **PHYSICS FOR SKILL ENHANCEMENT-I**	**I YEAR - SECOND SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHSE1	**PHYSICS FOR SKILL ENHANCEMENT-I**	**Skill Enhancement**				**2**	**4**	**75**

Pre-Requisites
Knowledge of applications physics.
Learning Objectives

- To understand the needs of research and to acquire the knowledge about research trends.
- To understand the working mechanisms of opto- electronic devices.
- To acquire the knowledge about satellite structures and to satellite propulsion.
- To acquire the knowledge about universe and to understand the scaling to measurements used in universe.
- To acquire knowledge about energy resources and to understand the energy conversion.

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHSE1	**PHYSICS FOR SKILL ENHANCEMENT-I**	**Skill Enhancement**				**2**	**4**	**75**

UNITS	Course Details
UNIT I: **RESEARCH**	Definition of Research – Types of Research – Formulating a Research Problem - Research Execution - Report Writing - Modern Research Trends in Physics: Quantum Computer - Particle Accelerator – Council European Nuclear Research (CERN).
UNIT II: **OPTO-ELECTRONIC DEVICES**	PN photodiode – Solar Cell – Light Emitting Diode (LED) — LASER Diode – Liquid Crystal Display (LCD) – Plasma Displays.
UNIT III: **SATELLITE MECHANISM**	Component of Satellite – Polar and Geostationary Satellite – Satellite Communication – GPS – Spacecraft Propulsion: Principle, Types.
UNIT IV: **UNIVERSE**	Solar Systems – Electromagnetic Radiation – Galaxy – Black Hole – Dark Matter –Expansion of Universe – Cosmological Red shift – Scaling of Universe: Light Year – Astronomical Unit – Parsec.
UNIT V: **ENERGY RESOURCE AND CONVERSION**	Renewable Energy Resources: Solar Cell – Wind Mill – Hydro Power – Tidal – Geothermal – Biomass. Non-renewable Energy Resources: Oil – Natural gas – Coal – Nuclear Energy.
UNIT VI: **PROFESSIONAL COMPONENTS**	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

REFERENCE BOOKS	1. Umesh Kumar B Dubey, D P Kothari, 2022, *Research Methodology: Techniques and Trends*, CRC Press, Florida, USA. 2. S. C. Gupta, 2015, *Opto-Electronic Devices and Systems*, PHI Learning PVT Ltd, Delhi. 3. A.K. Maini, Varsha Agarwal, 2011, *Satellite Technology*, John Wiley & Sons Ltd, United Kingdom. 4. Dinwiddie, Robert; Philip Eales, 2020, *Universe*, Martin Rees London. 5. Tushar K. Ghosh, Mark A. Prelas, 2011, *Energy Resources and Systems*, Springer Science & Business Media.
WEB SOURCES	1. https://www.questionpro.com/blog/what-is-research 2. https://www.geeksforgeeks.org/optoelectronic-devices 3. https://testbook.com/physics/rocket-propulsion 4. https://www.space.com/52-the-expanding-universe-from-the-big-bang-to-today.html 5. https://www2.tulane.edu/~sanelson/eens1110/energy.html

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand the needs of research and to acquire the knowledge about research trends.	**K2,K3,K4**
CO2	Understand the working mechanisms of opto- electronic devices.	**K1,K2**
CO3	Acquire the knowledge about satellite structures and to satellite propulsion.	**K2, K4**
CO4	Acquire knowledge about universe and to understand the scaling to measurements used in universe.	**K3, K2**
CO5	Acquire knowledge about energy resources and to understand the energy conversion	**K1,K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) **and** LOW (1)**.**

23PPHSE1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	3	3	3	3	2	2	2	2	2
CO2	3	3	3	3	3	2	2	2	2	2
CO3	3	3	3	3	3	2	2	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2
CO5	3	3	2	2	2	2	2	2	2	2

23PPHSE1	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	3	3	3	3	2	2	2	2	2
CO2	2	2	2	2	1	2	2	2	2	2
CO3	3	3	2	3	2	2	2	2	2	2

CO4	3	3	3	3	3	2	2	2	2	2
CO5	3	3	3	3	2	2	2	2	2	2

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Core 7 - QUANTUM MECHANICS – II		II YEAR - THIRD SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23PPH7	**QUANTUM MECHANICS – II**	**Core**				**5**	**6**	**75**

Pre-Requisites
Knowledge of postulates of Quantum mechanics, properties of Hermitian operators, ladder operators, degeneracy, angular momentum techniques and commutation rules
Learning Objectives

- Formal development of the theory and the properties of angular momenta, both orbital and spin
- To familiarize the students to the crucial concepts of scattering theory such as partial wave analysis and Barn approximation.
- Time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field
- To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts
- To introduce the concept of covariance and the use of Feynman graphs for depicting different interactions

UNITS	Course Details
UNIT I: SCATTERING THEORY	Scattering amplitude – Cross sections – Born approximation and its validity – Scattering by a screened coulomb potential – Yukawa potential – Partial wave analysis – Scattering length and Effective range theory for s wave – Optical theorem – Transformation from centre of mass to laboratory frame.
UNIT II: PERTURBATION THEORY	Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation
UNIT III: RELATIVISTIC QUANTUM MECHANICS	Klein – Gordon Equation – Charge And Current Densities – Dirac Matrices – Dirac Equation – Plane Wave Solutions – Interpretation of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment of an Electron Due To Spin
UNIT IV: DIRAC EQUATION	Covariant form of Dirac Equation – Properties of the gamma matrices – Traces - Relativistic invariance of Dirac equation – Probability Density – Current four vector – Bilinear covariant – Feynman's theory of positron (Elementary ideas only without propagation formalism)
UNIT V: CLASSICAL FIELDS AND SECOND QUANTIZATION	Classical fields – Euler Lagrange equation – Hamiltonian formulation – Noether's theorem – Quantization of real and complex scalar fields – Creation, Annihilation and Number operators – Fock states – Second Quantization of K-G field.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. P.M. Mathews and K. Venkatesan, A Text book of Quantum mechanics TMH, New Delhi, 6th edision, 2013. 2. S. Rajasekar and R. Velusamy, Quantum Mechanics: The Fundamentals (CRC Press, Boca Raton, 2015 3. G.Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009 4. Introduction to Quantum mechanics Second Edition David

	J.Griffiths,Published by Pearson Education 2015. 5. V. Devanathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005.
REFERENCE BOOKS	1. B.K.Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009. 2. Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics,1st edition,I.K.International Publishing house Pvt.Ltd., 2006 3. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 6th Edition, Macmillan India, New Delhi.2015. 4. Nouredine Zettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017. 5. Leonard I Schiff, Quantum mechanics Fourth Edition, Mc Graw Hill Education 2016.
WEB SOURCES	1. https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf 2. http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf 3. http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf 4. https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf 5. https://web.mit.edu/dikaiser/www/FdsAmSci.pdf

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Familiarize the concept of scattering theory such as partial wave analysis and Born approximation	**K1**
CO2	Give a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts	**K2**
CO3	Discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac equations and the phenomena accounted by them like electron spin and magnetic moment	**K1, K4**
CO4	Introduce the concept of covariance and the use of Feynman graphs for depicting different interactions	**K1, K3**
CO5	Demonstrate an understanding of field quantization and the explanation of the scattering matrix.	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

23PPH7	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	3	3	3	3

CO3	3	2	2	3	3	2	3	3	3	3
CO4	2	2	2	3	3	2	2	2	3	3
CO5	2	2	2	3	3	2	2	2	3	3

23PPH7	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	3	3	3	3
CO3	3	2	2	3	3	2	3	3	3	3
CO4	2	2	2	3	3	2	2	2	3	3
CO5	2	2	2	3	3	2	2	2	3	3

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
25	75	**100**	

Core 8- ATOMIC PHYSICS AND MOLECULAR SPECTROSCOPY	**II YEAR - THIRD SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23PPH8	**ATOMIC PHYSICS AND MOLECULAR SPECTROSCOPY**	**Core**				**5**	**6**	**75**

Pre-Requisites
Thorough understanding of electromagnetic spectrum, mathematical abilities, knowledge of molecules, their structure, bond nature, physical and chemical behaviour
Learning Objectives
➢ To comprehend the theory behind atomic spectra,Spectroscopic terms. ➢ To know the working principles along with an overview of construction of different types of spectrometers involved

- To explore various applications of these techniques in R &D.
- Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds.
- Understand this important analytical tool

UNITS	CourseDetails
UNIT I: **ATOMIC SPECTRA**	Quantum states of electron in atoms - Hydrogen atom spectrum - Electron spin - Stern Gerlach experiment - Spin-orbit interaction - Lande interval rule - Two electron systems, LS-JJ coupling schemes - Fine structure - Spectroscopic terms and selection rules - Hyperfine structure - Isotopic shift. Exchange symmetry of wave functions - Pauli's exclusion principle - Periodic table - Alkali type spectra - Equivalent electrons - Hund's rule.
UNIT II: **ATOMS IN EXTERNAL FIELDS AND X - RAY SPECTRA**	Zeeman and Paschen Back effect of one and two electron systems - Selection rules - Stark effect - Inner shell vacancy - X-ray- Auger transitions - Compton Effect. Molecules: Covalent, Ionic and van der Waal's interactions - Born Oppenheimer approximation. X - ray spectra: origin of x-rays - Emission spectra and double spectra - Absorption spectra.
UNIT III: **MICROWAVE AND IR SPECTROSCOPY**	Rotational spectra of diatomic molecules - Intensities of spectral lines – The effect of isotopic substitution - the non-rigid rotator - Rotational spectra of poly atomic molecules - Linear, symmetric top and asymmetric top molecules - Experimental techniques - Vibrating diatomic molecule - Diatomic vibrating rotator: Linear and symmetric top molecules - Analysis by infrared techniques.

UNIT IV: **RAMAN SPECTROSCOPY**	Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line-SR branch -Raman activity of H_2O and CO_2 -Mutual exclusion principle-determination of N_2O structure -Instrumentation technique and block diagram - structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy- SERS.
UNIT V: RESONANCE SPECTROSCOPY	Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction – interpretation of simple organic molecules - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries- MRI Scan. Electron Spin Resonance: Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) – Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation - Medical applications of ESR.

UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi. 2. A. Beiser, Concepts of Modern Physics (McGraw Hill, New York, 1995) 3. Manas Chanda, Atomic Structure and Chemical Bond, TMH 4th edision 2000. 4. G Aruldhas, 2nd Edision 2008, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi. 5. B.K. Sharma, 2015, *Spectroscopy*, Goel Publishing House Meerut. 6. Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7th Edition), New Age International Publishers.
REFERENCE BOOKS	1. J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi. 2. J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge. 3. Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, SpringerLink. 4. Vimal Kumar Jain, Introduction to molecular spectroscopy(Alpha science international,Ltd,2007. 5. Introduction to molecular spectroscopy - G.M.Barrow (McGraw Hill, New York, 2018.)
WEB SOURCES	1. https://www.youtube.com/watch?v=0iQhirTf2PI 2. https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5 3. https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee 4. https://onlinecourses.nptel.ac.in/noc20_cy08/preview 5. https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand fundamentals of atomic spectra, view molecules as elastic rotors and interpret their behaviour. Able to quantify their nature and correlate them with their characteristic properties.	**K2**
CO2	Understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules.	**K2, K3**
CO3	Interpret structures and composition of molecules Rotational spectra of poly atomic molecules & linear and symmetric top and asymmetric top molecules.	**K5**
CO4	Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances and use their knowledge of Raman Spectroscopy as an important analytical tool.	**K4**
CO5	Learn the electronic transitions caused by absorption of radiation in the NMR & ESR region of the electromagnetic spectrum and be able to analyze a simple Resonance	**K1, K5**

	spectrum.	

K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	3	3	3	2
CO3	3	2	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	3	3	3	2
CO3	3	2	3	3	3	3	3	3	3	3
CO4	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	75	**100**	

Core 9 - ELECTROMAGNETIC THEORY	**II YEAR - THIRD SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPH9	**ELECTROMAGNETIC THEORY**	**Core**				**5**	**6**	**75**

Pre-Requisites
Knowledge of different coordinate systems, Laplace's equation, conducting & non-conducting medium, basic definitions in magnetism, propagation of electromagnetic waves, plasma
Learning Objectives

- To acquire knowledge about boundary conditions between two media and the technique of method of separation of variables
- To understand Biot – Savart's law and Ampere's circuital law
- To comprehend the physical ideas contained in Maxwell's equations, Coulomb & Lorentz gauges, conservation laws
- To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves
- To grasp the concept of plasma as the fourth state of matter and wave guide,TM &TE modes.

UNITS	Course Details
UNIT I: **ELECTROSTATICS**	Coloumb's law - The electric field - Line, flux and gauss law in differential form-The electrostatic potential –Conductors and insulators: Gauss's law and its applications - The curl of E- Poisson equation in three dimensions Boundary value problems and Laplace equation – Boundary conditions and uniqueness theorem – Laplace equation in three dimension – Solution in Cartesian and spherical polar coordinates – Examples of solutions for boundary value problems. Polarization and displacement vectors - Boundary conditions - Dielectric sphere in a uniform field
UNIT II: **MAGNETOSTATICS**	Biot-Savart's Law - Ampere's law - Magnetic vector potential and magnetic field of a localized current distribution - Magnetic moment, force and torque on a current distribution in an external field - Magneto static energy - Magnetic induction and magnetic field in macroscopic media - Boundary conditions - Uniformly magnetized sphere.
UNIT III: **MAXWELL EQUATIONS**	Faraday's laws of Induction - Maxwell's displacement current - Maxwell's equations - Conservation laws - Continuity equation - Poynting's theorem - Vector and scalar potentials - Lorentz force - Maxwell's equation in a matter – Maxwell's equation in free space, in linear isotropic media - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges.
UNIT IV: **WAVE PROPAGATION**	Plane waves in non-conducting media - Linear and circular polarization, Energy flux in a plane wave - Radiation pressure and momentum -Reflection and refraction at a plane interface - Waves in a conducting medium - Frequency dispersion characteristics of dielectrics. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole Simplified model of propagation in the ionosphere and magnetosphere - Waves in a dissipative medium.

UNIT V: **WAVE GUIDE AND RADIATING SYSTEM**	Propagation of waves between conducting planes - waves in Guides of Arbitrary cross-section: Group velocity. Propagation of electromagnetic waves in hollow metallic cylindrical and rectangular wave guides- TM and TE modes- Transmission lines - Resonant cavities - Magnetic dipole and electric dipole field - Center-field linear antenna.
UNIT VI: PROFESSIONAL COMPONENTS:	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.
TEXT BOOKS	1. D. J. Griffiths, 2012, *Introduction to Electrodynamics*, 3rd Edition, Prentice-Hall of India, New Delhi. 2. K. K. Chopra and G.C. Agarwal, Electromagnetic theory, K. Nath & Co. Meerut 2016 3. B.Chakraborty,principles of electro dynamics ,books and allied ,kolkatta, 2002 4. J.D. Jackson, Classical Electrodynamics (Wiley Eastern, 1999) 5. Satya Prakash, Electromagnetic Theory and Electrodynamics (Kedar Nath Ram Nath,Meerut, 2015) 6. B.B. Laud, Elctromagnetics (New Age International Publishers).
REFERENCE BOOKS	1. John R. Reitz, Fredrick, J. Milford and Robert, W. Christy, Foundations of electromagnetic Theory,2012. 2. Classical Electromagnetism – Jerrold Franklin, Dover Publications, Inc.,2nd Edition, 2017 3. J. D. Kraus and D. A. Fleisch, 1999, *Electromagnetics with Applications*, 5th Edition, WCB McGraw-Hill, New York. 4. B. Chakraborty, 2002, *Principles of Electrodynamics*, Books and Allied, Kolkata. 5. P. Feynman, R. B. Leighton and M. Sands, 1998, *The Feynman Lectures on Physics*, Vols. 2, Narosa Publishing House, New Delhi. 6.Andrew Zangwill, 2013, Modern Electrodynamics,Cambridge University Press, USA.
WEB SOURCES	1. http://www.plasma.uu.se/CED/Book/index.html 2. http://www.thphys.nuim.ie/Notes/electromag/frame-notes.html 3. http://www.thphys.nuim.ie/Notes/em-topics/em-topics.html 4. http://dmoz.org/Science/Physics/Electromagnetism/Courses_and_Tutorials/ 5. https://www.cliffsnotes.com/study-guides/physics/electricity-and-magnetism/electrostatics

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Solve the differential equations using Laplace equation and to find solutions for boundary value problems	**K1, K5**
CO2	Use Biot-Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems	**K2, K3**

CO3	Apply Maxwell's equations to describe how electromagnetic field behaves in different media	**K3**
CO4	Apply the concept of propagation of EM waves through wave guides in optical fiber communications and also in radar installations, calculate the transmission and reflection coefficients of electromagnetic waves	**K3, K4**
CO5	Investigate the interaction of ionized gases with self-consistent electric and magnetic fields	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH9	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	2	2	3	3	1	3
CO2	3	3	3	1	2	2	3	3	1	3
CO3	3	3	3	1	2	2	3	3	1	3
CO4	3	3	3	1	2	2	3	3	1	3
CO5	3	3	3	1	2	2	3	3	1	3

23PPH9	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	1	2	2	3	3	1	3
CO2	3	3	3	1	2	2	3	3	1	3
CO3	3	3	3	1	2	2	3	3	1	3
CO4	3	3	3	1	2	2	3	3	1	3
CO5	3	3	3	1	2	2	3	3	1	3

Core 10 – MICROPROCESSOR , MICROCONTROLLER AND PYTHON LABORATORY	**II YEAR - THIRD SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23PPH10P	**MICROPROCESSOR , MICROCONTROLLER AND PYTHON LABORATORY**	**Core**				**4**	**6**	**75**

Knowledge and handling of general and experiments of Physics, as well as fundamentals of digital

principles, python programming.
Learning Objectives
➢ To understand the theory and working of Microprocessor, Microcontroller and their applications ➢ To use microprocessor and Microcontroller in different applications ➢ The aim and objective of the course on Computational Practical is to familiarize the of M.Sc. students with the numerical methods used in computation and programming using any high level language such as mathematical skills. . ➢ To equip the computational skill using numerical methods using python programming. ➢ To apply the software tools to explore the concepts of physical science.

Course Details

ANY 12 EXPERIMENTS (4 from each section)

MICROPROCESSOR

1. Addition, subtraction, multiplication and divison (8 bit)
2. 16 bit addition and 1's and two's complement subtraction(8 and 16 bit)
3. Conversion : Decimal to Octal and Decimal to hexadecimal
4. Searching for a number from a given list
5. Ascending and descending order
6. Stepper motor interface
7. Temperature measurement interface

MICROCONTROLLER

1. Addition, subtraction, multiplication and division
2. Fibonacci series
3. Factorial of a number
4. Square root of a number
5. Gray code to 8 bit binary number conversion
6. Ascending and descending order
7. Conversion : Decimal to Octal and Decimal to hexadecimal

PYTHON PROGRAMMING

1. Newton Raphson method
2. Simpson and Trapezoidal integration rules
3. Gauss Elimination method
4. Runge Kutta II and IV order methods
5. Newtons Forward and backward formulae
6. Bifurcation diagram of logistic map
7. Duffing Oscillator trajectory plot

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Develop the programming skills of Microprocessor	**K5**
CO2	Appreciate the applications of Microprocessor programming	**K3**
CO3	Understand the structure and working of 8085 microprocessor and apply it.	**K1, K3**
CO4	Acquire knowledge about the interfacing peripherals with 8085 microprocessor .and 8051 microcontroller with various peripherals.	**K1, K4**
CO5	Acquire knowledge about the interfacing problem-solving aptitudes of students using various numerical methods and apply numerical methods to find out solution of algebraic equation using python programming under different conditions, and numerical solution of system of algebraic equation.	**K1,K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH10P	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	3	3	2	2	2	3	2
CO2	2	2	3	3	3	2	2	1	3	2
CO3	3	3	2	3	3	2	2	1	3	2
CO4	3	3	3	3	3	2	2	2	3	2
CO5	3	3	3	3	3	2	2	2	3	2

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	2	2	2	3	3	2	2	2	3	2
CO2	2	2	3	3	3	2	2	2	3	2
CO3	3	3	2	3	3	2	2	2	3	2
CO4	3	3	3	3	3	2	2	2	3	2
CO5	3	3	3	3	3	2	2	2	3	2

Elective - 5. PHYSICS OF NANOSCIENCE AND TECHNOLOGY	**II YEAR – THIRD SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHE5A	**PHYSICS OF NANOSCIENCE AND TECHNOLOGY**	**Elective**				**3**	**3**	**75**

Pre-Requisites
Basic knowledge in nanoscience& technology

Learning Objectives
➢ Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale. ➢ To provide the basic knowledge about nanoscience and technology. ➢ To provide knowledge of synthesis and fabrication of nanotechnology. ➢ To learn the structures and properties of nanomaterials. ➢ To acquire the knowledge about synthesis methods and characterization techniques and its applications.

UNITS	Course Details
UNIT I: FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY	Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology -– Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.
UNIT II: PROPERTIES OF NANOMATERIALS	Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior:Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).
UNIT III: SYNTHESIS AND FABRICATION	Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator.
UNIT IV: CHARACTERIZATION TECHNIQUES	Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.
UNIT V: APPLICATIONS OF NANOMATERIALS	Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters – Photocatalytic application: Air purification, water purification -Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries - supercapacitors - photovoltaics.
UNIT VI:	Expert Lectures, Online Seminars - Webinars on Industrial

PROFESSIONAL COMPONENTS	Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. A textbook of Nanoscience and Nanotechnology, Pradeep T., Tata McGraw-Hill Publishing Co. (2012). 2. Principles of Nanoscience and Nanotechnology, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010). 3. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay and A.N. Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012). 4. Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002). 5. Nanotechnology and Nanoelectronics, D.P. Kothari, V. Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt.Ltd, New Delhi. (2018)
REFERENCE BOOKS	1. Nanostructures and Nanomaterials – HuozhongGao – Imperial College Press (2004). 2. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA 3. Nano particles and Nano structured films; Preparation, Characterization and Applications, J.H.Fendler John Wiley and Sons. (2007) 4. Textbook of Nanoscience and Nanotechnology, B.S.Murty, et al., Universities Press. (2012) 5. The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press, New Delhi.
WEB SOURCES	1. www.its.caltec.edu/feyman/plenty.html 2. http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm 3. http://www.understandingnano.com 4. http://www.nano.gov 5. http://www.nanotechnology.com

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand the basic of nanoscience and explore the different types of nanomaterials and should comprehend the surface effects of the nanomaterials.	**K1, K2**
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.	**K1**
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.	**K2, K3**
CO4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.	**K4**

CO5	Apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.	**K3**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPHE5A	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	2	2	3	3	3	3
CO2	3	3	3	2	2	2	3	3	3	3
CO3	3	3	2	2	2	2	3	3	3	3
CO4	3	3	3	2	2	2	3	3	3	3
CO5	3	3	2	2	2	2	3	3	3	3

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	2	2	3	3	3	3
CO2	3	3	3	2	2	2	3	3	3	3
CO3	3	3	2	2	2	2	3	3	3	3
CO4	3	3	3	2	2	2	3	3	3	3
CO5	3	3	2	2	1	2	3	3	3	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Elective 5 - NUMERICAL METHODS AND PYTHON PROGRAMMING	**II YEAR - THIRD SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHE5B	**NUMERICAL METHODS AND PYTHON PROGRAMMING**	**Elective**				**3**		**75**

Pre-Requisites
Basic knowledge in numerical methods and python programming.
Learning Objectives

- This advanced course on scientific computing using numerical methods and Python will focus on programming
- Facilitating comprehension of object-oriented programming through Fortran and python programming languages for simulating scientific problems.
- Understanding fundamentals of programming such as variables conditional and iterative execution, methods, etc.
- Enabling the handling of arrays and related operations for advanced problems and Improving scientific data plotting and analysis.
- Providing a working knowledge of practical numerical methods.

UNITS	Course Details
UNIT I: **NUMERICAL METHODS**	Root finding: Newton Raphson method - System of equations: Gauss elimination - Curve fitting: Linear least squares approximation Interpolation: Lagrange and Newton - Numerical differentiation - Numerical Integration: Trapezoidal and Simpson's rules - Solving ODES: Euler and Runge-Kutta methods.
UNIT II: **FORTRAN 95 BASICS**	Syntax - Data types - Variables - Constants - Operators - Branches and Loops - Strings -Decisions - Basic Input/Output - File Operations.
UNIT III: **ADVANCED COMPUTING IN FORTRAN 95**	1D Arrays - Multi-dimensional Arrays - Intrinsic Array functions - Pointers - Subprogram - Functions - subroutines - Modules - Formatted Input/Output - Visualization with GNUplot - Parallel programming with Fortran - Basics - OpenMP, MPI and Coarray Fortran .
UNIT IV: **PYTHON BASICS**	Python variables - Data types - Data structures: lists, dicts, tuples, sets, strings - Loops - Functions - Methods - Objects - File handling.
UNIT V: **PYTHON LIBRARIES**	Basic Numpy : 2D Numpy Arrays - Pandas : Basic data manipulation - Matplotlib: basic plotting - Plot types - Image functions - Axis functions - Figure functions - 2D and 3D plots - Annotations and texts.

TEXT BOOKS	**Unit 1,2:** 1. Ed Jorgensen, Introduction to Programming using Fortran 95, 2003, 2008, (Ed Jorgensen,2018). 2. A. Singaravelu, Numerical methods, Meenakshi Agency, Chennai(2008) 3. M.K.Venkataraman, Numerical method in Science and Engineering, The National Publishing Company, Chennai,(1999) 4. T. Williams and C. Kelley, Gnuplot 5.0 An Interactive Plotting Program(Samurai Media limited, 2015). 5. J. C. Adams, W. S. Brainerd, J. T. Martin, B. T. Smith, and J. L.

	Wagener, Fortran 90 Handbook (Multiscience press, New York, 1992). 6. R. Chandra, L. Dagum, D. Kohr, D. Maydan, J. McDonald, and R. Menon, Parallel Programming in openMP, (Morgan Kaufmann Publishers, San Francisco, 2001). 7. S. Ray, Fortran 2018 with Parallel Programming (CRC press, New York, 2019).
REFERENCE BOOKS	**Unit 3&4** 1. E. Matthes, Python Crash Course, 2nd Edition (No Starch Press, San Francisco, 2019). **2.** W. McKinney, Python for Data Analysis (O'Reilly Media, Sebastopol, 2013). **Unit 4&5** 3. T. Sauer, Numerical Analysis, 2nd Edition (Pearson, San Francisco, 2012). 4. K. N. Anagnostopoulos, Computational Physics (National Technical University of Athens,Greece, 2014)
WEB SOURCES	**Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]** 1. https://onlinecourses.nptel.ac.in/noc20_ma33/preview 2. https://nptel.ac.in/course/103106074/ 3. https://nptel.ac.in/course/122106033/

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods, their limitations.	**K1, K2**
CO2	Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations.	**K5**
CO3	Understand, how interpolation will be used in various realms of physics and Apply to some simple problems Analyze the newton forward and backward interpolation	**K2, K3**
CO4	Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson's method of numerical integration.	**K3, K4**
CO5	Understand the basics of C-programming and conditional statements.	**K2**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)

23PPHE5B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	2	3	2	2	3
CO2	3	2	3	2	2	2	3	2	2	3
CO3	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	2	2	3	2	2	3
CO5	3	2	3	2	2	2	3	2	2	3

23PPHE5B	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	2	3	2	2	2	3	2	2	3
CO2	3	2	3	2	2	2	3	2	2	3
CO3	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	2	2	2	3	2	2	3
CO5	3	2	3	2	2	2	3	2	2	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Skill Enhancement Course 2(Online objective) PHYSICS FOR COMPETITIVE EXAMINATION	II YEAR - THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHSE2	**PHYSICS FOR COMPETITIVE EXAMINATION**	**Skill Enhancement**				**2**	**3**	**75**

Pre-Requisites
Knowledge of different coordinate systems, Mathematical physics, Lagrangian and Hamiltonian formalism, basic definitions in quantum mechanics, propagation of electromagnetic waves, Electronics
Learning Objectives

- To acquire knowledge about special function applicable technique
- To understand classical mechanics and lagrangian and Hamiltonian formalism then physical ideas contained in Maxwell's equations
- To comprehend the quantum mechanics.
- To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves.
- To understand the concept of electronics.

UNITS	Course Details
UNIT I: **MATHEMATICAL PHYSICS**	Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals.
UNIT II: **CLASSICAL MECHANICS**	Two body Collisions - Scattering in laboratory and Centre of mass frames. Rigid body dynamics-Moment of inertia tensor. Non-inertial frames and Pseudo forces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: Small oscillations, Normal modes.
UNIT III: **QUANTUM MECHANICS**	Spin-orbit coupling, Fine structure - WKB approximation. Elementary theory of scattering: phase shifts,partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations.Semi-classical theory of radiation
UNIT IV: **ELECTROMAGNETIC THEORY**	Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell'sequations in free space and linear isotropic media; Boundary conditions on the fields at interfaces. Scalar and vector potentials, Gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors - Reflection and Refraction, Polarization, Fresnel's law, Interference, Coherence, and Diffraction.
UNIT V: **ELECTRONICS**	Semiconductor devices (Diodes, Junctions, Transistors, Field effect devices, homo- and hetero-junction devices)-Opto-electronic devices (solar cells, Photo-detectors, LEDs) - Operational amplifiers and their applications - Digital techniques and applications (Registers, Counters, Comparators and similar circuits).

TEXT BOOKS	1. Mathematical Physics, H.K.DASS, RAMA VERMA, Sultan Chand & Sons, New Delhi.(2010). 2. Classical Mechanics, J.C.Upadhya, Himalaya Publishing House,

	2012. & CSIR-UGC NET (JRF & LS) Physical Science 3. P.M. Mathews and K. Venkatesan, A Text book of Quantum mechanics TMH, New Delhi, 6th edision, 2013. 4. D.J.Griffiths, 2012, *Introduction to Electrodynamics*, 3rd Edition, Prentice-Hall of India, New Delhi. 5. Principles of Electronics by V.K.Metha, Rohith Metha, S.Chand &Company,New Delhi 11th edision(2015).
REFERENCE BOOKS	1. Sathyaprakash, Mathematical Physics, Sultan Chand & Sons, New Delhi. 6th edition, 2012. 2. N.C.Rana and P.S.Joag, Classical Mechanics, (Tata Mc-Graw Hill, New Delhi, 2001). 3. G. K. Sharma, Classical Mechanics, (Pragati Prakashan, New Delhi, 2012). 4. S. Rajasekar and R. Velusamy, Quantum Mechanics: The Fundamentals (CRC Press, Boca Raton, 2015). 5. K. K. Chopra and G.C. Agarwal, Electromagnetic theory, K. Nath & Co. Meerut 2016. 6. B.B. Laud, Elctromagnetics (New Age International Publishers). 7. Integrated Electronics by Jacob Milman and Christos Halkias , TMH 2nd edision (2017).
WEB SOURCES	1.https://nptel.ac.in/course.html/Physics/Integrals and vector calculus 2.https://nptel.ac.in/course.html/Physics/ Introduction to classical mechanics 3.https://medium.com/predict/what-is-quantum-mechanics 4.https://nptel.ac.in/courses/122/106/122106034/ 5. https://nptel.ac.in/course.html/electronics/operational amplifier

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand special functions and complex analysis for concepts & evaluation.	**K2**
CO2	Gain a working knowledge of Conservation laws and cyclic coordinates with Rigid body dynamics and Generalized coordinates.	**K1,K3**
CO3	Get an exposure to lagrangian and Hamiltonian formulism.	**K1,K4**
CO4	Understand the instrumentation used for powder diffraction, data collection, data interpretation, and structure refinement using Rietveld method	**K2, K4**
CO5	Get an insight into the structural aspects of proteins and nucleic acids, crystallization of proteins and methods to solve protein structures	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	2	3	2	1	2	2	2
CO2	3	3	3	2	2	2	1	2	2	2
CO3	3	3	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	3	2	1	2	2	2
CO2	3	3	3	2	2	2	1	2	2	2
CO3	3	3	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2

Online objective type	**End Semester Examination**	**Total**	**Grade**
100	**100**	**100**	

Core 11 - NUCLEAR AND PARTICLE PHYSICS	**II YEAR - FOURTH SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23PPH11	**NUCLEAR AND PARTICLE PHYSICS**	**Core**				**5**	**6**	**75**

Pre-Requisites
Knowledge of basic structure of atom and nucleus.
Learning Objectives
➢ Introduces students to the different models of the nucleus in a chronological order ➢ Imparts an in-depth knowledge on the nuclear force, experiments to study it and the types of nuclear reactions and their principles ➢ To acquire the knowledge of nuclear reactions nuclear reciprocity theorem ➢ Provides students with details of nuclear decay with relevant theories ➢ Exposes students to the Standard Model of Elementary Particles and Higgs boson

UNITS	Course Details
UNIT I: **NUCLEAR MODELS**	Liquid drop model – Weizacker mass formula – Isobaric mass parabola – Mirror Pair - Bohr Wheeler theory of fission – Shell model – Spin-orbit coupling – Magic numbers – Angular momenta and parity of ground states – Magnetic moment – Schmidt model – Electric Quadrapole moment - Bohr and Mottelson collective model – Rotational and Vibrational bands.
UNIT II: **NUCLEAR FORCES**	Nucleon – nucleon interaction – Tensor forces – Properties of nuclear forces – Ground state of deuteron – Exchange Forces - Meson theory of nuclear forces – Yukawa potential – Nucleon-nucleon scattering – Effective range theory – Spin dependence of nuclear forces - Charge independence and charge symmetry – Isospin formalism.
UNIT III: **NUCLEAR REACTIONS**	Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – Scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – Four Factor Formula- Nuclear Reactors.
UNIT IV: **NUCLEAR DECAY**	Alpha decay - Gamow's theory - Beta decay - G– Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – mass of neutrino – Allowed and forbidden decay – Neutrino physics – Helicity - Parity violation - Gamma decay – Multipole radiations – Angular Correlation - Internal conversion – Nuclear isomerism – Angular momentum and parity selection rules.

UNIT V: **ELEMENTARY PARTICLES**	Classification of Elementary Particles – Types of Interaction and conservation laws – CPT Theorem – CP Violation - Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks –SU (2) and SU (3) groups-Gell Mann matrices– Gell Mann Okuba Mass formula-Quark Model –Standard model of particle physics – Higgs boson.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2011) 2. K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008) 3. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011) 4. H.S.Hans, Nuclear Physics: Experimental and Theoretical, New Age intel, NewDelhi, 2001. 5. A.Beiser, Concepts of Mordern Physics, 5th Ed. (McGraw-Hill, 1995)
REFERENCE BOOKS	1. S.N. Ghoshal, Nuclear Physics (S. Chand & Company, New Delhi, 2006) 2. Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill

	Education (India) Private Limited; 1 edition (2001) 3. M. L. Pandya & R.P.S.Yadav Elements of Nuclear Physics 7th edition,Kedar Nath Ram Nath Delhi,1995 4. D.Griffths, Introduction to Elementary Particle Physics, Wiley Intel, Edition, New York, 1987.
WEB SOURCES	1. http://bubl.ac.uk/link/n/nuclearphysics.html 2. http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces 3. https://www.nuclear-power.net/nuclear-power/nuclear-reactions/ 4. http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.html 5. https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.html

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.	**K1, K5**
CO2	Demonstrate knowledge of fundamental aspects of the structure of the nucleus, radioactive decay, nuclear reactions and the interaction of radiation and matter.	**K2, K3**
CO3	Use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet-Weigner single level formula	**K3**
CO4	Analyze data from nuclear scattering experiments to identify different properties of the nuclear force.	**K3, K4**
CO5	Summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles.	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	2	1	2	1	2	2	2
CO3	3	3	1	2	1	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	3	3
CO5	3	3	2	3	2	3	2	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	2	1	2	1	2	2	2
CO3	3	3	1	2	1	2	1	1	2	2
CO4	3	3	2	3	2	3	2	2	3	3

CO5	3	3	2	3	2	3	2	3	3	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade
25	**75**	**100**	

Core 12 - CONDENSED MATTER PHYSICS	**II YEAR - FOURTH SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPH12	**CONDENSED MATTER PHYSICS**	**Core**				**5**	**6**	**75**

Pre-Requisites
Fundamentals of crystal structures, lattice dynamics and semiconductor/superconductor.
Learning Objectives
➢ To teach the concept of crystal structures and symmetry, and diffraction theory ➢ To provide students with a background to lattice dynamics, Debye's theory and experimental diffraction from single crystals ➢ To provide instruction on the methods and basis for determining low-molecular weight crystal structures using metals and semiconductors. ➢ To give the students a background to the instrumentation used magnetism. ➢ To teach the theoretical explanation of structure exhibited by using superconductors.

UNITS	Course Details
UNIT I: CRYSTAL PHYSICS	Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor- Crystal diffraction - Bragg's law – Scattered Wave Amplitude - Reciprocal Lattice (SC, BCC, FCC). Structure and properties of liquid crystals. Diffraction Conditions - Laue equations - Brillouin zone - Structure factor - Atomic form factor - Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).
UNIT II: LATTICE DYNAMICS	Lattice with two atoms per primitive cell - First Brillouin zone - Group and phase velocities - Quantization of lattice vibrations - Phonon momentum - Inelastic scattering by phonons - Debye's theory of lattice heat capacity - Thermal Conductivity - Umkalapp processes.
UNIT III: THEORY OF METALS AND SEMICONDUCTORS	Free electron gas in three dimensions - Electronic heat capacity - Wiedemann-Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration – Temperature Dependence - Mobility - Impurity conductivity – Impurity states - Hall effect - Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hass-van Alphen effect .
UNIT IV: MAGNETISM	Diamagnetism - Quantum theory of paramagnetism - Rare earth ion - Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.
UNIT V: SUPER CONDUCTIVITY	**Experimental facts:** Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors. **Theoretical Explanation:** Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs – Bardeen Cooper Schrieffer (BCS) Theory – BCS to Bose – Einstein Condensation (BEC) regime- Nature of paring and condensation of Fermions. Single particle tunneling - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. C. Kittel, Introduction to Solid State Physics, 7th Edition, Wiley Eastern, New Delhi, 2006. 2. S. O. Pillai, Solid State Physics, Seventh Edition, New Age International, New Delhi, 2014. 3. J.P. Srivastava : Elements of Solid State Physics, Prentice-Hall of India, 2006. 4. A.J. Dekker, Solid State Physics, Published by Macmillan India (2000). 5. J. R. Christman : Fundamentals of Solid State Physics, John Wiley & Sons, NY, 1988.
REFERENCE BOOKS	1. J. S. Blakemore,Solid State Physics,Second Edition,Cambridge University Press,CambridgeLondon.1985. 2. H. P. Myers, 1998, *Introductory SolidState Physics*, 2nd Edition, Viva Book, New Delhi. 3. H. M. Rosenburg, 1993, *The SolidState*, 3rd Edition, OxfordUniversity Press, Oxford.
WEB SOURCES	1. https://www.nationalgeographic.org/encyclopedia/magnetism 2. https://www.brainkart.com/article/Super-Conductors_6824 3.http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand crystal symmetry and reciprocal lattice concept for X-ray diffraction	**K2**
CO2	Gain a working knowledge of X-ray generation, X-ray photography with Laue, oscillation and moving film methods, and space group determination	**K1,K3**
CO3	Get an exposure to crystal structure determination using program packages	**K1,K4**
CO4	Understand the instrumentation used for powder diffraction, data collection, data interpretation, and structure refinement using Rietveld method	**K2, K4**
CO5	Get an insight into the structural aspects of proteins and nucleic acids, crystallization of proteins and methods to solve protein structures	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH12	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	2	1	2	2	2
CO2	3	3	3	2	2	2	1	2	2	2
CO3	3	3	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2

CO5	3	2	2	2	2	2	2	2	2	2

23PPH12	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	3	2	1	2	2	2
CO2	3	3	3	2	2	2	1	2	2	2
CO3	3	3	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
25	**75**	**100**	

CORE 13. PROJECT WITH VIVA-VOCE	**II YEAR - FOURTH SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23PPH3PW	**PROJECT WITH VIVA-VOCE**	**Core**				**7**	**10**	**75**

Pre-Requisites
Gain develop abilities and skills that encourage research and development activities and future research.
Learning Objectives
➢ To acquire knowledge of understanding and competencies required by practicing teachers for effective teaching-learning process at the secondary stage. ➢ Sustained in depth study on a specific topic to enable the students to critically examine the background literature relevant to their the background literature relevant to their specific research area. ➢ An environment that encourages the students originally and creativity in their research and opportunity to develop skills in making and testing hypotheses in developing new theories and in planning and conducting experiments, developing practical research skills and learn new stage of the art techniques.

- The opportunity to expand the student's knowledge of their research area, including its theoretical foundation and the specific techniques used to study it.
- An environment in which to develop skills in written work, oral presentation and publishing the results of their research scientific journals for future development and the students in acquiring basic knowledge in the specialized thrust areas such as Material science and Nanoscience, Theoretical physics, Crystal growth, Thin films in various fields of branch of physics.

PROJECT WITH VIVA-VOCE

Each candidate shall be required to take up a research project under the supervision of the qualified teachers in the department. The Head of the Department shall assign the Guide who, in turn, will suggest the Project Work to the student in the beginning of the final year.

At the end of fourth semester student should submit project report on or before the date fixed by the University. The Project will be evaluated by the project Guide as an internal examiner and an external examiner nominated by the University.

The viva – voce examination will be conducted to assess the knowledge of the candidate and the results of the title of the project. The candidate concerned will have to defend his/her Project through a Viva-voce.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Have some research experience within a specific field of physics, through a supervised project (Master dissertation).	**K2**
CO2	Have a thorough knowledge of literature and a understanding of scientific methods and techniques applicable in their field of research.	**K2,K3**
CO3	Be able to summarize major themes and current research problems in their area of specialization and be able to explain and identify open problems and areas needing development in their fields.	**K2,K4**
CO4	Be able to demonstrate originality in the application of knowledge, together with a practical understanding of how research and enquiry are a used to create and interpret knowledge in their fields.	**K2, K4**
CO5	Able to act independently in the planning and implementation of research and have carried out and presented an original work of research in their discipline.	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPH3PW	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	2	3	2	2	2
CO2	3	3	3	2	2	2	3	2	2	2
CO3	3	3	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2

CO5	3	2	2	2	2	2	2	2	2	2

23PPH3PW	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	2	3	2	3	2	2	2
CO2	3	3	3	2	2	2	3	2	2	2
CO3	3	3	2	2	2	2	2	2	2	2
CO4	3	2	2	2	2	2	2	2	2	2
CO5	3	2	2	2	2	2	2	2	2	2

ASSESSMENT /EVALUATION /VIVA-VOCE:

I. ASSESSMENT OF THE PROJECT (Internal):

a) Plan of the project submission : 20 Marks
b) Individual Initiative : 05 Marks

Total : 25 Marks

II.DISTRIBUTION OF MARKS:

a) Plan of the project :10 Marks
b) Evaluation of the Project report : 45 Marks
c) Assessment of the Project (CIA) : 25 Marks
d) Viva voce examination : 20 Marks

Total : 100Marks

III. VIVA VOCE EXAMINATION (Internal and External) :

Preparation, Presentation of work and response to questions : 20 Marks

Elective -6. ENERGY PHYSICS	**II YEAR - FOURTH SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHE6A	**ENERGY PHYSICS**	**Elective**				**3**	**4**	**75**

Pre-Requisites
Knowledge of conventional energy resources
Learning Objectives
➢ To learn about various renewable energy sources. ➢ To know the ways of effectively utilizing the oceanic energy. ➢ To study the method of harnessing wind energy and its advantages. ➢ To learn the techniques useful for the conversion of biomass into useful energy. ➢ To know about utilization of solar energy.

UNITS	Course Details

UNIT I: **INTRODUCTION TO ENERGY SOURCES**	Conventional and non-conventional energy sources and their availability– prospects of Renewable energy sources– Energy from other sources–chemical energy–Nuclear energy– Energy storage and distribution.
UNIT II: **ENERGY FROM THE OCEANS**	Energy utilization–Energy from tides–Basic principle of tidal power– utilization of tidal energy – Principle of ocean thermal energy conversion systems.
UNIT III: **WIND ENERGY SOURCES**	Basic principles of wind energy conversion–power in the wind–forces in the Blades– Wind energy conversion–Advantages and disadvantages of wind energy conversion systems (WECS) - Energy storage–Applications of wind energy.
UNIT IV: **ENERGY FROM BIOMASS**	Biomass conversion Technologies– wet and dry process– Photosynthesis - Biogas Generation: Introduction–basic process: Aerobic and anaerobic digestion – Advantages of anaerobic digestion–factors affecting bio digestion and generation of gas- bio gas from waste fuel– properties of biogas- utilization of biogas.
UNIT V: **SOLAR ENERGY SOURCES**	Solar radiation and its measurements–solar cells: Solar cells for direct conversion of solar energy to electric powers–solar cell parameter– solar cell electrical characteristics– Efficiency–solar water Heater – solar distillation– solar cooking–solar greenhouse – Solar pond and its applications.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. G.D. Rai, 1995,Solar energy Utilization, 5th edition, Khanna publishers, New Delhi. 2. Solar Energy : Fundamentals, Design, Modelling and Application (Revised edition)January 2012 by Tiwari G N. 3. Solar energy, principles of thermal collection and storage by S.P.Sukhatme, 2nd edition, Tata McGraw-Hill Publishing co.Ltd. 4. Maheshwar Sharon, Madhuri Sharon, Carbon ―Nano forms and Applications‖, McGrawHill, 2010. 5. Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems‟, Academic Press, London, 2009.
REFERENCE BOOKS	1. Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997. 2. John W. Twidell & Anthony D.Weir,Renewable Energy Resources,2005 3. John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes,4th Edition,John Wiley and Sons, 2013.

WEB SOURCES	1.https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=2411&printable=1 2. https://www.nationalgeographic.org/encyclopedia/tidal-energy/ 3. https://www.ge.com/renewableenergy/wind-energy/what-is-wind-energy 4. https://www.reenergyholdings.com/renewable-energy/what-is-biomass/ 5. https://www.acciona.com/renewable-energy/solar-energy/

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	To identify various forms of renewable and non-renewable energy sources	**K1**
CO2	Understand the principle of utilizing the oceanic energy and apply it for practical applications.	**K2**
CO3	Discuss the working of a windmill and analyze the advantages of wind energy.	**K3**
CO4	Distinguish aerobic digestion process from anaerobic digestion.	**K3,K4**
CO5	Understand the components of solar radiation, their measurement and apply them to utilize solar energy.	**K2,K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPHE6A	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	2	3	3	3	2	2	2	3	3	3
CO2	2	3	3	3	2	2	2	3	3	3
CO3	2	3	3	3	2	2	2	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3
CO5	2	3	3	3	2	2	2	3	3	3

23PPHE6A	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	2	3	3	3	2	2	2	3	3	3
CO2	2	3	3	3	2	2	2	3	3	3
CO3	2	3	3	3	2	2	2	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3
CO5	2	3	3	3	2	2	2	3	3	3

METHOD OF EVALUATION:

Continuous Internal Assessment	**End Semester Examination**	**Total**	**Grade**
25	**75**	**100**	

Elective – 6 MEDICAL PHYSICS	II YEAR – FOURTH SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHE6B	MEDICAL PHYSICS	Elective				3	4	75

Pre-Requisites
Fundamentals of physiological concepts, Basics of instruments principle,
Learning Objectives
➢ To understand the major applications of Physics to Medicine ➢ To study the aid of different medical devices such as X-ray machines, gamma camera, accelerator and nuclear magnetic resonance. ➢ To outline the principles of Physics of different medical radiation devices and their modern advances, especially in medical radiation therapy and different applications in medical physics. ➢ To introduce the ideas of Radiography. ➢ To form a good base for further studies like research.

UNITS	CourseDetails

UNIT I: X-RAYS AND TRANSDUCERS	Electromagnetic Spectrum – Production of X-Rays – X-Ray Spectrum – Bremsstrahlung – Characteristic X-Ray – X-Ray Tubes – Coolidge Tube – X-Ray Tube Design – Thermistors – photo electric transducers – Photo voltaic cells – photo emissive cells –Photoconductive cells– piezoelectric transducer
UNIT II: BLOOD PRESSURE MEASUREMENTS	Introduction – sphygmomanometer – Measurement of heart rate – Electrodes - basic principles of electrocardiogram (ECG) –Basic principles of electro-neurography (ENG) – EMG - EEG
UNIT III: RADIATION PHYSICS	Radiation Units – Exposure – Absorbed Dose – Red to Gray – Kera Relative Biological Effectiveness –Effective Dose – Sievert (Sv) – Inverse Square Law – Interaction of radiation with Matter – Linear Attenuation Coefficient – Radiation Detectors –Thimble Chamber – Condenser Chambers – Geiger Counter – Scintillation Counter
UNIT IV: MEDICAL IMAGING PHYSICS	Radiological Imaging – Radiography – Filters – Grids – Cassette – X-Ray Film – Film processing – Fluoroscopy – Computed Tomography Scanner – Principal Function – Display – Mammography – Ultrasound Imaging – Magnetic Resonance Imaging – Thyroid Uptake System – Gamma Camera (Only Principle, Function and display)

UNITV: RADIATION PROTECTION	Principles of Radiation Protection – Protective Materials – Radiation Effects – Somatic – Genetic Stochastic and Deterministic Effect – Personal Monitoring Devices – TLD Film Badge – Pocket Dosimeter
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. Dr.K.Thayalan ,*Basic Radiological Physics*, Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi, 2003. 2. R.S. Khandpur, *Hand Book of Biomedical Instrumentations*,1st ed TMG,New Delhi 2005. 3. FM Khan, *Physics of Radiation Therapy*, William and Wilkins, 3rd ed, 2003. 4. D. J. Dewhurst, *An Introduction to Biomedical Instrumentation*, 1st ed, Elsevier Science, 2014. 5. Curry, Dowdey and Murry,*Christensen's Physics of Diagnostic Radiology*
	-*Lippincot*Williams and Wilkins, 1990.
REFERENCE BOOKS	1. Muhammad Maqbool, *An Introduction to Medical Physics*, 1st ed, Springer International Publishing, 2017. 2. Daniel Jirák, FrantišekVítek, *Basics of Medical Physics*, 1st ed, Charles University, Karolinum Press, 2018 3. Anders Brahme, *Comprehensive Biomedical Physics*, Volume 1, 1st ed, Elsevier Science, 2014. 4. K. Venkata Ram, *Bio-Medical Electronics and Instrumentation*, 1st ed, Galgotia Publications, New Delhi, 2001. 5. John R. Cameron and James G. Skofronick, 2009, Medical Physics, John Wiley Interscience Publication, Canada, 2nd edition.

WEB SOURCES	1. https:nptel.ac.in/courses/108/103/108103157/ 2. https://www.studocu.com/en/course/university-of-technology-sydney/medical-devices-and-diagnostics/225692 3. https://www.technicalsymposium.com/alllecturenotes_biomed.html 4. https://lecturenotes.in/notes/17929-note-for-biomedical-instrumentation-bi-by-deepraj-adhikary/78 5. https://www.modulight.com/applications-medical/

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Learn the fundamentals, production and applications of X-rays.	**K1**
CO2	Understand the basics of blood pressure measurements. Learn about sphygmomanometer, EGC, ENG and basic principles of MRI.	**K2**
CO3	Apply knowledge on Radiation Physics	**K3**
CO4	Analyze Radiological imaging and filters	**K4**
CO5	Assess the principles of radiation protection	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) **and** LOW (1)**.**

23PPHE6B	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	1	2	3	3	1	3
CO2	3	3	3	2	1	2	3	3	1	3
CO3	3	3	3	2	1	2	3	3	1	3
CO4	3	3	3	2	1	2	3	3	1	3
CO5	3	3	3	1	1	2	3	3	1	3

23PPHE6B	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	3	1	1	2	3	3	1	3
CO2	3	3	3	2	1	2	3	3	1	3
CO3	3	3	3	2	1	2	3	3	1	3
CO4	3	3	3	2	1	2	3	3	1	3
CO5	3	3	3	1	1	2	3	3	1	3

METHOD OF EVALUATION:

Continuous Internal Assessment	End Semester Examination	Total	Grade

25	**75**	**100**	

Skill Enhancement Course 3 **ELECTRONICS AND COMMUNICATION SYSTEMS**	**II YEAR – FOURTH SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23PPHSE3	**ELECTRONICS AND COMMUNICATION SYSTEMS**	**Skill Enhancement**				**2**	**4**	**75**

Pre-Requisites
Knowledge of Regions of electromagnetic spectrum and its characteristics
Learning Objectives
• To comprehend the transmission of electromagnetic waves thorough different types of antenna and also to acquire knowledge about the propagation of waves through earth's atmosphere and along the surface of the earth • To gain knowledge in the generation and propagation of microwaves • To acquire knowledge about radar systems and its applications and also the working principle of colour television • To learn the working principle of fiber optics and its use in telecommunication • To understand the general theory and operation of satellite communication systems

UNITS	Course Details
UNIT I: **SEMICONDUCTOR DEVICES AND LINEAR INTEGRATED CIRCUITS**	UJT - VI characteristics - Relaxation Oscillators - JFET Characteristics - DC load line -Characteristics and application - SCR- DIAC - TRIAC. Operational amplifiers - DC Characteristics - Basic OP-AMP Application - Instrumentation Amplifier - Digital to analog conversion using op-amps - Binary weighted resistor method - R-2R ladder method - Analog to digital conversion - Successive approximation method and counter methods - IC 555 timer - Multivibrators with 555 : Astable and Monostable mutivibrator.
UNIT II: **ANTENNAS AND MICROWAVES**	Terms and definition - Effect of ground on Antenna - Grounded $\lambda/4$ - Ungrounded antenna - λ antenna - Antenna arrays - Broadside and end side arrays - Directional high frequency antenna - Sky wave propagation - Ionosphere - Eccles & Larmor theory - Thin linear antenna - Non resonant antenna - Loop antenna - Power gain - Dipole arrayed VHF, UHF and Microwave antennas - Microwave generation and application - Klystron - Magnetron - Traveling wave tubes - Microwave propagation through wave guides - Detection and ranging - Transmitters and receivers - MASER - Gunn diode.
UNIT III: **COMMUNICATION SYSTEM**	Introduction - Analog and digital signals - Modulation - Modulation index - AM Modulation - Frequency spectrum of the AM wave - Representation of AM - Power Relation in the AM wave - AM Transmitter - FM Modulation - Mathematical representation of FM - Frequency spectrum of FM wave - Pulse modulation - Sampling theorem - pulse position modulation(PPM) - Pulse code modulation(PCM) - Pulse width modulation (PWM) - Effects of noise on carrier.
UNIT IV: **OPTIC FIBER COMMUNICATION**	Introduction of Optic fiber communication - Propagation within a fiber - Step index and graded index fibre - Modes of fibers - Fabrication fibers - Losses in fibers - Dispersion - Light sources for fiber optics - Photo detectors - Optic fiber communication systems - Fibre as a cylindrical wave guide.
UNIT V: **COLOR TELEVISION**	Essential of color television - Perception - Three color theory - Luminescence - Hue saturation - TV Camera - VIDICON - Luminescence signal - CRT-LCD-LED Displays - Single transmission - Modulation of color different signals - PAL of color TV systems - PAL color receiver - Block diagram - Merits and Demerits.
UNIT VI: **PROFESSIONAL COMPONENTS**	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. D. Choudhury Roy, Jain, Shail B, Linear Integrated Circuits,(New Age International(P)Ltd. 2018. 2. R.R Gulathi, Monochrome and color television, Wily Eastern New Delhi (1995). 3. Dennis Roddy & John Coolen, Electronic Communication, 4th edition Pearson education.(1995)
REFERENCE BOOKS	1. George Kennedi, Electronic communication system. 4th edition, (Prentice-Hall of India.2004. Private Limited, New Delhi, 1999). 2. H. S. Kalsi, Electronic Instrumentation, Tata McGraw- Hill, New Delhi, 2004. 3. Optical fibre and fibre optic communication systems - SK Sarkar - S. Chand Publication 2007 edition.
WEB SOURCES	1. https://nptel.ac.in/courses/115/107/115107095/ 2. https://www.youtube.com/playlist?list=PLq-Gm0yRYwTgr7v3HhdrI_Kcc38369fw

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Discuss and compare the propagation of electromagnetic waves through sky and on earth's surface Evaluate the energy and power radiated by the different types of antenna	**K1, K5**
CO2	Compare and differentiate the methods of generation of microwaves analyze the propagation of microwaves through wave guides- discuss and compare the different methods of generation of microwaves	**K4**
CO3	Classify and compare the working of different radar systems- apply the principle of radar in detecting locating, tracking, and recognizing objects of various kinds at considerable distances – discuss the importance of radar in military- elaborate and compare the working of different picture tube	**K3**
CO4	Classify, discuss and compare the different types of optical fiber and also to justify the need of it-discover the use of optical fiber as wave guide	**K1, K3**
CO5	Explain the importance of satellite communication in our daily life-distinguish between orbital and geostationary satellites elaborate the linking of satellites with ground station on the earth	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

23PPHSE3	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**

CO1	3	3	3	1	2	2	3	2	1	3
CO2	3	3	3	1	2	2	3	2	1	3
CO3	3	3	3	1	2	2	3	2	1	3
CO4	3	3	3	1	2	2	3	2	1	3
CO5	3	3	3	1	2	2	3	2	1	3

23PPHSE3	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	1	2	2	3	2	1	3
CO2	3	3	3	1	2	2	3	2	1	3
CO3	3	3	3	1	2	2	3	2	1	3
CO4	3	3	3	1	2	2	3	2	1	3
CO5	3	3	3	1	2	2	3	2	1	3

ELECTIVE OPTIONAL PAPERS

Elective - List 2.2 ADVANCED OPTICS	**I YEAR – FIRST SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
	ADVANCED OPTICS	**Elective**						

Pre-Requisites
Knowledge of ray properties and wave nature of light
Learning Objectives
➢ To know the concepts behind polarization and could pursue research work on application aspects of laser ➢ To impart an extensive understanding of fiber and non-linear optics ➢ To study the working of different types of LASERS ➢ To differentiate first and second harmonic generation ➢ Learn the principles of magneto-optic and electro-optic effects and its applications

UNITS	Course Details
UNIT 1: **POLARIZATION AND DOUBLE REFRACTION**	Classification of polarization – Transverse character of light waves – Polarizer and analyzer – Malu's law – Production of polarized light – Wire grid polarizer and the polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction – Normal and oblique incidence – Interference of polarized light: Quarter and half wave plates – Analysis of polarized light – Optical activity
UNIT II: **LASERS**	Basic principles – Spontaneous and stimulated emissions – Components of the laser – Resonator and lasing action – Types of lasers and its applications – Solid state lasers – Ruby laser – Nd:YAG laser – gas lasers – He-Ne laser – CO_2 laser – Chemical lasers – HCl laser – Semiconductor laser
UNIT III: **FIBER OPTICS**	Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers – Fiber-optic sensors: precision displacement sensor – Precision vibration sensor
UNIT IV: **NON-LINEAR OPTICS**	Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Third harmonic generation – Optical mixing – Parametric generation of light – Self-focusing of light

UNIT V: **MAGNETO-OPTICS AND ELECTRO-OPTICS**	Magneto-optical effects – Zeeman effect – Inverse Zeeman effect – Faraday effect – Voigt effect – Cotton-mouton effect – Kerr magneto-optic effect – Electro-optical effects – Stark effect – Inverse stark effect – Electric double refraction – Kerr electro-optic effect – Pockels electro-optic effect
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd. 2. AjoyGhatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd. 3. William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York 4. J. Peatros, Physics of Light and Optics, a good (and free!) electronic book 5. B. Saleh, and M. Teich, Fundamentals of Photonics, Wiley-Interscience,
REFERENCE	1. F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th

BOOKS	Edition), McGraw – Hill International Edition. 2. Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH. 3. Lipson, S. G. Lipson and H. Lipson, 2011, Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011. 4. Y. B. Band, Light and Matter, Wiley and Sons (2006) 5. R. Guenther, Modern Optics, Wiley and Sons (1990)
WEB SOURCES	1. https://www.youtube.com/watch?v=WgzynezPiyc 2. https://www.youtube.com/watch?v=ShQWwobpW60 3. https://www.ukessays.com/essays/physics/fiber–optics–and–it-applications.php 4. https://www.youtube.com/watch?v=0kEvr4DKGRI 5. http://optics.byu.edu/textbook.aspx

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Discuss the transverse character of light waves and different polarization phenomenon	**K1**
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices	**K2**
CO3	Demonstrate the basic configuration of a fiber optic – communication system and advantages	**K3, K4**
CO4	Identify the properties of nonlinear interactions of light and matter	**K4**
CO5	Interpret the group of experiments which depend for their action on an applied magnetics and electric field	**K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) andLOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	3	3	3	3	3	3
C02	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3

CO5	3	3	3	3	3	3	3	3	3	3

Elective - List 2.3 PLASMA PHYSICS	

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
	PLASMA PHYSICS	**Elective**						

Pre-Requisites
Fundamentals of Electricity and Magnetism, Electromagnetic theory, Maxwell's equation, Basic knowledge of electrical and electronics instrumentation.
Learning Objectives
➢ To explore the plasma universe by means of in-site and ground-based observations. ➢ To understand the model plasma phenomena in the universe. ➢ To explore the physical processes which occur in the space environment.

UNITS	**Course Details**
UNIT I: FUNDAMENTAL CONCEPTS OF PLASMA	Kinetic pressure in a partially ionized - mean free path and collision cross section - Mobility of charged particles - Effect of magnetic field on the mobility of ions and electrons-Thermal conductivity- Effect of magnetic field- Quasi- neutrality of plasma Debye shielding distance - Optical properties of plasma.

UNIT II: MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD	Particle description of plasma- Motion of charged particle in electrostatic field- Motion of charged particle in uniform magnetic field - Motion of charged particle in electric and magnetic fields- Motion of charged particle inhomogeneous magnetic field - Motion of charged particle in magnetic mirror confinement - motion of an electron in a time varying electric field- Magneto- hydrodynamics - Magneto-hydrodynamic equations – Condition for magneto hydrodynamic behaviour.
UNIT III: PLASMA OSCILLATIONS AND WAVES	Introduction, theory of simple oscillations - electron oscillation in a plasma – Derivations of plasma oscillations by using Maxwell's equation - Ion oscillation and waves in a magnetic field - thermal effects on plasma oscillations - Landau damping - Hydro magnetic waves - Oscillations in an electron beam.
UNIT IV: PLASMA DIAGNOSTICS TECHNIQUES	Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - -laser as a tool for plasma diagnostics-X-ray diagnostics of plasma - acoustic method - conclusion.
UNIT V: APPLICATIONS OF PLASMA PHYSICS	Magneto hydrodynamic Generator - Basic theory - Principle of Working- Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma - Plasma Diode.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. Plasma Physics- Plasma State of Matter - S. N.Sen, PragatiPrakashan, Meerut. 2. Introduction to Plasma Physics-M. Uman 3. Krall, N. A., and A. W. Trivelpiece. Principles of Plasma Physics. Berkeley, CA: San Francisco Press, 1986. ISBN: 9780911302585.Tanenbaum, B. S. Plasma Physics. New York, NY: McGraw-Hill, 1967. ISBN: 9780070628120. 4. Goldston, R. J., and P. H. Rutherford. Introduction to Plasma Physics. Philadelphia, PA: IOP Publishing, 1995. ISBN: 9780750301831. 5. Hutchinson, I. H. Principles of Plasma Diagnostics. Cambridge, UK: Cambridge University Press, 2005. ISBN: 9780521675741.
REFERENCE BOOKS	1. Chen, F. F. Introduction to Plasma Physics. 2nd ed. New York, NY: Springer, 1984. ISBN: 9780306413322. 2. Introduction to Plasma Theory-D.R. Nicholson 3. Shohet, J. L. The Plasma State. San Diego, CA: Academic Press Inc., 1971. ISBN: 9780126405507. 4. Hazeltine, R. D., and F. L. Waelbroeck. The Framework of Plasma

	Physics. Boulder, CO: Westview Press, 2004. ISBN: 9780813342139. 5. Huddlestone, R. H., and S. L. Leonard. Plasma Diagnostic Techniques. San Diego, CA: Academic Press, 1965
WEB SOURCES	1. https://fusedweb.llnl.gov/Glossary/glossary.html 2. http://farside.ph.utexas.edu/teaching/plasma/lectures1/index.html 3. http://www.plasmas.org/ 4. http://www.phy6.org/Education/whplasma.html 5. http://www.plasmas.org/resources.htm

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand the collision, cross section of charged particles and to able to correlate the magnetic effect of ion and electrons in plasma state.	**K1, K2**
CO2	Understand the plasma and learn the magneto-hydrodynamics concepts applied to plasma.	**K2**
CO3	Explore the oscillations and waves of charged particles and thereby apply the Maxwell's equation to quantitative analysis of plasma.	**K1, K3**
CO4	Analyze the different principle and techniques to diagnostics of plasma.	**K2, K5**
CO5	Learn the possible applications of plasma by incorporating various electrical and electronic instruments.	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	2	1	1	2	1	2	3	3
CO2	3	3	2	1	1	2	1	2	3	3
CO3	3	3	2	2	1	2	1	3	3	3
CO4	3	3	3	2	1	2	1	3	3	3
CO5	3	3	3	2	1	2	1	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	2	1	1	2	1	2	3	3
CO2	3	3	2	1	1	2	1	2	3	3
CO3	3	3	2	2	1	2	1	3	3	3
CO4	3	3	3	2	1	2	1	3	3	3
CO5	3	3	3	2	1	2	1	3	3	3

Elective - List 2.4 **BIO PHYSICS**	

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	BIO PHYSICS	**Elective**						

Pre-Requisites
Fundamental concepts of Physics and Biology
Learning Objectives
➢ To understand the physical principles involved in cell function maintenance. ➢ To understand the fundamentals of macromolecular structures involved in propagation of life. ➢ To understand the biophysical function of membrane and neuron. ➢ To understand various kinds of radiation and their effects on living system and to know the hazards posed by such radiations and the required precautions. ➢ To understand the physical principles behind the various techniques available for interrogating biological macromolecules.

UNITS	Course Details
UNIT I: CELLULAR	Architecture and Life Cycle of cells – Organelles of Prokaryotic and Eukaryotic cell – Cell size and shape – Fine structure of Prokaryotic and Eukaryotic cell organization – Compartment & assemblies membrane system – Extracellular

BIOPHYSICS	matrix - Molecular mechanisms of Vesicular traffic - Electrical activities of cardiac and neuronal cells.
UNIT II: MOLECULAR BIOPHYSICS	Macromolecular structure: Protein structure – amino acids, peptide bonds, primary, secondary, tertiary and quaternary structures of proteins Nucleic acid structure: nucleosides and nucleotides, RNA structure, DNA structure and conformation. Special Bio-macromolecules: Metalloproteins, nucleoproteins, ribozymes, chaperons and prions.
UNIT III: MEMBRANE AND NEURO BIOPHYISCS	Models membranes - Biological membranes and dynamics – Membrane Capacitors – Transport across cell and organelle membranes – Ion channels. Nervous system: Organization of the nervous system –Membrane potential – Origins of membrane potential - Electrochemical potentials – Nernst equation – Goldman equation.
UNIT IV: RADIATION BIO PHYSICS	X-Ray: Effects on bio-macromolecules – Gamma Radiation: Molecular effects of gamma radiation, Radiation effects on nucleic acids and membranes, Effects on cell and organelles – UV radiation: Effects on bio-macromolecules and proteins – Radiation hazards and protection – use of radiations in cancer.

UNIT V: PHYSICAL METHODS IN BIOLOGY	Spectroscopy: UV-Visible absorption spectrophotometry – Optical Rotatory Dispersion (ORD) – Structure Determination: X-ray Crystallography, Electron spin resonance (ESR) and biological applications. Chromatography: Thin layer chromatography (TLC), Gas liquid chromatography (GLC) – Centrifugation: Differential centrifugation, density gradient centrifugation. Electrophoresis: Gel electrophoresis, polyacrylamide gel electrophoresis.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013. 2. Biophysics, VasanthaPattabhi, N. Gautham, Narosa Publishing, 2009 3. Biophysics, P. S. Mishra VK Enterprises, 2010. 4. Biophysics, M. A Subramanian, MJP Publishers, 2005. 5. Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.
REFERENCE BOOKS	1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008). 2. Essential cell biology by Bruce Albert et al (Garland Science) 3. Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983).

	4. Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media). 5. Biological spectroscopyby Iain D. Campbell, Raymond A. Dwek
WEB SOURCES	1. General Bio:http://www.biology.arizona.edu/DEFAULT.html 2. Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm 3. Electrophoresis:http://learn.genetics.utah.edu/content/labs/gel/ 4. Online biophysics programs: http://mw.concord.org/modeler/ 5. https://blanco.biomol.uci.edu/WWWResources.html

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Understand the structural organization and function of living cells and should able to apply the cell signaling mechanism and its electrical activities.	**K2, K3**
CO2	Comprehension of the role of biomolecular conformation to function.	**K1**
CO3	Conceptual understanding of the function of biological membranes and also to understand the functioning of nervous system.	**K2, K5**
CO4	To know the effects of various radiations on living systems and how to prevent ill effects of radiations.	**K1, K5**
CO5	Analyze and interpret data from various techniques viz., spectroscopy, crystallography, chromatography etc.,	**K4**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes (CO) for each course with program outcomes (PO) and program specific outcomes (PSO) in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1).

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	1	2	1	3	3	2
CO2	3	3	3	2	1	2	1	3	3	2
CO3	3	3	3	3	1	1	2	3	3	2
CO4	3	3	3	2	1	1	2	3	3	3
CO5	3	3	3	3	1	1	2	3	3	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	1	2	1	3	3	2
CO2	3	3	3	2	1	2	1	3	3	2
CO3	3	3	3	3	1	1	2	3	3	2
CO4	3	3	3	2	1	1	2	3	3	3
CO5	3	3	3	3	1	1	2	3	3	3

Elective - List 3.3 **CHARACTERIZATON OF MATERIALS**	

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
	CHARACTERIZATON OF MATERIALS	**Elective**						

Pre-Requisites
Fundamentals of Heat and Thermodynamics, Basics of Optical systems, Microscopic systems, Electrical measurements and Fundamentals of Spectroscopy.
Learning Objectives
➢ To make the students learn some important thermal analysis techniques namely TGA, DTA, DSC and TMA. ➢ To make the students understand the theory of image formation in an optical microscope and to introduce other specialized microscopic techniques. ➢ To make the students learn and understand the principle of working of electron microscopes and scanning probe microscopes. ➢ To make the students understand some important electrical and optical characterization techniques for semiconducting materials. ➢ To introduce the students the basics of x-ray diffraction techniques and some important spectroscopic techniques.

UNITS	Course Details
UNIT I **THERMAL ANALYSIS**	Introduction – thermogravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves – differential

	scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermomechanical parameters.
UNIT II MICROSCOPIC METHODS	Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy – Dispersion staining microscopy - phase contrast microscopy –differential interference contrast microscopy - fluorescence microscopy - confocal microscopy - - digital holographic microscopy - oil immersion objectives - quantitative metallography - image analyzer.
UNIT III ELECTRON MICROSCOPY AND SCANNING PROBE MICROSCOPY	SEM, EDAX, EPMA, TEM: working principle and Instrumentation – sample preparation –Data collection, processing and analysis-Scanning tunnelingmicroscopy (STEM) - Atomic force microscopy (AFM) - Scanning new field optical microscopy.

UNIT IV **ELECTRICAL METHODS AND OPTICAL CHARACTERZATION**	Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations. Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.
UNIT V **X-RAY AND SPECTROSCOPIC METHODS**	Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, XPS, AES and SIMS-proton induced X-ray Emission spectroscopy (PIXE) –Rutherford Back Scattering (RBS) analysis-application - Powder diffraction - Powder diffractometer -interpretation of diffraction patterns - indexing - phase identification - residual stress analysis - Particle size, texture studies - X-ray fluorescence spectroscopy - uses.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism
TEXT BOOKS	1. R. A. Stradling and P. C. Klipstain. Growth and Characterization of semiconductors. Adam Hilger, Bristol, 1990. 2. J. A. Belk. Electron microscopy and microanalysis of crystalline materials. Applied Science Publishers, London, 1999. 3. Lawrence E. Murr. Electron and Ion microscopy and Microanalysis principles and Applications. Marcel Dekker Inc., New York, 1991 4. D. Kealey and P. J. Haines. Analytical Chemistry. Viva Books Private Limited, New Delhi, 2002. 5. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press,(2008).

REFERENCE BOOKS	1. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001). 2. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging,Wiley-Liss, Inc. USA, (2001). 3. Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009).Volumes 49 – 51, (2009). 4. Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986). 5. Wachtman, J.B., Kalman, Z.H., Characterization of Materials, ButterworthHeinemann, (1993)
WEB SOURCES	1. https://cac.annauniv.edu/uddetails/udpg_2015/77.%20Mat%20Sci(AC).pdf 2. http://www.digimat.in/nptel/courses/video/113106034/L11.html 3. https://nptel.ac.in/courses/104106122 4. https://nptel.ac.in/courses/118104008

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Describe the TGA, DTA, DSC and TMA thermal analysis techniques and make interpretation of the results.	**K1, K3**
CO2	The concept of image formation in Optical microscope, developments in other specialized microscopes and their applications.	**K2**
CO3	The working principle and operation of SEM, TEM, STM and AFM.	**K2, K3**
CO4	Understood Hall measurement, four –probe resistivity measurement, C-V, I-V, Electrochemical, Photoluminescence and electroluminescence experimental techniques with necessary theory.	**K3, K4**
CO5	The theory and experimental procedure for x- ray diffraction and some important spectroscopic techniques and their applications.	**K4,K5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) **and** LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	2	2	2	2	2	2	3
CO2	3	3	3	2	2	2	2	2	2	2
CO3	3	3	2	2	2	3	2	2	2	2
CO4	2	2	2	3	2	3	2	2	2	2
CO5	2	2	2	2	2	2	3	2	2	2

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	2	2	2	2	2	2	3
CO2	3	3	3	2	2	2	2	2	2	2
CO3	3	3	2	2	2	3	2	2	2	2

CO4	2	2	2	3	2	3	2	2	2	2
CO5	2	2	2	2	2	2	3	2	2	2

Elective - List 3.4 DIGITAL COMMUNICATION	

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
	DIGITAL COMMUNICATION	**Elective**						

Pre-Requisite
Exposure to Fourier transform, pulse modulation, multiplexing, noises in communication signals
Learning Objectives
➢ To understand the use of Fourier, transform in analyzing the signals ➢ To learn about the quanta of transmission of information ➢ To make students familiar with different types of pulse modulation ➢ To have an in depth knowledge about the various methods of error controlling codes ➢ To acquire knowledge about spread spectrum techniques in getting secured communication

UNITS	**Course Details**
UNIT I: **SIGNAL ANALYSIS**	Fourier transforms of gate functions, delta functions at the origin – Two delta function and periodic delta function – Properties of Fourier transform – Frequency shifting –Time shifting - Convolution –Graphical representation – Convolution theorem – Time Convolution theorem – Frequency Convolution theorem –Sampling theorem.
UNIT II: **INFORMATION**	Communication system – Measurement of information – Coding – Bandot Code CCITT Code –Hartley Law – Noise in an information Carrying

THEORY	Channel- Effects of noise- Capacity of noise in a channel – Shannon Hartley theorem –Redundancy.
UNIT III: **PULSE** **MODULATION**	Pulse amplitude modulation - natural sampling – Instantaneous sampling - Transmission of PAM Signals -Pulse width modulation – Time division multiplexing – Band width requirements for PAM Signals. Pulse Code Modulation –Principles of PCM –Quantizing noise – Generation and demodulation of PCM -Effects of noise –Companding – Advantages and application
UNIT IV: **ERROR CONTROL CODING**	Introduction to Linear Block Codes, Hamming Codes, BCH Coding, RS Coding, Convolutional Coding, Coding Grain Viterbi Coding
UNIT V: **SPREAD SPECTRUM SYSTEMS**	Pseudo Noise sequences, generation and Correlation properties, direct sequence spread spectrum systems, frequency HOP Systems, processing gain, anti-jam and multipath performance
UNIT VI: **PROFESSIONAL COMPONENTS**	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS	1. B.P. Lathi, *Communication system*, Wiley Eastern. 2. George Kennedy, *Electronic Communication Systems*, 3rd Edition, Mc Graw Hill. 3. Simon Haykin, *Communication System*, 3rd Edition, John Wiley & Sons. 4. George Kennedy and Davis, 1988, *Electronic Communication System*, Tata McGraw Hill 4th Edition. 5. Taub and Schilling, 1991, *"Principles of Communication System"*, Second edition Tata McGraw Hill.
REFERENCE BOOKS	1. John Proakis, 1995, *Digital Communication*, 3rd Edition, McGraw Hill, Malaysia. 2. M. K. Simen, 1999, *Digital Communication Techniques, Signal Design and Detection*, Prentice Hall of India. 3. Dennis Roddy and Coolen, 1995, *Electronics communications*,Prentice Hall of India IV Edition. 4. Wave Tomasi, 1998, *"Advanced Electronics communication System"* 4th Edition Prentice Hall, Inc. 5. M.Kulkarni, 1988, *"Microwave and Radar Engineering"*, Umesh Publications.
WEB SOURCES	1. http://nptel.iitm.ac.in/ 2. http://web.ewu.edu/ 3. http://www.ece.umd.edu/class/enee630.F2012.html 4. http://www.aticourses.com/Advanced%20Topics%20in%20Digital%20Signals 5. http://nptel.iitm.ac.in/courses/117101051.html

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1	Apply the techniques of Fourier transform, convolution and sampling theorems in signal processing	**K1, K3**
CO2	Apply different information theories in the process of study of coding of information, storage and communication	**K3**
CO3	Explain and compare the various methods of pulse modulation techniques	**K4**
CO4	Apply the error control coding techniques in detecting and correcting errors-able to discuss, analyze and compare the different error control coding	**K3, K4**
CO5	Apply, discuss and compare the spread spectrum techniques for secure communications	**K3, k5**
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate;		

MAPPING WITH PROGRAM OUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes **(PSO)** in the 3-point scale of STRONG (3), MEDIUM (2) and LOW (1)**.**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	3	3	1	2	2	3	2	2	3
CO2	3	3	3	1	2	2	3	2	2	3
CO3	3	3	3	1	2	2	3	2	2	3
CO4	3	3	3	1	2	2	3	2	2	3
CO5	3	3	3	1	2	2	3	2	2	3

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**	**PSO7**	**PSO8**	**PSO9**	**PSO10**
CO1	3	3	3	1	2	2	3	2	2	3
CO2	3	3	3	1	2	2	3	2	2	3
CO3	3	3	3	1	2	2	3	2	2	3
CO4	3	3	3	1	2	2	3	2	2	3
CO5	3	3	3	1	2	2	3	2	2	3