KUNTHAVAI NAACHIYAAR GOVERNMENT ARTS COLLEGE FOR WOMEN (AUTONOMOUS), THANJAVUR- 613 007, TAMILNADU, INDIA.

Accredited by NAAC with 'B' Grade

M.Sc., PHYSICS

SYLLABUS

(I to IV Semester)

Effective from 2023 – 2024 onwards

FROM THE ACADEMIC YEAR
2023 – 2024

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION,
CHENNAI – 600 005

KUNTHAVAI NAACCHIYAAR GOVT. ARTS COLLEGE FOR WOMEN
(AUTONOMOUS), THANJAVUR-613007.

DEPARTMENT OF PHYSICS

VISION

The Vision of the Department of Physics is to provide in depth understanding of, the principles and concept of Physics and to acquire proficiency, both in theoretical and experimental Physics. The Department aims to enhance the student's knowledge in basics as well as in Applied Physics. To inculcate aptitude for a research career in academic or in industry, by introducing advanced ideas and techniques that are applicable.

MISSION

To import quality education in Physics such that, they aim to attain better position in the best Organizations. To make the students effectively disseminate their knowledge to the next coming generation. To develop the capacity and know-how to apply the principles and laws of Physics to solve problems. Enhance their ability to do and interpret the data obtained in experiments. To extend research facilities and thereby approaching towards the centre for excellence. To apply the knowledge of Physics for sustainable development of the society. Assume responsibility and always practice ethical principles, to function effectively, as individual as well as in a team.

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 complies 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 student store call 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 recall and require students to combine data 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 breakdown something 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

K. N. Govt. Arts College (W) Autonomous, Thanjavur - 7.
Physics Course Structure - TANSCHE REGULATION
(For the candidates admitted from the academic year 2023 - 2024 onwards)

Semester	Course	Subject Code	Title of the Paper	Inst. Hrs.	Credit	Exam. Hrs.	Marks		Total
							Int.	Ext.	
I	CC 1	23KP1P01	Mathematical Physics	7	5	3	25	75	100
	CC 2	23KP1P02	Classical Mechanics and Relativity	7	5	3	25	75	100
	CC3 (P)	23KP1P03P	Practical I	6	4	3	25	75	100
	EL - I	23KP1PECP1:1	Linear and Digital ICs and Applications	5	3	3	25	75	100
		23KP1PECP1:2	Materials Science						
	EL - II	23KP1PECP2:1	Physics of Nano Science and Technology	5	3	3	25	75	100
		23KP1PECP2:2	Astrophysics						
				30	**20**	-	**125**	**375**	**500**
II	CC 4	23KP2P04	Statistical Mechanics	6	5	3	25	75	100
	CC 5	23KP2P05	Quantum Mechanics - I	6	5	3	25	75	100
	CC6 (P)	23KP2P06P	Practical II	6	4	3	25	75	100
	EL - III	23KP2PECP3:1	Advanced Optics	4	3	3	25	75	100
		23KP2PECP3:2	Biophysics						
	EL – IV	23KP2PECP4:1	Microprocessor8085 and Microcontroller 8051	4	3	3	25	75	100
		23KP2PECP4:2	Characterization of Materials						
	SEC – I	23KP2PSEC1	Crystal Growth and Thin Films	4	2	3	25	75	100
	ECC1	23KP2PECC1:1	Self Study- Solar Energy	-	3	3	-	100	100
		23KP2PECC1:2	MOOC	-	3	-	-	-	-
	ECC2	23KP2PECC2	Add on Course	-	4	-	-	-	-
				30	**22**	-	**150**	**450**	**600**
III	CC 7	23KP3P07	Quantum Mechanics - II	6	5	3	25	75	100

	CC 8	23KP3P08	Condensed Matter Physics	6	5	3	25	75	100
	CC 9	23KP3P09	Electromagnetic Theory	6	5	3	25	75	100
	CC10(P)	23KP3P10P	Numerical Methods and Computer Programming (FORTRAN / C) - Practical – III	6	4	3	25	75	100
	EC - V	23KP3PECP5:1	Communication Electronics	3	3	3	25	75	100
		23KP3PECP5:2	Digital Communication						
	SEC – II	23KP3PSEC2	Energy Physics	3	2	3	25	75	100
	IT/IA	23KP3I	Internship / Industrial Activity	-	2	-	-	-	-
	ECC3	23KP3PECC3:1	Self Study – Laser Physics	-	3	-	-	100	100
		23KP3PECC3:2	MOOC	-	3	-	-	-	-
				30	**26**	-	**150**	**450**	**600**
IV	CC 11	23KP4P11	Nuclear and Particle Physics	6	5	3	25	75	100
	CC 12	23KP4P12	Spectroscopy	6	5	3	25	75	100
	Project Work	23KP4PPW	Project with Viva voce	10	7	-	-	100	100
	EL- VI (P)	23KP4PECP6P	Practical – IV	4	3	3	25	75	100
	SEC -III	23KP4PSEC3	Numerical Methods and Computer Programming	4	2	3	25	75	100
	EA	23KP4EA	Extension Activities	-	1	-	-	-	-
				30	**23**	-	**100**	**400**	**500**
				120	**91**	-	**525**	**1675**	**2200**

ELECTIVE PAPERS

LIST 1

1. Energy Physics
2. Crystal Growth and Thin films
3. Analysis of Crystal Structures
4. Materials Science
5. Physics of Nano Science and Technology
6. Digital Communication
7. Communication Electronics
8. Astrophysics

LIST 2

9. Plasma Physics
10. Bio Physics
11. Non-linear Dynamics
12. Quantum Field Theory
13. General Relativity and Cosmology
14. Advanced Optics
15. Advanced Mathematical Physics

LIST 3
INDUSTRY ORIENTED ELECTIVE (IOE)

16. Advanced Spectroscopy
17. Microprocessor 8086 and Microcontroller 8051
18. Characterization of Materials
19. Medical Physics
20. Solid Waste Management
21. Sewage and Waste Water Treatment and Reuse
22. Solar Energy Utilization

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

Paper-1 - MATHEMATICAL PHYSICS	I YEAR - FIRST SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP1P01	MATHEMATICAL PHYSICS	Core				5	7	75

Pre-Requisites
Knowledge of Matrices, vectors, differentiation, integration, differential equations
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

UNITS	Course Details
UNIT I: **LINEAR VECTOR SPACE**	Basic concepts – Definitions- examples of vector space – Linear independence - Scalar product- Orthogonality – Gram-Schmidt orthogonalization procedure –linear operators – Dual space- ket and bra notation – orthogonal basis – change of basis – Isomorphism of vector space – projection operator –Eigen values and Eigen functions – Direct sum and invariant subspace – orthogonal transformations and rotation
UNIT II: **COMPLEX ANALYSIS**	Review of Complex Numbers -de Moivre's theorem-Functions of a Complex Variable-Differentiability -Analytic functions- Harmonic Functions- Complex Integration-Contour Integration, Cauchy – Riemann conditions – Singular points – Cauchy's Integral Theorem and integral Formula -Taylor's Series - Laurent's Expansion- Zeros and poles – Residue theorem and its Application: Potential theory - (1) Electrostatic fields and complex potentials - Parallel plates, coaxial cylinders and an annular region (2) Heat problems - Parallel plates and coaxial cylinders
UNIT III: **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
UNIT IV: **FOURIER TRANSFORMS & LAPLACE TRANSFORMS**	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 – Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi - infinite strip

UNITV: **DIFFERENTIAL EQUATIONS**	Second order differential equation- Sturm-Liouville's theory - Series solution with simple examples - Hermite polynomials - Generating function - Orthogonality properties - Recurrence relations – Legendre polynomials - Generating function - Rodrigue formula – Orthogonality properties - Dirac delta function- One dimensional Green's function and Reciprocity theorem -Sturm-Liouville's type equation in one dimension & their Green's 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. George Arfken and Hans J Weber, 2012, Mathematical Methods for Physicists – A Comprehensive Guide (7th edition), Academic press. 2. P.K. Chattopadhyay, 2013, *Mathematical Physics* (2^{nd} edition), New Age, New Delhi 3. A W Joshi, 2017, Matrices and Tensors in Physics, 4th Edition (Paperback), New Age International Pvt.Ltd., India 4. B. D. Gupta, 2009, *Mathematical Physics* (4^{th} edition), VikasPublishing House, New Delhi. 5. H. K. Dass and Dr. Rama Verma, 2014, Mathematical Physics, Seventh Revised Edition, S. Chand & Company Pvt. Ltd., New Delhi.
REFERENCE BOOKS	1. E. Kreyszig, 1983, Advanced Engineering Mathematics, Wiley Eastern, New Delhi, 2. D. G. Zill and M. R. Cullen, 2006, Advanced Engineering Mathematics, 3rd Ed. Narosa, New Delhi. 3. S. Lipschutz, 1987, Linear Algebra, Schaum's Series, McGraw - Hill, New York 3. E. Butkov, 1968, Mathematical Physics Addison - Wesley, Reading, Massachusetts. 4. P. R. Halmos, 1965, Finite Dimensional Vector Spaces, 2nd Edition, Affiliated EastWest, New Delhi. 5. C. R. Wylie and L. C. Barrett, 1995, Advanced Engineering Mathematics, 6 th Edition, International Edition, McGraw-Hill, New York
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/

COURSE OUTCOMES:

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

CO1	Understand use of bra-ket vector notation and explain the meaning of complete ortho normal set of basis vectors, and transformations and be able to apply them	**K1, K2**

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)**.**

	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

	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

Paper-2 - CLASSICAL MECHANICS AND RELATIVITY		**I YEAR - FIRST SEMESTER**						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23KP1P02	**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 – Lagrangian equations of motion for conservative systems – 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 normal modes – linear triatomic molecule.
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. H. Goldstein, 2002, *Classical Mechanics*, 3rd Edition, Pearson Edu. 2. J. C. Upadhyaya, *Classical Mechanics*, Himalaya Publshing. Co.New Delhi. 3. R. Resnick, 1968, *Introduction to Special Theory of Relativity*, Wiley Eastern, New Delhi. 4. R. G. Takwala and P.S. Puranik, Introduction to Classical Mechanics –Tata – McGraw Hill, New Delhi, 1980. 5. N. C. Rana and P.S. Joag, Classical Mechanics - Tata McGraw Hill, 2001
REFERENCE BOOKS	1. K. R. Symon,1971, *Mechanics*, Addison Wesley, London. 2. S. N. Biswas, 1999, *Classical Mechanics*, Books & Allied, Kolkata. 3. Gupta and Kumar, *Classical Mechanics*, KedarNath. 4. T.W.B. Kibble, *Classical Mechanics*, ELBS. 5. Greenwood, *Classical Dynamics*, PHI, New Delhi.

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)**.**

	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

	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

Paper - 3 - PRACTICAL I	**I YEAR - FIRST SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23KP1P03P	**PRACTICAL I**	**Core**				**4**	**6**	**75**

Pre-Requisites
Knowledge and hands on experience of basic general and 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.

Course Details

(Minimum of Twelve Experiments from the list)

1. Determination of Young's modulus and Poisson's ratio by Hyperbolic fringes - Cornu's Method
2. Determination of Viscosity of the given liquid – Meyer's disc
3. Measurement of Coefficient of linear expansion- Air wedge Method
4. B-H loop using Anchor ring.
5. Determination of Thickness of the enamel coating on a wire by diffraction
6. Determination of Rydberg's Constant - Hydrogen Spectrum
7. Thickness of air film - FP Etalon
8. Measurement of Band gap energy- Thermistor
9. Determination of Specific charge of an electron – Thomson's method.
10. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer
11. GM counter – Characteristics and inverse square law.
12. Measurement of Conductivity - Four probe method.
13. Molecular spectra – AlO band.
14. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating.
15. Measurements of Standing wave and standing wave co-efficient, Law of Inverse square, Receiver end transmitter behavior, Radiation Pattern - Microwave test bench
16. UV-Visible spectroscopy – Verification of Beer-Lambert's law and identification of wavelength maxima – Extinction coefficient
17. Construction of relaxation oscillator using UJT
18. FET CS amplifier- Frequency response, input impedance, output impedance
19. Study of important electrical characteristics of IC741.
20. V- I Characteristics of different colours of LED.
21. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp.
22. Study of attenuation characteristics of Phase shift network and design of Phase shift oscillator using Op-Amp.
23. Construction of Schmidt trigger circuit using IC 741 for a given hysteresis- application as squarer
24. Construction of square wave Triangular wave generator using IC 741
25. Construction of a quadrature wave using IC 324
26. Construction of pulse generator using the IC 741 – application as frequency divider
27. Study of R-S, clocked R-S and D-Flip flop using NAND gates
28. Study of J-K, D and T flip flops using IC 7476/7473
29. Arithmetic operations using IC 7483- 4-bit binary addition and subtraction.
30. Study of Arithmetic logic unit using IC 74181.

TEXT BOOKS	1. Practical Physics, Gupta and Kumar, Pragati Prakasan. 2. Kit Developed for doing experiments in Physics- Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences.

	3. Electronic Laboratory Primer a design approach, S. Poorna chandra, B.Sasikala, Wheeler Publishing, New Delhi. 4. Electronic lab manual Vol I, K ANavas, Rajath Publishing. 5. Electronic lab manual Vol II, K ANavas, PHI eastern Economy Edition
REFERENCE BOOKS	1. Advanced Practical Physics, S.P Singh, Pragati Prakasan. 2. An advanced course in Practical Physics, D.Chattopadhayay, C.R Rakshit, New Central Book Agency Pvt. Ltd 3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition. 4. A course on experiment with He-Ne Laser, R.S. Sirohi, John Wiley & Sons (Asia) Pvt. Ltd. 5. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing.

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)**.**

	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

	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**
25	75	**100**	

Paper - 4 - LINEAR AND DIGITAL ICs & APPLICATIONS	**I YEAR - FIRST SEMESTER**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23KP1PECP1:1	**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: Solution to simultaneous equations and differential equations, Instrumentation amplifiers, V to I and I to V converters. NON-LINEAR APPLICATIONS OF OP-AMP: Sample and Hold circuit, Log and Antilog amplifier, multiplier and divider, Comparators, Schmitt trigger, Multivibrators, 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, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, basic principle, phase detector/comparator, voltage controlled oscillator (IC 566), low pass filter, monolithic PLL and applications of PLL
UNIT IV: VOLTAGE REGULATOR & D to A AND A to D CONVERTERS	VOLTAGE REGULATOR: Introduction, Series Op-Amp regulator, IC Voltage Regulators, IC 723 general purpose regulators, Switching Regulator. D to A AND A to D CONVERTERS: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, A to D converters -parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.
UNIT V: CMOS LOGIC, COMBINATIONAL CIRCUITS USING TTL 74XX ICs & SEQUENTIAL CIRCUITS USING	CMOS LOGIC:CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates, CMOS AND-OR-INVERT and OR-AND-INVERT gates, implementation of any function using CMOS logic. 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), BCD to 7-segment decoder (IC7447), Encoder (IC74147), Multiplexer (IC74151), Demultiplexer (IC 74154). SEQUENTIAL CIRCUITS USING TTL 74XX ICs: Flip Flops (IC 7474, IC 7473), Shift Registers, Universal Shift Register (IC 74194), 4- bit asynchronous binary counter

TTL 74XX ICs	(IC 7493).
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. V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition. 4. 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. 5. Integrated Electronics, Millman &Halkias, Tata McGraw Hill, 17th Reprint (2000)
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/ 4. https://www.electrical4u.com/applications-of-op-amp/ 5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

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 IC 555 timer and can solve problems related to it.	**K1, K3**

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)**.**

	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

	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

MATERIALS SCIENCE	**I/II YEAR - FIRST/THIRD SEMESTER**

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

23KP1PECP1:2	**MATERIALS SCIENCE**	**Elective**				**3**	**5**	**75**

Pre-Requisites
➢ Basic knowledge on different types of materials
Learning Objectives
➢ To gain knowledge on optoelectronic materials ➢ To learn about ceramic processing and advanced ceramics ➢ To understand the processing and applications of polymeric materials ➢ To gain knowledge on the fabrication of composite materials ➢ To learn about shape memory alloys, metallic glasses and nanomaterials

UNITS	**Course details**
UNIT I: OPTOELECTRONIC MATERIALS	Importance of optical materials – properties: Band gap and lattice matching – optical absorption and emission – charge injection, quasi-Fermi levels and recombination – optical absorption, loss and gain. Optical processes in quantum structures: Inter-band and intra-band transitions Organic semiconductors. Light propagation in materials – Electro-optic effect and modulation, electro- absorption modulation – exciton quenching.
UNIT II CERAMIC MATERIALS	Ceramic processing: powder processing, milling and sintering – structural ceramics: zirconia, almina, silicon carbide, tungsten carbide – electronic ceramics – refractories – glass and glass ceramics
UNIT III POLYMERIC MATERIALS	Polymers and copolymers – molecular weight measurement – synthesis: chain growth polymerization – polymerization techniques – glass transition temperature and its measurement – viscoelasticity – polymer processing techniques – applications: conducting polymers, biopolymers and high temperature polymers.
UNIT IV COMPOSITE MATERIALS	Particle reinforced composites – fiber reinforced composites – mechanical behavior –fabrication methods of polymer matrix composites and metal matrix composites – carbon/carbon composites: fabrication and applications.
UNIT V: NEW MATERIALS	Shape memory alloys: mechanisms of one-way and two-way shape memory effect, reverse transformation, thermo-elasticity and pseudo-elasticity, examples and applications-bulk metallic glass: criteria for glass formation and stability, examples and mechanical behavior - nanomaterials: classification, size effect on structural and functional properties, processing and properties of Nano crystalline materials, single walled and multi walled carbon nanotubes
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. Jasprit Singh, Electronic and optoelectronic properties of semiconductor structures, Cambridge University Press, 2007 2. P. K. Mallick. Fiber-Reinforced Composites. CRC Press, 2008. 3. V. Raghavan, 2003, Materials Science and Engineering, 4th Edition, Prentice- Hall India, New Delhi(For units 2,3,4 and 5)

	4. G.K. Narula, K.S. Narula and V.K. Gupta, 1988, Materials Science, Tata McGraw-Hill 5. M. Arumugam, 2002, Materials Science, 3rd revised Edition, Anuratha Agenciess
REFERENCE BOOKS	1. B. S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday. Textbook of Nanoscience and Nanotechnology. Springer- Verlag, 2012. 2. K. Yamauchi, I. Ohkata, K. Tsuchiya and S. Miyazaki (Eds). Shape Memory and Super Elastic Alloys: Technologies and Applications. Wood head Publishing Limited, 2011. 3. Lawrence H. VanVlack, 1998. Elements of Materials Science and Engineering, 6th Edition, Second ISE reprint, Addison-Wesley. 4. H. Iabch and H. Luth, 2002, Solid State Physics – An Introduction to Principles of Materials Science, 2nd Edition, Springer. 5. D. Hull & T. W. Clyne, An introduction to composite materials, Cambridge University Press, 2008.
WEB SOURCES	1. https://onlinecourses.nptel.ac.in/noc20_mm02/preview 2. https://nptel.ac.in/courses/112104229 3. https://archive.nptel.ac.in/courses/113/105/113105081 4. https://nptel.ac.in/courses/113/105/113105025/ https://eng.libretexts.org/Bookshelves/Materials_Science/Supplemental_Modules_(Materials_Science)/Electronic_Properties/Lattice_Vibrations

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

CO1	Acquire knowledge on optoelectronic materials	**K1**
CO2	Be able to prepare ceramic materials	**K3**
CO3	Be able to understand the processing and applications of polymeric materials	**K2, K3**
CO4	Be aware of the fabrication of composite materials	**K5**
CO5	Be knowledgeable of shape memory alloys, metallic glasses and nanomaterials	**K1**
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	2	3	3	2	2	2	2	1	2	3
CO2	2	3	3	2	2	2	2	1	2	2
CO3	2	3	2	2	2	2	2	2	2	2
CO4	1	3	2	3	2	3	2	2	2	2
CO5	2	3	2	2	2	2	2	2	2	2

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

Paper-5- PHYSICS OF NANOSCIENCE AND TECHNOLOGY	**I/II YEAR – FIRST/THIRD SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP1PECP2:1	PHYSICS OF NANOSCIENCE AND TECHNOLOGY	Elective				3	5	75

Pre-Requisites
Basic knowledge in Solid State Physics
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 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: 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 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)**.**

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

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

ASTROPHYSICS	**I/II YEAR – FIRST/THIRD SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP1PECP2:2	ASTROPHYSICS	Elective				3	5	75

Pre-Requisites
Fundamental knowledge about electromagnetic spectrum, wave nature of light and about the universe and the galaxy where we live in.
Learning Objectives
➢ To impart knowledge on the physical universe and its evolution. ➢ To make the student to understand fundamental principles and techniques of astronomy and astrophysics. ➢ To make the student to study electromagnetic radiation from stars, atomic spectra and classification of stars. ➢ To provide information about the properties and the evolution of stars. ➢ To render information about astronomical instrumentation.

UNITS	Course Details
UNIT I: OBSERVATIONAL ASTRONOMY	The electromagnetic spectrum; geometrical optics (ray diagrams, focal length, magnification etc); diffraction (resolving power, Airy disc, diffraction limit etc); telescopes (reflecting, refracting, multiwavelength)
UNIT II: PROPERTIES OF STARS	Brightness (luminosities, fluxes and magnitudes); colours (black body radiation, the Planck, Stefan-Boltzmann and Wien's laws, effective temperature, interstellar reddening); spectral types; spectral lines (Bohr model, Lyman & Balmer series etc, Doppler effect); Hertzprung-Russell diagram; the main sequence (stellar masses ,binary systems, Kepler's laws, mass-luminosity relations); distances to stars (parallax, standard candles, P-L relationships, ms-fitting etc); positions of stars (celestial sphere, coordinate systems, proper motions, sidereal and universal time).
UNIT III: THE LIFE AND DEATH OF STARS	Energy source (nuclear fusion, p-pchain, triple-alpha, CNO cycle, lifetime of the Sun); solar neutrinos; basic stellar structure hydro static equilibrium, equation of state);evolution beyond the main sequence; formation of the heavy elements; supernovae; stellar remnants(white dwarfs, neutron stars, black holes, degeneracy pressure, Swarszchild radius, escape velocities).
UNIT IV: GALAXIES	Constituents of galaxies; stellar populations; the interstellar medium; HII regions; 21cm line; spirals and ellipticals; galactic dynamics; galaxy rotation curves and dark matter ; active galaxies and quasars.

UNIT V: COSMOLOGY	Galaxies and the expanding Universe; Hubble's Law; the age of the Universe; the Big Bang; cosmic microwave background (black body radiation);big bang nucleosynthesis (cosmic abundances, binding energies, matter & radiation); introductory cosmology (the cosmological principle, homogeneity and isotropy, Olber's paradox); cosmological models (critical density, geometry of space, the fate of the Universe); dark energy and the accelerating Universe.
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.Zeilik& Gregory, Introductory Astronomy & Astrophysics,4thedition (Saunders College Publishing) 2.Morison,I.,IntroductiontoAstronomyand Cosmology, (Wiley) 3.Kutner,M.L., Astronomy: A Physical Perspective (Cambridge University Press) 4. Green,S.F.& Jones,M.H.,An Introduction to the Sunand Stars (Cambridge University Press)
REFERENCE BOOKS	5.Jones,M.H.&Lambourne,R.J.A.,An Introduction to Galaxies & Cosmology (Cambridge UniversityPress) 6.Carroll,B.W.&Ostlie,D.A.,An Introduction to ModernAstrophysics (Pearson) 7.Shu,F.H.,The Physical Universe, An Introduction to Astronomy, (University Science Books) 8.Motz,L.&Duveen,A.,The Essentials of Astronomy, (ColombiaUniversityPress)
WEB SOURCES	1. https://www.coursera.org/courses?query=astrophysics 2. https://www.space.com 3. https://www.britanica.com 4. https://science.nasa.gov 5. https://merriam-webster.com

COURSE OUTCOMES:

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

CO1	Recall and understand the electromagnetic ration from celestial objects. Analyze the wave nature of light in the form of ray diagram. Apply the knowledge of phenomenon of diffraction and asses, how diffraction limits the resolution of any system having a lens or mirror. Distinguish between reflecting and refracting telescopes and their usage.	**K1 K2 K3 K4 K5**
CO2	Correlate luminosity, flux and magnitude, related to the brightness of a star. Analyze the evolution of stars using HR diagram. Apply and examine the various laws related to temperature of a star. Assess the distance of stars, measured using trigonometric parallax method. Understand the position of star in the celestial sphere. Distinguish between sideral and universal time.	**K1 K2 K3 K4 K5**
CO3	Define nuclear fusion, which is the fundamental energy source of stars. Analyze, how neutrinos are born during the process of nuclear fusion in the sun. Recall and explain the CNO cycle – the main source of energy of hotter stars. Comprehend stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories	**K1 K2 K3 K4**
CO4	Remember and illustrate the structure of our Milky way galaxy. Classify the types of galaxies. Understand thepresence of dark matter in the universe. Explain, howquasars and active galaxies are powered by supermassiveblack holes which produce copious luminosity.	**K1 K2 K3 K4**
CO5	Explain cosmology, a branch of astronomy that involvesthe origin and evolution of the universe, from the Big Bangto today and on into the future. Define Hubble's law ofcosmic expansion. Analyze and assess the big bangnucleosynthesis universe that explains the relative	**K1 K2 K3 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) andLOW (1)**.**

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

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

Paper -6- STATISTICAL MECHANICS	I YEAR - SECOND SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP2P04	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 - Critical indices - Scale transformations and dimensional analysis.
UNIT II: STATISTICAL MECHANICS AND THERMODYNAMICS	Foundations of statistical mechanics - Specification of states of a system - Micro canonical ensemble - Phase space – Entropy - Connection between statistics and thermodynamics – Entropy of an ideal gas using the micro canonical ensemble - Entropy of mixing and Gibb's paradox.
UNIT III: CANONICAL AND GRAND CANONICAL ENSEMBLES	Trajectories and density of states - Liouville's theorem - Canonical and grand canonical ensembles - Partition function - Calculation of statistical quantities - Energy and density fluctuations.
UNIT IV: CLASSICAL AND QUANTUM STATISTICS	Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Maxwell-Boltzmann statistics - Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics - Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.

UNIT V: REAL GAS, ISING MODEL AND FLUCTUATIONS	Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in onedimension. Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin's theory - Fluctuation-dissipation theorem - The Fokker-Planck equation
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. S. K. Sinha, 1990, Statistical *Mechanics*, Tata McGraw Hill, New Delhi. 2. B. K. Agarwal and M. Eisner, 1998, *Statistical Mechanics*, Second Edition New Age International, New Delhi. 3. J. K. Bhattacharjee, 1996, *Statistical Mechanics*: An Introductory Text, Allied Publication, New Delhi. 4. F. Reif, 1965, *Fundamentals of Statistical and Thermal Physics*, McGraw - Hill, New York. 5. M. K. Zemansky, 1968, *Heat and Thermodynamics*, 5th edition, McGraw-Hill New York.
REFERENCE BOOKS	1. R. K. Pathria, 1996, *Statistical Mechanics*, 2nd edition, Butter WorthHeinemann, New Delhi. 2. L. D. Landau and E. M. Lifshitz, 1969, *Statistical Physics*, Pergamon Press, Oxford. 3. K. Huang, 2002, *Statistical Mechanics*, Taylor and Francis, London 4. W. Greiner, L. Neiseand H.Stoecker, *Thermodynamics and Statistical Mechanics*, Springer Verlang, New York. 5. A. B. Gupta, H. Roy, 2002, *Thermal Physics*, Books and Allied, Kolkata.
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 relation between thermo dynamical quantities and partition function	**K1**
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 thermo dynamical 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)**.**

	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

	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

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP2P05	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-Hydrogen atom-Rigid rotator
UNIT III: 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
	Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and

UNIT IV: APPROXIMATION METHODS	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, 2nd edition(37th Reprint),Tata McGraw-Hill, New Delhi, 2010. 2. G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 2009. 3. David J Griffiths, Introduction to Quantum Mechanics. 4th edition, Pearson, 2011. 4. SL Gupta and ID Gupta, Advanced Quantum Theory and Fields, 1st Edition, S.Chand& Co., New Delhi, 1982. 5. A. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4thEdition, Macmillan, India, 1984.
REFERENCE BOOKS	1. E. Merzbacher, Quantum Mechanics, 2nd Edition, John Wiley and Sons, New York, 1970. 2. V. K. Thankappan, Quantum Mechanics, 2nd Edition, Wiley Eastern Ltd, New Delhi, 1985. 3. L. D. Landau and E. M. Lifshitz, Quantum Mechanics, 1st edition, Pergomon Press, Oxford, 1976. 4. S. N. Biswas, Quantum Mechanics, Books and Allied Ltd., Kolkata, 1999. 5. V. Devanathan, Quantum Mechanics, 2nd edition, Alpha Science International Ltd, Oxford , 2011.
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) and LOW (1)**.**

	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

	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

Paper-8- PRACTICAL II	I YEAR - SECOND SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP2P06P	PRACTICAL II	Core				4	6	75

Pre-Requisites
Knowledge and handling of basic general and 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 FET and UJT. ➢ To study the different applications of operational amplifier circuits. ➢ To learn about Combinational Logic Circuits and Sequential Logic Circuits

Course Details

(Minimum of Twelve Experiments from the list)

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method
2. Determination of Stefan's constant of radiation from a hot body
3. Measurement of Susceptibility of liquid - Quincke's method
4. B-H curve using CRO
5. Thickness of LG Plate
6. Arc spectrum: Copper
7. Determination of e/m - Millikan's method
8. Miscibility measurements using ultrasonic diffraction method
9. Determination of Thickness of thin film. - Michelson Interferometer
10. Iodine absorption spectra
11. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source.
12. Measurement of Dielectricity - Microwave test bench
13. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility

14. Interpretation of vibrational spectra of a given material
15. Determination of I-V Characteristics and efficiency of solar cell
16. GM counter – Absorption coefficient – Maximum range of β rays
17. IC 7490 as scalar and seven segment display using IC7447
18. Solving simultaneous equations – IC 741 / IC LM324
19. Op-Amp –Active filters: Low pass, High pass and Band pass filters (Second Order) Batter worth filter
20. Construction of Current to Voltage and Voltage to Current Conversion using IC 741.
21. Construction of second order butterworth multiple feedback narrow band pass filter
22. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193
23. Construction of Schmidt trigger circuit using IC555 for a given hysteresis – Application as squarer
24. Construction of pulse generator using the IC 555 – Application as frequency divider
25. BCD to Excess- 3 and Excess 3 to BCD code conversion
26. Study of binary up / down counters - IC 7476 / IC7473
27. Shift register and Ring counter and Johnson counter- IC 7476/IC 7474

TEXT BOOKS	1. Practical Physics, Gupta and Kumar, Pragati Prakasan 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. Electronic lab manual Vol I, K ANavas, Rajath Publishing 5. 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)**.**

	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

	PSO 1	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**	**PSO 7**	**PSO 8**	**PSO 9**	**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	S	S	2	2	2	3	3
CO7	2	2	S	S	S	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**
25	75	**100**	

Paper-9- **ADVANCED OPTICS**	**I/II YEAR – SECOND/THIRD SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP2PECP3:1	**ADVANCED OPTICS**	**Elective**				**3**	**4**	**75**

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 BOOKS	1. F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th 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) and LOW (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

BIO PHYSICS	I/II YEAR – SECOND/THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP2PECP3:2	BIOPHYSICS	Elective				3	4	75

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 BIOPHYSICS	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 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, Vasantha Pattabhi, 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

Paper-10- MICROPROCESSOR 8085 AND MICROCONTROLLER 8051	I/II YEAR – SECOND/THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP2PECP4:1	MICROPROCESSOR 8085 AND MICROCONTROLLER 8051	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

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 MICROCONTROLLERHARDWARE	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 EXTERNAL WORLD	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 , 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. A. P. Godse and D. A. Godse, Microprocessors, Technical Publications, Pune (2009). 3. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishing (2013). 4. B. Ram, Fundamentals of Microprocessors & Microcontrollers, DhanpatRai publications New Delhi (2016). 5. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.
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. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi. 4. J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi. 5. W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi.

WEB SOURCES	1. https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html 2. http://www.electronicsengineering.nbcafe.in/peripheral-mapped-io-interfacing/ 3. https://www.geeksforgeeks.org/programmable-peripheral-interface-8255/ 4. http://www.circuitstoday.com/8051-microcontroller 5. https://www.elprocus.com/8051-assembly-language-programming/

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

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

CHARACTERIZATON OF MATERIALS	**I/II YEAR – SECOND/THIRD SEMESTER**

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

23KP2PECP4:2	**CHARACTERIZATON OF MATERIALS**	**Elective**				**3**	**4**	**75**

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 CHARACTERISATION	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:	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. 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, 1979. 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 5. https://www.sciencedirect.com/journal/materials-characterization

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

Paper-11- CRYSTAL GROWTH AND THIN FILM PHYSICS	**I/II YEAR – FIRST/THIRD SEMESTER**

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

23KP2PSEC1	**CRYSTAL GROWTH AND THIN FILMS**	**Elective**				**2**	**4**	**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 crystalizer
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. M. Ohora and R. C. Reid, "Modeling of Crystal Growth Rates from Solution" 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. P. SanthanaRaghavan and P. Ramasamy, "Crystal Growth Processes",KRU Publications. 4. H.E. Buckley, 1951, 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)**.**

	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

	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

Paper - 12 - QUANTUM MECHANICS – II	**II YEAR - THIRD SEMESTER**

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

23KP3P07	**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 1: 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	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.

QUANTIZATION	
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,2nd Edition,Tata McGraw-Hill, New Delhi, 2010. 2. G. Aruldhas, Quantum Mechanics, 2nd Edition, Prentice-Hall of India, NewDelhi,2009 3. L. I. Schiff, Quantum Mechanics, 3rd Edition, International Student Edition, McGraw-Hill Kogakusha, Tokyo, 1968 4. V. Devanathan, Quantum Mechanics, 1st Edition, Narosa Publishing House, New Delhi, 2005. 5. NouredineZettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017
REFERENCE BOOKS	1. P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition,Oxford University Press, London, 1973. 2. B.K.Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009. 3. Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics,1st edition,I.K.International Publishing house Pvt.Ltd., 2006 4. Ghatak and S. Lokanathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi. 5. E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970
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) and LOW (1)**.**

	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	1	1	3	3	1	2	2	3	3
CO5	2	1	1	3	3	2	2	2	3	3

	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	1	1	3	3	1	2	2	3	3
CO5	2	1	1	3	3	2	2	2	3	3

Paper -13 - **CONDENSED MATTER PHYSICS**	**II YEAR - THIRD SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP2P08	**CONDENSED MATTER PHYSICS**	**Core**				**5**	**6**	**75**

Pre-Requisites
Basic knowledge of atomic physics, quantum mechanics and statistical mechanics.
Learning Objectives
➢ To describe various crystal structures, symmetry and to differentiate different types of bonding. ➢ To construct reciprocal space, understand the lattice dynamics and apply it to concept of specific heat. ➢ To critically assess various theories of electrons in solids and their impact in distinguishing solids. ➢ Outline different types of magnetic materials and explain the underlying phenomena. ➢ Elucidation of concepts of superconductivity, the underlying theories – relate to current areas of research.

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 – Block walls – spin waves - Quantization - Magnons - Thermal excitation of magnons - Curie temperature and susceptibility of ferrimagnets - Theory of antiferomagnetism - Neel temperature.

UNIT V: Superconductivity	**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, 1996, *Introduction to SolidState Physics*, 7th Edition, Wiley, New York. 2 Rita John, Solid State Physics,Tata Mc-GrawHill Publication. 3 J. Dekker, *Solid State Physics*, Macmillan India, New Delhi. 4 M. Ali Omar, 1974, *Elementary Solid State Physics – Principles and Applications*, Addison - Wesley 5 H. P. Myers, 1998, *Introductory Solid State Physics*, 2nd Edition, Viva Book, New Delhi.
REFERENCE BOOKS	1. J. S. Blakemore, 1974, *Solid state Physics*, 2nd Edition, W.B. Saunder, Philadelphia 2. H. M. Rosenburg, 1993, *The Solid State*, 3rd Edition, OxfordUniversity Press, Oxford. 3. J. M. Ziman, 1971, Principles *of the Theory of Solids*, Cambridge University Press, London. 4. C. Ross-Innes and E. H. Rhoderick, 1976, *Introduction to Superconductivity*, Pergamon, Oxford. 5. J. P. Srivastava, 2001, *Elements of Solid State Physics*, Prentice-Hall of India, New Delhi.
WEB SOURCES	1. http://www.physics.uiuc.edu/research/electronicstructure/389/389-cal.html 2. http://www.cmmp.ucl.ac.uk/%7Eaph/Teaching/3C25/index.html 3. https://www.britannica.com/science/crystal 4. https://www.nationalgeographic.org/encyclopedia/magnetism/ 5. https://www.brainkart.com/article/Super-Conductors_6824/

COURSE OUTCOMES:

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

CO1	Student will be able to list out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure	**K1**
CO2	Students will be able to visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.	**K1, K2**
CO3	Student will be able to comprehend the heat conduction in solids	**K3**
CO4	Student will be able to generalize the electronic nature of solids from band theories.	**K3, K4**
CO5	Student can compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.	**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	2	3	2	2	2	2	2	2	2
CO2	3	2	3	2	3	2	3	3	2	3
CO3	3	3	3	2	3	2	3	3	2	3
CO4	2	2	2	2	2	2	2	2	2	3
CO5	2	2	2	2	2	2	2	2	2	3

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

Paper - 14 - ELECTROMAGNETIC THEORY	II YEAR - THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP3P09	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

UNITS	Course Details
UNIT I: ELECTROSTATICS	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 – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion.
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 - Vector and scalar potentials - Gauge invariance - Wave equation and plane wave solution- Coulomb and Lorentz gauges - Energy and momentum of the field - Poynting's theorem - Lorentz force - Conservation laws for a system of charges and electromagnetic fields.

UNIT IV: WAVE PROPAGATION	Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole
UNIT V: ELEMENTARY PLASMA PHYSICS	The Boltzmann Equation - Simplified magneto-hydrodynamic equations - Electron plasma oscillations - The Debye shielding problem - Plasma confinement in a magnetic field - Magneto-hydrodynamic waves - Alfven waves and magnetosonic waves.
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, 2002, *Introduction to Electrodynamics*, 3rd Edition, Prentice-Hall of India, New Delhi. 2. J. R. Reitz, F. J. Milford and R. W. Christy, 1986, *Foundations of Electromagnetic Theory*, 3rd edition, Narosa Publishing House, New Delhi. 3. J. D. Jackson, 1975, *Classical Electrodynamics*, Wiley Eastern Ltd. New Delhi. 4. J. A. Bittencourt, 1988, *Fundamentals of Plasma Physics*, Pergamon Press, Oxford. 5. Gupta, Kumar and Singh, Electrodynamics, S.Chand & Co., New Delhi
REFERENCE BOOKS	1. W. Panofsky and M. Phillips, 1962, *Classical Electricity and Magnetism*, Addison Wesley, London. 2. J. D. Kraus and D. A. Fleisch, 1999, *Electromagnetics with Applications*, 5th Edition, WCB McGraw-Hill, New York. 3. B. Chakraborty, 2002, *Principles of Electrodynamics*, Books and Allied, Kolkata. 4. P. Feynman, R. B. Leighton and M. Sands, 1998, *The Feynman Lectures on Physics*, Vols. 2, Narosa Publishing House, New Delhi. 5. 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)**.**

	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

	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

AND COMPUTER PROGRAMMING (FORTRAN/C)	

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP3P10P	Practical – III NUMERICAL METHODS AND COMPUTER PROGRAMMING (FORTRAN/C)	Core				4	6	75

Pre-Requisites

Basic knowledge in differential equation and linear algebra
Basic knowledge of operating system and computer fundamentals.

Learning Objectives

- 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 C/FORTRAN
- To equip the computational skill using various mathematical tools.
- To apply the software tools to explore the concepts of physical science.
- To approach the real time activities using physics and mathematical formulations.

Course Details

(Minimum of Twelve Experiments from the list)

1. Lagrange interpolation with Algorithm, Flow chart and output.
2. Newton forward interpolation with Algorithm, Flow chart and output.
3. Newton backward interpolation with Algorithm, Flow chart and output.
4. Curve-fitting: Least squares fitting with Algorithm, Flow chart and output.
5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output.
6. Numerical integration by Simpson's rule with Algorithm, Flow chart and output.
7. Numerical solution of ordinary first-order differential equations by the Euler method with Algorithm, Flow chart and output.
8. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method with Algorithm, Flow chart and output.
9. Finding Roots of a Polynomial - Bisection Method –
10. Finding Roots of a Polynomial - Newton Raphson Method –
11. Solution of Simultaneous Linear Equation by Gauss elimination method.
12. Solution of Ordinary Differential Equation by Euler
13. Runge Kutta Fourth Order Method for solving first order Ordinary Differential Equations
14. Newton's cotes formula
15. Trapezoidal rule
16. Simpson's 1/3 rule
17. Simpson's 3/8 rule
18. Boole's rule
19. Gaussian quadrature method (2 point and 3 point formula)
20. Giraffe's root square method for solving algebraic equation

TEXT BOOKS	1. Numerical methods using Matlab – John Mathews & Kurtis Fink, Prentice Hall, New Jersey 2006 2. Numerical methods in Science and Engineering - M.K. Venkataraman, National Publishing Co. Madras, 1996 3. V. Rajaraman, 1993, Computer Oriented Numerical Methods, 3rd Ed. (Prentice-Hall, New Delhi. 4. M.K. Jain, S.R. Iyengar and R.K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Ed. New Age International, New Delhi. 5. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, New Delhi.
REFERENCE BOOKS	1. S.D. Conte and C. de Boor, 1981, Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., International Ed. (McGraw-Hill). 2. B.F. Gerald and P.O. Wheately, 1994, Applied Numerical Analysis, 5th Edition, Addison Wesley, Reading, MA. 3. B. Carnahan, H.A. Luther and J.O. Wikes, 1969, Applied Numerical Methods (Wiley, New York. 4. S.S. Kuo, 1996, Numerical Methods and Computers, Addison - Wesley, London. 5. V. Rajaraman, Programming in FORTRAN/ Programming in C, PHI, New Delhi.

COURSE OUTCOMES:

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

CO1	Program with the C Program/ FORTRAN with the C or any other high level language	**K1**
CO2	Use various numerical methods in describing/solving physics problems.	**K4**
CO3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems.	**K5**
CO4	To enhance the problem-solving aptitudes of students using various numerical methods.	**K5**
CO5	To apply various mathematical entities, facilitate to visualise any complicate tasks.	**K3**
CO6	Process, analyze and plot data from various physical phenomena and interpret their meaning	**K4**
CO7	Identify modern programming methods and describe the extent and limitations of computational methods in physics	**K1**
CO8	Work out numerical differentiation and integration whenever routine are not applicable.	**K5**
CO9	Apply various interpolation methods and finite difference concepts.	**K4**
CO10	Understand and apply numerical methods to find out solution of algebraic equation using different methods under different conditions, and numerical	**K1, K4**

	solution of system of algebraic equation.	
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	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

	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**
25	75	**100**	

Paper-16- COMMUNICATION ELECTRONICS	I/II YEAR – FIRST/THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP3PECP5:1	COMMUNICATION ELECTRONICS	Elective				3	3	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: ANTENNAS AND WAVE PROPAGATION	Radiation field and radiation resistance of short dipole antenna-groundedantenna-ungrounded antenna-antenna arrays-broadside and end side arrays-antenna gain-directional high frequency antennas-sky wave-ionosphere- Ecles and Larmor theory- Magnento ionic theory-ground wave propagation
UNIT II: MICROWAVES	Microwave generation—multicavity Klystron-reflex klystron-magnetrontravelling wave tubes (TWT) and other microwave tubes-MASER-Gunndiode-wave guides-rectangular wave guides-standing wave indicator andstanding wave ratio(SWR)
UNIT III: RADAR AND TELEVISION	Elements of a radar system-radar equation-radar performance Factorsradar transmitting systems-radar antennas-duplexers-radarreceivers and indicators-pulsed systems-other radar systems-colour TVtransmission and reception-colour mixing principle-colour picture tubes-Delta gun picture tube-PIL colour picture tube-cable TV, CCTV andtheatre TV
UNIT IV: OPTICAL FIBER	Propagation of light in an optical fibre-acceptance angle-numericalaperture-step and graded index fibres-optical fibres as a cylindrical waveguide-wave guide equations-wave guide equations in step index fibres -fibre losses and dispersion-applications

UNIT V: SATELLITE COMMUNICATION	Orbital satellites-geostationary satellites-orbital patterns-satellite systemlink models-satellite system parameters-satellite system link equationlinkbudget-INSAT communication satellites
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. Handbook of Electronics by Gupta and Kumar, 2008 edition. 2. Electronic communication systems – George Kennedy and Davis, Tata McGraw Hill, 4th edition, 1988. 3. Taub and Schilling, principles of communication systems, second edition, Tata Mc Graw Hill (1991). 4. M. Kulkarani, Microwave and radar engineering, UmeshPublications, 1998. 5. Mono Chrome and colour television, R. R. Ghulathi
REFERENCE BOOKS	1. Electronic communications – Dennis Roody and Coolen, Prentice Hall of India, IV edition, 1995. 2. Wayne Tomasi, Advanced electronics communication systems, fourth edition, Prentice Hall of India, 1998 3. Dennis Roddy and Coolen,1995,*Electronics communications*,Prentice Hall of India IV Edition. 4. Wayne Tomasi,1998 *"Advanced Electronics communication System"* 4th edition, Prentice Hall of India, 1998 5. S. Salivahanan, N. Suersh Kumar & A. Vallavaraj, 2009, Electronic Devices and Circuits, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition.
WEB SOURCES	1. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/ 2. https://www.polytechnichub.com/difference-analog-instruments-digital-instruments/ 3. http://nptel.iitm.ac.in/ 4. http://web.ewu.edu/ 5. http://nptel.iitm.ac.in/

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) andLOW (1)**.**

	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

	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

DIGITAL COMMUNICATION	I/II YEAR - FIRST/THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP3PECP5:2	DIGITAL COMMUNICATION	Elective				3	3	75

Pre-Requisites
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 THEORY	Communication system – Measurement of information – Coding – Bandot Code CCITT Code –Hartley Law – Noise in an information Carrying 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) andLOW (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

Paper-17- ENERGY PHYSICS	I/II YEAR - FIRST/THIRD SEMESTER

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP3PSEC2	ENERGY PHYSICS	Elective				2	3	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, 1996, Non – convention sources of, 4th edition, Khanna publishers, New Delhi. 2. S. Rao and Dr. ParuLekar, Energy technology. 3. M.P. Agarwal, Solar Energy, S. Chand and Co., New Delhi (1983). 4. Solar energy, principles of thermal collection and storage by S.P.Sukhatme, 2nd edition, Tata McGraw-Hill Publishing Co. Lt., New Delhi (1997). 5. Energy Technology by S.Rao and Dr.Parulekar.
REFERENCE BOOKS	1. Renewable energy resources, John Twidell and Tonyweir, Taylor and Francis group, London and New York. 2. Applied solar energy, A.B.MeinelandA.P.Meinal 3. John Twidell and Tony Weir, Renewable energy resources, Taylor and Francis group, London and New York. 4. Renewal Energy Technologies: A Practical Guide for Beginners C.S. Solanki-PHI Learning 5. Introduction to Non-Conventional Energy Resources -Raja et. al., Sci. Tech Publications
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) andLOW (1)**.**

	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

	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

Paper -18- **NUCLEAR AND PARTICLE PHYSICS**	**II YEAR - FOURTH SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP4P11	**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 ➢ 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 – iso spin 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.
UNIT IV: **NUCLEAR DECAY**	Beta decay – 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 – 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. R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996) 4. S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011) 5. S. Glasstone – Source Book of Atomic Energy – Van Nostrand Reinhold Inc.,U.S.- 3rd Revised edition (1968)
REFERENCE BOOKS	1. L. J. Tassie – The Physics of elementary particles – Prentice Hall Press (1973) 2. H. A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974). 3. Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002) 4. Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001) 5. B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.
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

Paper 19- SPECTROSCOPY		II YEAR - FOURTH SEMESTER						
Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**Credits**	**Inst. Hours**	**Marks**
23KP4P12	**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 different spectroscopic methods ➢ 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	**Course Details**
UNIT I: **MICROWAVE SPECTROSCOPY**	Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)-reduced mass – rotational constant - - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Instrumentation techniques – block diagram – Information derived from rotational spectra-stark effect-problems
UNIT II: **INFRA-RED SPECTROSCOPY**	Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator – fundamentals, overtones and combinations- Diatomic Vibrating Rotator- PR branch – PQR branch- Fundamental modes of vibration of H_2O and CO_2 -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra– remote analysis of atmospheric gases like N2O using FTIR by National Remote Sensing Centre (NRSC), India– other simple applications
UNIT III: **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 –structure determination of planar and non-planar molecules using IR and Raman techniques - FT Raman spectroscopy-SERS

UNITIV: **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
UNITV: **UV SPECTROSCOPY**	Origin of UV spectra - Laws of absorption – Lambert Bouguer law – Lambert Beer law - molar absorptivity – transmittance and absorbance - Color in organic compounds- Absorption by organic Molecule -Chromophores -Effect of conjugation on chromophores - Choice of Solvent and Solvent effect - Absorption by inorganic systems - Instrumentation - double beam UV-Spectrophotometer -Simple 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. C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi. 2. G Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi. 3. D.N. Satyanarayana, 2001, *Vibrational Spectroscopy and Applications*, New Age International Publication. 4. B.K. Sharma, 2015, *Spectroscopy*, Goel Publishing House Meerut. 5. Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7^{th} 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. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York. 4. K. Chandra, 1989, Introductory Quantum Chemistry, Tata McGraw Hill, New Delhi. 5. Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, SpringerLink.
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 rotational spectroscopy, 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 and use their knowledge of Raman Spectroscopy as an important analytical tool	**K5**
CO4	Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances	**K4**
CO5	Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.	**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)**.**

	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

Paper-20 - **PRACTICAL IV**	**II YEAR - FOURTH SEMESTER**

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP4PECP6P	**PRACTICAL IV**	**Core**				**3**	**4**	**75**

Pre-Requisites
Knowledge and handling of general and experiments of Physics, as well as fundamentals of digital principles,
Learning Objectives
➢ To understand the theory and working of Microprocessor, Microcontroller and their applications ➢ To use microprocessor and Microcontroller in different applications

Course Details

(Minimum of NINE Experiments from the list)

1. Determination of Thickness of air film. - Solar spectrum – Hartmann's formula. Edser and Butler fringes.
2. Determination of Solar constant
3. Determination of velocity and compressibility of a liquid using Ultrasonics Interferometer
4. Arc spectrum – Iron.
5. Determination of Diffraction pattern of light with circular aperture using Diode/He-Ne laser.
6. Measurement of Magnetic Susceptibility - Guoy's method
7. GM counter – Feather's analysis: Range of Beta rays
8. Study the beam divergence, spot size and intensity profile of Diode/He-Ne laser.
9. Determination of Refractive index of liquids using diode Laser/ He – Ne Laser
10. Molecular spectra – CN bands
11. Determination of Planck Constant – LED Method
12. Construction of Op-Amp- 4 bit Digital to Analog converter (Binary Weighted and R/2R ladder type)
13. Construction of square wave generator using IC 555 – Study of VCO
14. Study of Binary to Gray and Gray to Binary code conversion.
15. Construction of Encoder and Decoder circuits using ICs.
16. Study of synchronous parallel 4-bit binary up/down counter using IC 74193
17. Study of asynchronous parallel 4-bit binary up/down counter using IC 7493
18. Study of Modulus Counter
19. Construction of Multiplexer and Demultiplexer using ICs.
20. 8-bit addition and subtraction, multiplication and division using microprocessor 8085

21. Sum of a set of N data (8-bit number), picking up the smallest and largest number in an array. Sorting in ascending and descending orderusing microprocessor 8085
22. Code conversion (8-bit number): a) Binary to BCD b) BCD to binaryusing microprocessor 8085
23. Addition of multi byte numbers, Factorialusing microprocessor 8085
24. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters using microprocessor 8085
25. Interfacing of LED – Binary up/down counter, BCD up/down counter and N/2N up/down counter using microprocessor 8085
26. Interfacing of seven segment display using microprocessor 8085
27. Interfacing of 8-bit R / 2R ladder DAC (IC 741) – Wave form generation – Square, Rectangular, Triangular, Saw tooth and Sine waves using microprocessor 8085
28. Interfacing of DC stepper motor – Clockwise, Anti-clockwise, Angular movement and Wiper action using microprocessor 8085
29. Interfacing of Temperature Controller and Measurementusing microprocessor 8085
30. Interfacing of Traffic light controller using microprocessor 8085

TEXT BOOKS	1. Practical Physics, Gupta and Kumar, Pragati Prakasan 2. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition. 3. Electronic lab manual Vol I, K ANavas, Rajath Publishing 4. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008) 5. V. Vijayendran, 2005, Fundamentals of Microprocessor-8085", 3rd Edition S.Visvanathan Pvt, Ltd.
REFERENCE BOOKS	1. Advanced Practical Physics, S.P Singh, Pragati Prakasan 2. A course on experiment with He-Ne Laser, R. S. Sirohi, John Wiley & Sons (Asia) Pvt. ltd 3. Electronic lab manual Vol II, Kuriachan T.D, Syam Mohan, Ayodhya Publishing 4. Electronic Laboratory Primer a design approach, S. Poornachandra, B. Sasikala, Wheeler Publishing, New Delhi 5. Microprocessor and Its Application - S. Malarvizhi, Anuradha Agencies Publications

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.	**K1, K4**
CO5	Acquire knowledge about the interfacing 8051 microcontroller with various peripherals.	**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)**.**

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

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

METHOD OF EVALUATION:

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

Paper – 21 - NUMERICAL METHODS AND COMPUTER PROGRAMMING	II YEAR - FOURTH SEMESTER

Pre-Requisites
Prior knowledge on computer and basic mathematics

Learning Objectives

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23KP4PSEC3	NUMERICAL METHODS AND COMPUTER PROGRAMMING	Core				2	4	75

- To make students to understand different numerical approaches to solve a problem.
- To understand the basics of programming

UNITS	Course Details
UNIT I: SOLUTIONS OF EQUATIONS	Zeros or Roots of an equation - Non-linear algebraic equation and transcendental equations - Zeros of polynomials –Roots of polynomials, nonlinear algebraic equations and transcendental equations using Bisection and Newton-Raphson methods – Convergence of solutions in Bisection and Newton-Raphson methods – Limitations of Bisection and Newton-Raphson methods.
UNIT II: LINEAR SYSTEM OF EQUATIONS	Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Solution of simultaneous equations by Matrix inversion method and its limitations – Gaussian elimination method – Gauss Jordan method – Inverse of a matrix by Gauss elimination method - Eigen values and eigenvectors of matrices – Direct method - Power method and Jacobi Method to find the Eigen values and Eigen vectors.
UNIT III: INTERPOLATION AND CURVE FITTING	Interpolation with equally spaced points - Newton forward and backward interpolation - Interpolation with unevenly spaced points - Lagrange interpolation – Curve fitting – Method of least squares – Fitting a polynomial.
UNIT IV: DIFFERENTIATION, INTEGRATION AND SOLUTION OF DIFFERENTIAL EQUATIONS	Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Error estimates – Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss-Chebyshev quadrature – solution of ordinary differential equations – Euler and RungaKutta methods.

UNIT V: PROGRAMMING WITH C	Flow-charts – Integer and floating point arithmetic expressions – Built-in functions – Executable and non-executable statements – Subroutines and functions – Programs for the following computational methods: (a) Zeros of polynomials by the bisection method, (b) Zeros of polynomials/non-linear equations by the Newton-Raphson method, (c) Newton's forward and backward interpolation, Lagrange Interpolation, (d) Trapezoidal and Simpson's Rules, (e) Solution of first order differential equations by Euler's method.
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. Rajaraman, 1993, Computer oriented Numerical Methods, 3rd Edition. PHI, New Delhi 2. M. K .Jain, S. R. Iyengar and R. K. Jain, 1995, Numerical Methods for Scientific and Engineering Computation, 3rd Edition, New Age Intl., New Delhi 3. S. S. Sastry, Introductory Methods of Numerical analysis, PHI, New Delhi 4. F. Scheid, 1998, Numerical Analysis, 2nd Edition, Schaum's series, McGraw Hill, New York 5. W. H. Press, S. A. Teukolsky, W. T. Vetterling and B. P. Flannery, 1992, Numerical Recipes in FORTRAN, 2nd Edition, Cambridge Univ. Press
REFERENCE BOOKS	1. S. D. Conte and C. de Boor, 1981, Elementary Numerical analysis-an algorithmic approach, 3rd Edition, McGraw Hill,) 2. B. F. Gerald, and P. O. Wheatley, 1994, Applied Numerical analysis, 5th Edition, Addison-Wesley, MA. 3. B. Carnagan, H. A. Luther and J. O. Wilkes, 1969, Applied Numerical Methods, Wiley, New York. 4. S. S. Kuo, 1996, Numerical Methods and Computers, Addison-Wesley. 5. V. Rajaraman, Programming in FORTRAN / Programming in C, PHI, New Delhi
WEB SOURCES	1. https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-V-RajaRaman 2. https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55))/reference/referencespapers.aspx?referenceid=1682874 3. https://nptel.ac.in/course/122106033/ 4. https://nptel.ac.in/course/103106074/ 5. https://onlinecourses.nptel.ac.in/noc20_ma33/preview

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) andLOW (1)

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

ECC1	Self Study - SOLAR ENERGY	23KP2PECC1:1	Ins.Hrs. - NIL	Credit:3

Course Objective: To introduce the awareness of non- conventional energy**.** To make the students to understand the present day crisis of need for conserving energy and alternative are provided

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CO	STATEMENT
1	Describe the layers of the sun. Demonstrate knowledge of the electromagnetic spectrum.
2	Illustrate the impacts on non-conventional energy**.**
3	Applying knowledge of fabricate solar cells for energy storage purpose
4	Explain the principles that underlie the ability of various nature phenomena to deliver solar energy
5	Understand the solar energy utilization**,** discuss the basics of solar cooking.

Unit - I: Structure of Sun

Thermonuclear reactions- Structure of Sun- Solar Constant- Electromagnetic Spectrum- Beam and diffuse radiations- Basic Earth Sun angles- Determination of Solar time.

Unit - II: Impacts of non-conventional energy

Conservation of energy - energy crisis and possible solutions -Patterns of energy consumptions: domestic sector, agricultural sector - Conservation principles: domestic sector, Agricultural sector - Energy Alternatives - impact due to non-conventional energy sources.

Unit- III :Photo Voltaic Power

Photo Voltaic generation - Merits and demerits - Solar Cell- Types of Solar Cells- Applications of Solar Cells.

Unit - IV: Renewable energy sources

Bio mass- Photo synthesis- wind energy- ocean thermal energy- open cycle and closed cycle- tidal energy- geothermal energy (basic ideas only).

Unit- V: Applications of Solar Energy Utilization

1) Crop Drier
2) Solar Cooker
3) Solar Distillation(Solar Stills)
4) Solar Green House

Unit-VI: Emerging Trends in Solar Energy (Only for CIA**)**

Solar in household, solar powered vehicles and solar panels to power electric vehicles

Textbooks

1. Solar Energy utilization - G. D. Rai.(Khanna Publishers 2012)
2. Solar Energy- S.P.Sukhatme (TMH 1999)
3. Energy Physics -K.Karuppannan , N.Suganthi(Priya Publications,Karur

References

1. Solar Energy utilization - G. D. Rai.(Khanna Publishers 2012)
2. Solar Energy- S.P.Sukhatme (TMH 1999)

CO-PO Mapping with Programme Outcomes **SOLAR ENERGY Code: 23KP2PECC1:1**

CO/PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	1							
2	3	3	3							
3	3	1	3	1						1
4	3	1	1					1		
5	3	3	3	1				1		

1 – Low, 2 – Moderate, 3 – High Correlation

ECC3	Self Study - LASER PHYSICS	23KP3PECC3:1	Ins. Hrs. - NIL	Credit: 3

Course Objectives: To understand the basics of light in Physics and describe the concepts of lasers. To understand the types and applications of lasers in current technology.

CO	Statement
1	Recall the basics of light and lasers in Physics.
2	Summarize the concepts of lasers.
3	Understand the principles of lasers.
4	Classify the types of lasers.
5	Interpret the applications of lasers in daily life.

Unit-I: Light

Electromagnetic Spectrum- Light- Rectilinear propagation of light- Laws of Reflection and Refraction- Dispersion- Interference- Diffraction- Polarization- Scattering (Basic definitions only).

Unit-II: LASER

Introduction of Laser- Concept of Laser- Population Inversion- Condition for population Inversion- Interaction of light with materials- Stimulated absorption- Spontaneous emission- Stimulated emission- Difference between Spontaneous emission and Stimulated emission.

Unit-III: Laser principle

Introduction- Basic components of laser system- Active medium- Methods for pumping action-optical pumping- Electrical discharge- Direct conversion- Characteristics- High directionality- High Intensity- Highly monochromatic- Highly Coherent- Difference between ordinary light and laser light.

Unit-IV: LASER Types

Types of Laser: Ruby Laser- Helium-Neon Laser- CO_2 Laser- Semiconductor Laser- Nd: YAG Laser.

Unit-V: Applications

Lasers in medicine: surgery- ophthalmology- cancer treatment.
Lasers in Industries: cutting- welding- drilling.
Lasers in Holography: Hologram- recording and reconstruction of hologram.

Unit-VI: Emerging Trends in LASER technology (Only for CIA**)**

History of LASER technology- From Maser to Laser- Evoloution of laser- Laser in use today: Lasers in Fashion Industry- Lasers in Automotive industry- Lasers in Agriculture- Lasers in Household- Conclusion.

Textbooks

1. Brijlal and Subrahmanyam, (2004) A Text Book of Optics, S. Chand & Co., New Delhi.
2. Dr. P. Mani, 2014 Engineering Physics-I, Dhanam Publications,. Chennai.
3. M. N. Avadhanulu, 2008 An Introduction to LASERS Theory and Applications, S. Chand & Co., New Delh

References

1. A.K. Ghatak, 1984 Lasers theory and Applications, Rajiv Bery for Macmillan India Ltd., Chennai.
2. G. Vijayakumari, 2013, Engineering Physics, Vikas Publications, New Delhi.

CO-PO Mapping with Programme Outcomes**: Laser Physics** Code: **23KP3PECC3:1**

CO/PO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	3	3	-	-	3	-	-	3	-	-
2	3	-	3	-	3	-	-	3	-	-
3	3	-	3	-	-	-	-	3	-	-
4	-	-	-	-	1	-	-	3	-	-
5	3	-	-	3	-	-	-	-	-	3

1- Low 2- Moderate 3- High Correlation