ANNAMALAI UNIVERSITY

(Affiliated Colleges)

403 -M.Sc. Physics

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

Part	Course Code	Study Components & Course Title	Credit	Hours/ Week	Maximum Marks		
					CIA	ESE	Total
		SEMESTER – I					
A	23PPHYC11	**Core I:** Mathematical Physics	5	7	25	75	100
	23PPHYC12	**Core II:** Classical Mechanics and Relativity	5	7	25	75	100
	23PPHYC13	**Core III:** Linear and Digital ICs and Applications	4	6	25	75	100
	23PPHYP14	**Core IV:** Practical - I	3	5	25	75	100
	23PPHYE15-1 23PPHYE15-2	**Elective – I:** Energy Physics (or) Crystal Growth and Thin films	3	5	25	75	100
		Total	**20**	**30**			**500**
		SEMESTER – II					
A	23PPHYC21	**Core V:** Statistical Mechanics	5	6	25	75	100
	23PPHYC22	**Core VI:** Quantum Mechanics –I	5	6	25	75	100
	23PPHYP23	**Core VII:** Practical – II	4	6	25	75	100
	23PPHYE24-1 23PPHYE24-2	**Elective – II:** Plasma Physics (or) Bio Physics	3	4	25	75	100
	23PPHYE25-1 23PPHYE25-2	**Elective – III: (INDUSTRY ORIENTED** Advanced Spectroscopy (or) Microprocessor 8085 and Microcontroller 8051	3	4	25	75	100
B (i)	23PPHYS26	**Skill Enhancement Course – I:** Research Methodology and IPR	2	4	25	75	100
		Total	**22**	**30**			**600**

		SEMESTER – III					
A	23PPHYC31	**Core -VIII:** Electromagnetic Theory	5	6	25	75	100
	23PPHYC32	**Core - IX:** Quantum Mechanics–II	5	6	25	75	100
	23PPHYC33	**Core - X:** Condensed Matter Physics	5	6	25	75	100
	23PPHYP34	**Core – XI:** Practical – III Microprocessor 8085 and Microcontroller 8051	4	6	25	75	100
	23PPHYE35-1 23PPHYE35-2	**Elective – IV:** Material Science (or) Physics of Nanoscience and Nanotechnology	3	3	25	75	100
B(i)	23PPHYS36	**Skill Enhancement Course (SEC-II):** Solar Energy Utilisation	2	3	25	75	100
B(ii)	23PPHYI37	Summer Internship *	2	-	25	75	100
		Total	**26**	**30**			**700**
		SEMESTER – IV					
A	23PPHYC41	**Core -XII:** Nuclear and Particle Physics	5	6	25	75	100
	23PPHYC42	**Core – XIII:** Spectroscopy	5	6	25	75	100
	23PPHYD43	Project with Viva Voce	7	8	25	75	100
	23PPHYE44	**Elective – V** Numerical Methods and Computer Programming (C) (20 % Theory & 80% Practical)**	3	6	25	75	100
B (i)	23PPHYS45	Skill Enhancement Course (SEC- III): Numerical Methods and Computer Programming	2	4	25	75	100
C	23PPHYX46	Extension Activity	1	-	-	100	100
		Total	**23**	**30**			**600**
			91				**2400**

* Students should complete two weeks of internship before the commencement of III semester.

** Evaluation is to be done both for theory (15 marks) and practical (60 marks) components separately by the examiners who will be conducting the practical and the marks should be awarded out of 75. Questions for the theory and practical are to be set by the concerned examiner.

Credit Distribution

Study Components	Papers	Total Credits	Marks/Sub	Total Marks
Core theory	10	49	100	1000
Core Electives	5	15	100	500
Practical	3	11	100	300
Skill Enhancement Courses SEC1, SEC2, SEC3	3	6	100	300
Internship/Industrial Activity (Carried out in Summer Vacation at the end of I Year – Two Weeks Period)	1	2	-	100
Project	1	7	100	100
Extension Activity	1	1	-	100
Total	**24**	**91**		**2400**

Credit Distribution for PG Science Programme

Part	Course Details	No. of courses	Total Credit
A	Core Theory	10	49
	Core Practical	3	11
	Elective Course	5	15
	Project Work with VIVA-VOCE	1	7
B(i)	Skill Enhancement Course	3	6
B(ii)	Summer Internship	1	2
C	Extension Activity	1	1
	Total	**24**	**91**

Component-wise Credit Distribution

Part	Courses	Sem I	Sem II	Sem III	Sem IV	Total
A	Core (including Practical and Project)	17	14	19	17	**67**
	Elective	6	6	3	3	**18**
B(i)	Skill Enhancement Course	-	2	2	2	**6**
B(ii)	Summer Internship	-	-	2	-	**2**
C	Extension Activity	-	-	-	1	**1**
						91

Part A and B(i) component will be taken into account for CGPA calculation for the post graduate programme and the other components Part B(ii) and C have to be completed during the duration of the programme as per the norms, to be eligible for obtaining PG degree.

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

Programme Specific Outcomes (PSOs)	**PSO1 – Placement** To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, beliefs and apply diverse frames of reference to decisions and actions. **PSO 2 - Entrepreneur** To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations. **PSO3 – Research and Development** Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. **PSO4 – Contribution to Business World** To produce employable, ethical and innovative professionals to sustain in the dynamic business world. **PSO 5 – Contribution to the Society** To contribute to the development of the society by collaborating with stakeholders for mutual benefit. **PSO 6** Students will utilize e-resources, digital tools and techniques for widening their knowledge base.

	PSO 7 Students gain exposure to programming language and skills. **PSO 8** Student will appreciate the interplay of mathematics, physics and technology. **PSO 9** Students will develop adequate knowledge and skills for employment and entrepreneurship. **PSO 10** An awareness of civic and ecological duties as good citizens and importance of human values will be inculcated in students

SEMESTER: I PART: A CORE – I	23PPHYC11: MATHEMATICAL PHYSICS	Credit:5 Hours:7

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	CourseDetails
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
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
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
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
V	**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.

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* (2nd 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* (4th 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/

COURSEOUTCOMES:

At the endofthe course, thestudentwillbeableto:

CO1	Understand use of bra-ket vector notation and explain the meaning of complete orthonormal 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		

MAPPINGWITHPROGRAMOUTCOMES:

Mapcourseoutcomes**(CO)**foreachcoursewithprogramoutcomes**(PO)**and program specific outcomes **(PSO)**inthe 3 pointscaleofSTRONG(3),MEDIUM(2)andLOW (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

SEMESTER: I PART: A CORE – II	23PPHYC12: CLASSICAL MECHANICS AND RELATIVITY	Credit:5 Hours:7

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
I	**PRINCIPLES OFCLASSICAL 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.
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.
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.
IV	**SMALL OSCILLATIONS**: Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.
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
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*, HimalayaPublshing. 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

SEMESTER: I **PART: A** **CORE – III**	**23PPHYC13: LINEAR AND DIGITAL ICs AND APPLICATIONS**	**Credit: 4** **Hours: 6**

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**
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.
II	**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.
III	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
IV	**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.
V	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 (IC 7493).

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

TEXT BOOKS

1. D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt.Ltd.,NewDelhi,India
2. Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, NewDelhi.
3. B.L. Theraja and A.K. Theraja, 2004, A Textbook of Electrical technology, S. Chand & Co.
4. V.K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
5. 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.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) andLOW (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

SEMESTER: I PART: A PRACTICAL – I	23PPHYP14: PRACTICAL I	Credit: 3 Hours: 5

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, PragatiPrakasan. 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. Poornachandra, 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, PragatiPrakasan. 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) andLOW (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

SEMESTER: I PART: A ELECTIVE – I	23PPHYE15-1: ENERGY PHYSICS	Credit: 3 Hours: 5

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
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.
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.
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.
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.
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.
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

SEMESTER: I PART: A ELECTIVE – I	23PPHYE15-2: CRYSTAL GROWTH AND THIN FILMS	Credit: 3 Hours: 5

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
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
II	**CRYSTALLIZATION PRINCIPLES:** Crystallization Principles and Growth techniques Classes of Crystal system - Crystal symmetry - Solvents and solutions - Solubility diagram - Super solubility - expression for super saturation - Metastable zone and introduction period - Miers TC diagram - Solution growth - Low and high temperatures solution growth - Slow cooling and solvent evaporation methods - Constant temperature bath as a Crystallizer.
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.
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.
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.
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) andLOW (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

SEMESTER: II PART: A CORE – IV	23PPHYC21: STATISTICAL MECHANICS	Credit: 5 Hours: 6

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
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.
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.
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.
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.
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
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 thermodynamical 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 thermodynamical behaviour of gases under fluctuation and also using Ising model	K3
K1 - Remember; K2 – Understand; K3 - Apply; K4 - Analyze; K5 – Evaluate		

MAPPING WITH PROGRAM OUTCOMES:

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

SEMESTER: II PART: A CORE – V	23PPHYC22: QUANTUM MECHANICS – I	Credit: 5 Hours: 6

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
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
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
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
IV	**APPROXIMATION METHODS:** Time independent perturbation theory for non-degenerate energy levels – Degenerate energy levels – Stark effect in Hydrogen atom – Ground and excited state – Variation method – Helium atom – WKB approximation – Connection formulae (no derivation) – WKB quantization – Application to simple harmonic oscillator.
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.
	PROFESSIONAL COMPONENTS: Expert Lectures, Online Seminars - Webinars on

VI	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) andLOW (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

SEMESTER: II PART: A PRACTICAL – II	23PPHYP23: PRACTICAL II	Credit: 4 Hours: 6

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, PragatiPrakasan 2. Kit Developed for doing experiments in Physics- Instruction manual, R.Srinivasan K.R Priolkar, Indian Academy of Sciences 3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition. 4. 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) andLOW (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

	PSO1	**PSO2**	**PSO3**	**PSO4**	**PSO 5**	**PSO6**	**PSO7**	**PSO8**	**PS O9**	**PSO 10**
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

SEMESTER: II PART: A ELECTIVE – II	23PPHYE24-1: PLASMA PHYSICS	Credit: 3 Hours: 4

Learning Objectives
➢ To explore the plasma universe by means of in-site and ground-based observations. ➢ To understand the model plasma phenomena in the universe. ➢ To explore the physical processes which occur in the space environment.

UNITS	Course Details
I	**FUNDAMENTAL CONCEPTS OF PLASMA** : Kinetic pressure in a partially ionized - mean free path and collision cross section - Mobility of charged particles - Effect of magnetic field on the mobility of ions and electrons-Thermal conductivity- Effect of magnetic field- Quasi- neutrality of plasma Debye shielding distance - Optical properties of plasma.
II	**MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD** : Particle description of plasma- Motion of charged particle in electrostatic field- Motion of charged particle in uniform magnetic field - Motion of charged particle in electric and magnetic fields- Motion of charged particle inhomogeneous magnetic field - Motion of charged particle in magnetic mirror confinement - motion of an electron in a time varying electric field- Magneto- hydrodynamics - Magneto-hydrodynamic equations – Condition for magneto hydrodynamic behaviour.
III	**PLASMA OSCILLATIONS AND WAVES**: Introduction, theory of simple oscillations - electron oscillation in a plasma – Derivations of plasma oscillations by using Maxwell's equation - Ion oscillation and waves in a magnetic field - thermal effects on plasma oscillations - Landau damping - Hydro magnetic waves - Oscillations in an electron beam.
IV	**PLASMA DIAGNOSTICS TECHNIQUES**: Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - -laser as a tool for plasma diagnostics-X-ray diagnostics of plasma - acoustic method - conclusion.
V	**APPLICATIONS OF PLASMA PHYSICS**: Magneto hydrodynamic Generator - Basic theory - Principle of Working-Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma - Plasma Diode.
VI	**PROFESSIONAL COMPONENTS** : Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXT BOOKS
1. Plasma Physics- Plasma State of Matter - S. N.Sen, PragatiPrakashan, Meerut. 2. Introduction to Plasma Physics-M. Uman 3. Krall, N. A., and A. W. Trivelpiece. Principles of Plasma Physics. Berkeley, CA: San Francisco Press, 1986. ISBN: 9780911302585.Tanenbaum, B. S. Plasma Physics. New York, NY: McGraw-Hill, 1967. ISBN: 9780070628120. 4. Goldston, R. J., and P. H. Rutherford. Introduction to Plasma Physics. Philadelphia, PA: IOP Publishing, 1995. ISBN: 9780750301831. 5. Hutchinson, I. H. Principles of Plasma Diagnostics. Cambridge, UK: Cambridge University Press, 2005. ISBN: 9780521675741.
REFERENCE BOOKS
1. Chen, F. F. Introduction to Plasma Physics. 2nd ed. New York, NY: Springer, 1984. ISBN: 9780306413322. 2. Introduction to Plasma Theory-D.R. Nicholson 3. Shohet, J. L. The Plasma State. San Diego, CA: Academic Press Inc., 1971. ISBN: 9780126405507. 4. Hazeltine, R. D., and F. L. Waelbroeck. The Framework of Plasma Physics. Boulder, CO: Westview Press, 2004. ISBN: 9780813342139. 5. Huddlestone, R. H., and S. L. Leonard. Plasma Diagnostic Techniques. San Diego, CA: Academic Press, 1965
WEB SOURCES
1. https://fusedweb.llnl.gov/Glossary/glossary.html 2. http://farside.ph.utexas.edu/teaching/plasma/lectures1/index.html 3. http://www.plasmas.org/ 4. http://www.phy6.org/Education/whplasma.html 5. http://www.plasmas.org/resources.htm

COURSE OUTCOMES:

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

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

MAPPING WITH PROGRAM OUTCOMES:

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

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

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

SEMESTER: II PART: A ELECTIVE – II	23PPHYE24-2: BIO PHYSICS	Credit: 3 Hours: 4

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

TEXT BOOKS

1. The cell: A molecular approach, Geoffrey M. Cooper, ASM Press, 2013.
2. Biophysics, VasanthaPattabhi, N. Gautham, Narosa Publishing, 2009
3. Biophysics, P. S. Mishra VK Enterprises, 2010.

4. Biophysics, M. A Subramanian, MJP Publishers, 2005. 5. Bioinstrumentation, L. Veerakumari, MJP Publishers, 2006.
REFERENCE BOOKS
1. Chemical Biophysics by Daniel A Beard (Cambridge University Press, 2008). 2. Essential cell biology by Bruce Albert et al (Garland Science) 3. Biophysics, W. Hoppe, W. Lohmann, H. Markl and H. Ziegler. Springer Verlag, Berlin (1983). 4. Membrane Biophysics by Mohammad Ashrafuzzaman, Jack A. Tuszynski, (Springer science & business media). 5. Biological spectroscopyby Iain D. Campbell, Raymond A. Dwek
WEB SOURCES
1. General Bio:http://www.biology.arizona.edu/DEFAULT.html 2. Spectroscopy: http://www.cis.rit.edu/htbooks/nmr/inside.htm 3. Electrophoresis:http://learn.genetics.utah.edu/content/labs/gel/ 4. Online biophysics programs: http://mw.concord.org/modeler/ 5. https://blanco.biomol.uci.edu/WWWResources.html

COURSE OUTCOMES:

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

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

MAPPING WITH PROGRAM OUTCOMES:

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

SEMESTER: II PART: A ELECTIVE – III	23PPHYE25-1: ADVANCED SPECTROSCOPY	Credit: 3 Hours: 4

Learning Objectives
➢ Helps students understand and appreciate spectroscopy as a sufficiently broad field in which many sub disciplines exist. ➢ Make them appreciate each of these specific techniques with numerous implementations. ➢ To realize the progress in this field that is rapid, resulting in improved instrument capabilities and an ever-widening range of applications. ➢ To apply group theory in spectroscopy to shed light on molecular symmetry and determine important physical parameters.

UNITS	CourseDetails
I	**MOLECULAR SPECTROSCOPY AND GROUP THEORY**: Group axioms – subgroup, simple group, Abelian group, cyclic group, order of a group, class- Lagrange's theorem statement and proof - Symmetry operations and symmetry elements - Application: construction of group multiplication table (not character table) for groups of order 2, 3, cyclic group of order 4, noncyclic group of order 4 – reducible and irreducible representations- Unitary representations – Schur's lemmas – Great orthogonality theorem - point group -Simple applications : Symmetry operations of water and ammonia- Construction of character table for C_{2v} (water) and C_{3v} (ammonia) molecules
II	**LASER SPECTROSCOPY**: Lasers as Spectroscopy Light sources – Special Characteristics of Laser emission- ultra short pulses- laser cooling -Single and multi-mode lasers- Laser tenability- Fluorescence spectroscopy with lasers- Laser Raman Spectroscopy – Non-linear Spectroscopy – Applications of Laser Spectroscopy in medical fields, materials science research
III	**MOSSBAUER SPECTROSCOPY** : Basic idea of Mossbauer spectroscopy - Principle- Mossbauer effect- Recoilless emission and absorption- Chemical shift -Effect of electric and magnetic fields – hyperfine interactions- instrumentation-Applications: understanding molecular and electronic structures
IV	**XRAY PHOTOELECTRON SPECTROSCOPY**: Principle – XPS spectra and its interpretation- ECSA-EDAX- other forms of XPS – chemical shift - Applications : - stoichiometric analysis- electronic structure- XPES techniques used in astronomy, glass industries, paints and in biological research
V	**MOLECULAR MODELLING**: Determination of force constants- force field from spectroscopic data-normal coordinate analysis of a simple molecule (H2O) – analyzing thermodynamic functions, partition functions, enthalpy, specific heat and related parameters from spectroscopic data- molecular modelling using data from various spectroscopic studies

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. William Kemp, 2019, Organic Spectroscopy (2nd Edition) MacMillan, Indian Edition.
2. C N Banwell and McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, 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. J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.

REFERENCE BOOKS

1. Demtroder. W, Laser Spectroscopy: Basic concepts and Instrumentation, SpringerLink.
2. B. P. Straughan and S. Walker, 1976, Spectroscopy Vol.I., Chapman and Hall, New York.
3. J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
4. David. L. Andrews**,** Introduction to Laser Spectroscopy, Springer, 2020
5. Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7th Edition) New Age International Publishers.

WEB SOURCES

1. Fundamentals of Spectroscopy - Course (nptel.ac.in)
2. http://mpbou.edu.in/slm/mscche1p4.pdf
3. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
4. https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu
5. https://serc.carleton.edu/research_education/geochemsheets/techniques/mossbauer.html

COURSE OUTCOMES:

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

CO1	Comprehend set of operations associated with symmetry elements of a molecule, apply mathematical theory while working with symmetry operations. Apply mathematical theory while working with symmetry operations. To use group theory as a tool to characterize molecules.	**K1, K2**
CO2	Align with the recent advances in semiconductor laser technology combined sensitive spectroscopic detection techniques.	**K3**
CO3	Understand principle behind Mossbauer spectroscopy and apply the concepts of isomer shift and quadrupole splitting to analyse molecules.	**K2, K3**
CO4	Assimilate this XPES quantitative technique and the instrumentation associated with this, as applied in understanding surface of materials.	**K3, K4**
CO5	Employ IR and Raman spectroscopic data along with other data for structural investigation of molecules. Analyze thermodynamic functions and other parameters to evolve molecular models.	**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	2	2	3	3	3	3	3	2
CO2	2	2	2	3	3	3	2	3	3	2
CO3	2	2	3	3	3	3	3	2	3	3
CO4	3	2	3	3	2	3	3	3	3	2
CO5	3	2	3	3	3	3	3	3	3	3

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

SEMESTER: II PART: A ELECTIVE – III	23PPHYE25-2: MICROPROCESSOR 8085 AND MICROCONTROLLER 8051	Credit: 3 Hours: 4

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
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.
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).
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.
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.
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).

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) andLOW (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

SEMESTER:II PART: B SKILL ENHANCEMENT COURSE I	23PPHYS26: RESEARCH METHODOLOGY AND IPR	CREDIT: 3 HOURS: 4

Unit-I: Research Methodology

Research methods and research methodology – types –various stages of research – presenting a scientific seminar-oral report-art of writing a research paper– layout of a research report -Project Proposal – Funding Agencies – Research Fellowship.

Unit-II: ICT Support and Cyber Security

Information and communication technology, tools and services: Search engines & research papers – shared datasets & codes – connect and communicate with experts and researchers – free digital library–simulation/lab & project management – write and publish research papers.

Cyber space – security challenges – evolution & threats – Indian cyber situation –cyber disruptions - challenges in cyber space domain – 10 steps to cyber security.

Unit-III: The Future Physics

A brief history of Physics – Predicting the next 100 years: Mind over Matter – rise of machines –everything from nothing– perfection and beyond– energy from stars.

Examination skills in Physics – competitive exams towards research –preparation strategy.

Unit-IV: The Role of Incubators and Public Policy

Introducing a framework for Physics Innovation and Entrepreneurship (PIE) education-Examining students' perceptions of innovation and entrepreneurship in physics –National Innovation & Start-up Policy 2019 for Students and Faculty by MHRD –Tamil Nadu Start-up &Innovation policy 2023.

Concept note on business incubator - Incubation and S&T Innovation-based Entrepreneurship in India-insights from Case Studies: Factors for Favourable Incubator Outcomes

Unit-V: Intellectual Property Rights

Project concept–project design-Intellectual Property Law Basics-Types of Intellectual Property: Patents, Copyright Trademarks, Industrial Designs and Integrated Circuits, Geographical indications-Agencies Responsible for Intellectual Property Registration -International Organizations, Agencies, and Treaties - Search engines for IPR -The Indian patent act 1970.

Books for Reference

1. C.R.Kothari, Research Methodology, 2nd ed.New Age International(P) Ltd.2004.
2. Deborah E. Bouchoux, Intellectual Property, 4thed. Cengage Learning, 2013

COURSE OUTCOMES

CO-1	Know the basics of research methodology, information communication technologies, cyber security and the future of physics.	**K1**
CO-2	Understand the fundamentals of intellectual property rights and the role of incubators and public policies.	**K2**
CO-3	Identify and classify various types of reports, ICT tools, ICT services, intellectual properties, agencies, treaties and public policies.	**K3**
CO-4	Utilize search engines for finding research articles, patents, designs, incubator policies and current research topics in physics.	**K4**
CO-5	Evaluate and create new ideas in the situation in cyber security, intellectual property and innovation-incubator system in India.	**K5 &K6**

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)**.**

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO-1	3	3	3	2	2	1	3	3	2	3
CO-2	3	3	3	2	2	1	3	3	3	3
CO-3	3	3	3	2	2	1	3	3	3	3
CO-4	3	3	3	2	2	1	3	3	3	3
CO-5	3	3	3	2	2	1	3	3	3	3

SEMESTER:III	COURSECODE: 23PPHYC31	CREDITS:5
PART: A CORE: VIIIs	ELECTROMAGNETICTHEORY	Hours/Week:6

Pre-Requisites
Differentcoordinatesystems,Laplace'sequation,conducting&non-conductingmedium,basic definitions in magnetism, propagation of electromagnetic waves, plasma
Learning Objectives
➢ To acquire know ledge about boundary conditions between two media and the technique of method of separation of variables ➢ To understand BiotSavart's law and Ampere's circuital law ➢ TocomprehendthephysicalideascontainedinMaxwell'sequations,Coulomb&Lorentz gauges, conservation laws ➢ Toassimilatetheconceptsofpropagation,polarization,reflectionandrefractionofelectromagnetic waves ➢ To grasp the concept of plasmas the fourth state of matter

UNITS	CourseDetails
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 - Dielectricsphereinauniformfield–Molecularpolarizabilityandelectrical susceptibility–Electrostaticenergyinthepresenceofdielectric–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 aplaneinter face-Waves in a conducting medium - Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials- Radiation Formal ocalizedsource –Oscillating electric dipoles
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-Web in arson Industrial Interactions/Visits, Competitive Examinations, Employable
TEXTBOOKS	1. D.J.Griffiths,2002,*IntroductiontoElectrodynamics,* 3rdEdition,Prentice-HallofIndia,NewDelhi. 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,KumarandSingh,Electrodynamics,S.Chand&Co.,New Delhi
REFERENCE BOOKS	1. W.PanofskyandM.Phillips,1962, *Classical Electricity and Magnetism,* Addison Wesley, London. 2. J.D.KrausandD.A.Fleisch,1999, *Electromagnetics with Applications,* 5th Edition, WCB McGraw-Hill, New York. 3. B.Chakraborty,2002, *PrinciplesofElectrodynamics,*BooksandAllied, Kolkata. 4. P.Feynman, R.B.Leighton and M.Sands,1998,*TheFeynman Lectures on Physics*, Vols. 2, Narosa Publishing House, New Delhi. 5. AndrewZangwill,2013,ModernElectrodynamics,Cambridge University Press, USA.
WEBSOURCES	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

COURSEOUTCOMES:

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

CO1	SolvethedifferentialequationsusingLaplaceequationandtofindsolutionsfor boundary value problems	**K1,K5**
CO2	UseBiot-Savart'slawandAmperecircuitallawtofindthemagneticinduction&magneticvectorpotentialforvariousphysicalproblems	**K2,K3**
CO3	ApplyMaxwell'sequationstodescribehowelectromagneticfieldbehavesin 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	Investigatetheinteractionofionizedgaseswithself-consistentelectricand magnetic fields	**K5**
K1-Remember;K2–Understand;K3-Apply;K4-Analyze;K5–Evaluate		

MAPPINGWITHPROGRAMOUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes**(PSO)** inthe 3-pointscale 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	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

SEMESTER:III	COURSECODE: 23PPHYC32	CREDITS:5
PART:A CORE: IX	QUANTUMMECHANICS–II	Hours/Week:6

Pre-Requisites
KnowledgeofpostulatesofQuantummechanics,propertiesofHermitianoperators,ladder operators,degeneracy,angularmomentumtechniquesandcommutationrules
Learning Objectives
➢ For mal development of the theory and the properties of an gular momenta, both orbital and spin ➢ Tofamiliarizethestudentstothecrucialconceptsofscatteringtheorysuchaspartial wave analysis and Born approximation. ➢ Time-dependentPerturbationtheoryanditsapplicationtostudyofinteractionofan atom with the electromagnetic field ➢ To give the students a firm grounding in relativistic quantum mechanics, with emphasison Dirac equation and related concepts ➢ TointroducetheconceptofcovarianceandtheuseofFeynmangraphsfordepicting different interactions

UNITS	CourseDetails
UNIT1: SCATTERING THEORY	Scattering amplitude–Cross sections –Born approximation and its validity– Scatteringbyascreenedcoulombpotential–Yukawapotential–Partialwave analysis–Scattering length and Effective range theory for swave–Optical theorem–Transformation fromcentre of masstolaboratory frame.
UNIT II: PERTURBATION THEORY	Time depend Ent perturbation theory–Constant and harmonic per turbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of anatom with electromagnetic radiation– Selection rules for dipole radiation
UNIT III: RELATISTIC 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
UNITIV: DIRACEQUATION	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)

UNITV: CLASSICALFIELDS ANDSECOND QUANTIZATION	Classical fields–Euler Lagrange equation–Hamiltonian formulation– No ether's theorem–Quantization of real and complex scalar fields– Creation, Annihilation and Number operators–Fock states–Second Quantization of K-Gfield.
UNITVI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars-Web in arson Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.
TEXTBOOKS	1. P.M.Mathews and K.Venkatesan, ATextbookofQuantumMechanics,2nd Edition, Tata McGraw-Hill, New Delhi, 2010. 2. G.Aruldhas,QuantumMechanics,2ndEdition,Prentice-Hallof 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,Quantummechanicsconceptsandapplications,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 s& HariPrakash, QuantumMechanics,7threprint,PHI Learning Pvt. Ltd., New Delhi, 2009. 3. DeepChandraJoshi,QuantumElectrodynamicsandParticlePhysics,1st edition, I.K. International Publishing house Pvt. Ltd., 2006 4. Ghatak and S.Lokanathan, Quantum Mechanics: Theoryand Applications, 4th Edition, Macmillan India, New Delhi. 5. E.Merzbacher,QuantumMechanics,2nd edition, John Wiley and Sons,NewYork,1970
WEBSOURCES	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

COURSEOUTCOMES:

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

CO1	Familiarize the concept of scattering the orysuchaspartial 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	Demon straiten understanding of field quantization and the explanation Of the scattering matrix.	K5
K1-Remember;K2–Understand;K3-Apply;K4-Analyze;K5-Evaluate		

MAPPINGWITHPROGRAMOUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes**(PSO)** in the 3-pointscale 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

SEMESTER:III	COURSECODE: 23PPHYC33	CREDITS:5
PART:A CORE: X	CONDENSED MATTER PHYSICS	Hours/Week:6

Pre-Requisites
Basic knowledge of atomic physics, quantum mechanics and statistical mechanics.
Learning Objectives
➢ To describe various crystal structures, symmetry and to differentiated different types of bonding. ➢ To construct reciprocal space, understand the latticed dynamics and apply it to concept of specific heat. ➢ Tocriticallyassessvarioustheoriesofelectronsinsolidsandtheirimpactindistinguishing solids. ➢ Outlinedifferenttypesofmagneticmaterialsandexplaintheunderlyingphenomena. ➢ Elucidationofconceptsofsuperconductivity,theunderlyingtheories–relatetocurrentareas of research.

UNITS	Course Details
UNIT I: CRYSTAL PHYSICS	Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simplecrystalstructures–AtomicPackingFactor-Crystaldiffraction-Bragg'slaw – Scattered Wave Amplitude - Reciprocal Lattice (sc, bcc, fcc). Structure and propertiesofliquidcrystals.DiffractionConditions-Laueequations-Brillouin zone-Structurefactor-Atomicformfactor-Inertgascrystals-Cohesiveenergy 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 SEMI CONDUCTORS	Freeelectrongasinthreedimensions-Electronicheatcapacity-Wiedemann- Franz law - Band theory of metals and semiconductors - Bloch theorem - Kronig- Penney model - Semiconductors - Intrinsic carrier concentration – Temperature Dependence-Mobility-Impurityconductivity–Impuritystates-Halleffect-Fermisurfacesandconstruction-ExperimentalmethodsinFermisurfacestudies-De Hass-van Alphen effect.
UNIT IV: MAGNETISM	Diamagnetism-Quantum theory of paramagnetic-Rare earth ion-Hund's rule - Quenching of orbital angular momentum -Adiabatic demagnetization- Quantum theory of ferromagnetism -Curie point - Exchange integral - Heisenberg's interpretation of Weiss field - Ferromagnetic domains - Bloch wall - Spin waves - Quantization-Magnons-Thermalexcitationofmagnons-Curietemperatureand susceptibilityofferrimagnets-Theoryofantiferomagnetism-Neeltemperature.

UNITV: Super conductivity	**Experimental facts:** Occurrence - Effect of magnetic fields - Meissner effect– Critical field – Critical current - Entropy and heat capacity - Energy gap - Microwave and infrared properties - Type I and II Superconductors. **Theoretical Explanation:** Thermodynamics of super conducting transition - London equation - Coherence length – Isotope effect - Cooper pairs – Bardeen Cooper Schrieffer(BCS)Theory–BCS to Bose–Einstein Condensation (BEC)regime- Nature of paring and condensation of Fermions. Single particle tunneling –Josephs on tunneling-DC and AC Josephs on effects-High temperature Superconductors–SQUIDS.
UNIT VI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, CompetitiveExaminations,EmployableandCommunicationSkillEnhancement, Social Accountability and Patriotism
TEXTBOOKS	1. C.Kittel, 1996, *IntroductiontoSolidStatePhysics*,7th Edition,Wiley,New York. 2. RitaJohn, Solid State Physics, Tata Mc-GrawHill Publication. 3. A.J.Dekker, *Solid State Physics*, Macmill an India, New Delhi. 4. M.AliOmar,1974,*ElementarySolidStatePhysics–Principles And Applications*, Addison-Wesley 5. H.P.Myers,1998,*IntroductorySolidStatePhysics*,2nd Edition, Viva Book, New Delhi.
REFERENCE BOOKS	1. J.S.Blakemore,1974,*SolidstatePhysics*,2nd Edition,W.B.Saunder, Philadelphia 2. H.M.Rosenburg,1993, *The Solid State*, 3rd Edition, Oxford University Press, Oxford. 3. J.M.Ziman,1971, Principles *of the Theory of Solids*, Cambridge University Press, London. 4. C.Ross-InnesandE.H.Rhoderick,1976,*IntroductiontoSuperconductivity*, Pergamon, Oxford. 5. J. P. Srivastava, 2001, *Elements of Solid State Physics*, Prentice-Hall of India, New Delhi.
WEBSOURCES	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/

COURSEOUTCOMES:

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	Studentswillbeabletovisualizetheideaofreciprocalspaces,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		

MAPPINGWITHPROGRAMOUTCOMES:

Map course out comes **(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	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

SEMESTER:III	COURSECODE: 23PPHYP34	CREDITS: 4
PART:A CORE: XI PRACTICAL - III	MICRO PROCESSOR8085AND MICRO CONTROLLER8051	Hours/Week:6

Pre-Requisites
Fundamentals of digital principles
Learning Objectives
➢ TounderstandthetheoryandworkingofMicroprocessor,Microcontrollerandtheirapplications ➢ To use microprocessor and Micro controller in different applications

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Course Details
Practical IV: MICRO PROCESSOR 8085 AND MICRO CONTROLLER 8051 (ANY TWELVE EXPERIMENTS) 1. 8-bitadditionandsubtraction,multiplicationanddivision 2. Sum of a set of Ndata (8-bitnumber),picking up the smallest and largest number nan array. Sorting in ascending and descending order 3. Code conversion(8-bitnumber):a)Binary to BCD b) BCD to binary 4. Addition of multi by ten umbers, Factorial 5. Clock program- 12/24 hours-Real time application – Six Digits Hexa Decimal and Decimal Counters 6. InterfacingofLED–Binaryup/downcounter,BCDup/downcounterandN/2Nup/down counter 7. Inter facing of seven segment display 8. Interfacingof8-bitR/2RladderDAC(IC741)–Waveformgeneration–Square, Rectangular, Triangular, Saw tooth and Sine waves 9. DAC0800/DAC1048interfaceandwaveformgeneration(Unipolar/Bipolaroutput) 10. ADC0809interface 11. InterfacingofDCsteppermotor–Clockwise,Anti-clockwise,AngularmovementandWiper action 12. Interfacing of Temperature Controller and Measurement 13. Water level detector 14. Elevator 15. Traffic Light Controller 16. Keyboard Interface 17. Addition, Subtraction ,MultiplicationandDivisionof8-bitnumbers. 18. Sumofaseriesof8-bitnumbers 19. Average of Nnumbers 20. Factorial of number

21. Fibonacci series of Terms 22. Multi byte Addition/Subtraction Sorting 23. Gin ascending and descending order–Picking up smaller stand largest number 24. LEDinterface–Binaryup/downcounter,BCDup/downcounter,Ringandtwistedring counter. 25. Inter facings even segment displays 26. DAC0800/1408interfaceandwaveformgeneration 27. ADC interfacing 28. Stepper motorinter facing 29. Temperature controller and Measurements 30. Traffic light controller	
TEXTBOOKS	1. Douglas V. Hall, Microprocessors and Interfacing programming and Hardware, Tata Mc Graw Hill Publications (2008) 2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, The8051MicrocontrollerandEmbeddedSystems,Pearson Education (2008). 3. V.Vijayendran,2005,FundamentalsofMicroprocessor-8085",3rd Edition S. Visvanathan Pvt, Ltd. 4. The8085Microprocessor,Architecture,Programmingand Interfacing – K. Udaya Kumar, S. Uma Shankar, Pearson 5. FundamentalsofMicroprocessorsandMicrocontrollers-B.Ram, DhanpatRaiPublications
REFERENCEBOOKS	1. W. A. Tribel, Avtar Singh, "The 8086/8088 Microprocessors: Programming, Interfacing, Software, Hardware and Applications", Prentice-Hall of India, New Delhi. 2. Microprocessor and Its Application - S. Malarvizhi, AnuradhaAgencies Publications 3. MicroprocessorArchitecture,ProgramAndItsApplicationWith 8085 - R.S. Gaonkar, New Age International (P) Ltd 4. Barry B. Brey, 1995, The Intel Microprocessors 8086/8088, 80186, 80286, 80386 and 80486, 3rd Edition, Prentice- Hall of India, New Delhi. 5. J. Uffrenbeck, "The 8086/8088 Family-Design, Programming and Interfacing,Software,HardwareandApplications",Prentice-Hallof India,NewDelhi.

METHODOFEVALUATION:

Continuous Internal Assessment	EndSemester Examination	Total	Grade
25	**75**	**100**	

COURSEOUTCOMES:

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	Understandthestructureandworkingof8085microprocessorandapplyit.	**K1, K3**
CO4	Acquireknowledgeabouttheinterfacingperipheralswith8085 microprocessor.	**K1, K4**
CO5	Acquireknowledgeabouttheinterfacing8051microcontrollerwithvarious peripherals.	**K1, K4**
K1-Remember;K2–Understand;K3-Apply;K4-Analyze;K5-Evaluate;		

MAPPINGWITHPROGRAMOUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes**(PSO)** in the 3-pointscale 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

	PSO 1	**PSO 2**	**PSO 3**	**PSO4**	**PSO5**	**PSO6**	**PSO 7**	**PSO 8**	**PSO9**	**PSO1 0**
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

SEMESTER:III	COURSECODE: 23PPHYE35-1	CREDITS: 3
PART: A ELECTIVE - IV	MATERIALS SCIENCE	Hours/Week: 3

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 shapememoryalloys, metallic glasses and nanomaterials

UNITS	Course details
UNIT I: OPTOELECTRONIC MATERIALS	Importance of optical materials–properties: Bandgap and lattice matching – optical absorption and emission – charge injection, quasi-Fermi levels and recombination–optical absorption, loss and gain. Light propagation in materials–Electro-optic effect and modulation.
UNIT II CERAMIC MATERIALS	Ceramicprocessing:powderprocessing,millingandsintering– structuralceramics:zirconia,almina,siliconcarbide,tungstencarbide–electronic ceramics–refractories–glass and glass ceramics
UNIT III POLYMERIC MATERIALS	Polymers and copolymers – synthesis: chain growth polymerization – polymerization techniques – glass transition temperature and its measurement–viscoelasticity– applications: conducting polymers, biopolymers and high temperature polymers.
UNITIV COMPOSITE MATERIALS	Particle reinforced composites – fiber reinforced composites – mechanical behavior –fabrication methods of polymer 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, - 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- Webinar son Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism

TEXTBOOKS	1. JaspritSingh,Electronicandoptoelectronicpropertiesofsemiconductor structures,CambridgeUniversityPress,2007 2. P.K.Mallick.Fiber-ReinforcedComposites.CRCPress,2008. 3. V.Raghavan,2003,MaterialsScienceandEngineering,4th Edition, Prentice- Hall India, New Delhi(For units 2,3,4 and 5) 4. G.K.Narula,K.S.NarulaandV.K.Gupta,1988,MaterialsScience,Tata McGraw-Hill 5. M.Arumugam,2002,MaterialsScience,3rd revisedEdition,Anuratha Agencies
REFERENCEBOOKS	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. Van Vlack, 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,Anintroductiontocompositematerials, CambridgeUniversityPress,2008.
WEBSOURCES	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

COURSEOUTCOMES:

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	Beabletounderstandtheprocessingandapplicationsofpolymericmaterials	**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;		

MAPPINGWITHPROGRAMOUTCOMES:

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

SEMESTER:III	COURSECODE: 23PPHYE35-2	CREDITS: 3
PART: A ELECTIVE - IV	PHYSICS OF NANOSCIENCE AND NANOTECHNOLOGY	Hours/Week: 3

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 –Classification of Nanomaterials – Metal and Semiconductor Nanomaterials -2D, 1D, 0D nanostructured materials - Quantumdots–Quantumwires–Quantumwells - Surfaceeffectsof nanomaterials.
UNIT II: PROPERTIES OFNANOMATERIALS	Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior:Opticalproperties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magneticproperties–superparamagnetism–Dilutedmagnetic semiconductor(DMS).
UNIT III: SYNTHESIS ANDFABRICATION	Physicalvap our deposition –Chemicalvap our deposition-sol-gel– Wet deposition techniques - electrochemical deposition method – Electrospinning method – ball milling technique-pulsed laser deposition -Nanolithography: photolithography
UNIT IV: CHARACTERIZATION TECHNIQUES	Powder X-ray diffraction–X-ray photoelectronspectros copy(XPS)-UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy(SEM)-Transmission electron microscopy (TEM)-Vibrating sample Magnetometer.
UNIT V: APPLICATIONS OF NANOMATERIALS	Sensors: Nano sensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - Carbon Nanotube Emitters – Photocatalytic application: Airpurification, water purification-Energy: fuel cells- rechargeable batteries-super capacitors-photovoltaics.
UNITVI: 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. AtextbookofNanoscienceandNanotechnology,PradeepT.,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. NanostructuredMaterialsandNanotechnology,HariSinghNalwa,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–ImperialCollegePress (2004). 2. Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley PublishingInc. USA 3. Nanoparticles and Nanostructured films; Preparation, Characterizationand Applications, J. H. Fendler John Wiley and Sons. (2007) 4. Text book of Nanoscience and Nanotechnology, B.S.Murty,etal., 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

COURSEOUTCOMES:

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

CO1	Understand the basic of nanoscience, explore the different types of nanomaterials, and should comprehend the surface effects ofthe nanomaterials.	**K1, K2**
CO2	Explore various mechanical, optical, electrical and magnetic physical, properties nanomaterials.	**K1**
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.	**K2, K3**
CO4	AnalyzethevariouscharacterizationofNano-productsthroughdiffraction, 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-sEvaluate;		

MAPPINGWITHPROGRAMOUTCOMES:

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

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO 1	3	3	3	2	1	1	3	3	3	3
CO 2	3	3	3	2	1	1	3	3	3	3
CO 3	3	3	2	2	1	1	3	3	3	3
CO 4	3	3	3	2	1	1	3	3	3	3
CO 5	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

SEMESTER:III	COURSECODE: 23PPHYS36	CREDITS: 2
PART: B(i) SEC-II	SOLARENERGYUTILIZATION	Hours/Week: 3

Pre-Requisites
Basicknowledgeofheatenergy,wayoftransferofheat,solarenergy,materialstypes
LearningObjectives
➢ To impart fundamental aspects of solar energy utilization. ➢ To give adequate exposure to solar energy related industries ➢ To harness entrepreneur ship skills ➢ To understand the different types of solar cells and channelizing them to the differentsectors of society ➢ Todevelopanindustrialistmindsetbyutilizingrenewablesourceofenergy

UNITS	Course Details
UNIT I: HEAT TRANSFER & RADIATIONANALYSIS	Conduction, Convection and Radiation –Solar Radiation at the earth's surface-Determination of solar time–Solar energy measuring instruments.
UNIT II:SOLAR COLLECTORS	Physic AL principles of conversion of solar radiation into heat flat plate collectors-General characteristics–Focusing collector systems– Thermal performance evaluation of optical loss.
UNITIII: SOLARHEATERS	Types of solar water heater-Solar heating system–Collectors and storage tanks–Solar ponds–Solar cooling systems.
UNIT IV: SOLARENERGY CONVERSION	Photo Voltaic principles – Types of solar cells – Crystalline silicon/amorphous silicon and Thermo-electric conversion-process flow of silicon solar cells –different approaches on the process-texturization, diffusion, Antireflective coatings, metallization.
UNIT V: NANOMATERIALS IN FUEL CELL APPLICATIONS	Use of nanostructures and nanomaterials in fuel cell technology - high and low temperature fuel cells, cathode and anode reactions, fuel cell catalysts, electrolytes, ceramic catalysts. Use of Nano technology in hydrogen production and storage. Industrial visit–data collection and analysis-presentation
UNITVI: PROFESSIONAL COMPONENTS	Expert Lectures, Online Seminars - Webinars on Industrial Interactions/Visits, Competitive Examinations, Employable and Communication Skill Enhancement, Social Accountability and Patriotism.

COURSE OUTCOMES:

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

CO1	Gained knowledge in fundamental aspects of solar energy utilization	**K1**
CO2	Equipped to take up related job by gaining industry exposure	**K3**
CO3	Develop entrepreneurial skills	**K5**
CO4	Skilled to approach the needy society with different types of solar cells	**K4**
CO5	Gained industrialist mindset by utilizing renewable source of energy	**K2, K3**
K1-Remember;K2–Understand;K3-Apply;K4-Analyze;K5-Evaluate;		

MAPPINGWITHPROGRAMOUTCOMES:

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

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

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

SEMESTER:III	**COURSECODE: 23PPHYI37**	**CREDITS: 2**
PART: B (ii)	**SUMMER INTERNSHIP**	**Hours/Week:--**

Internship/Industrial activity will be carried out during the summer vacation of the first year and marks should be sent to the University by the College.

(Refer to the regulations for additional information)

SEMESTER:IV	COURSECODE: 23PPHYC41	CREDITS:5
PART:A CORE: XII	NUCLEARANDPARTICLEPHYSICS	Hours/Week:6

LEARNING OBJECTIVES

LO1	To elaborate the properties of nuclear forces based on various theories.
LO2	To teach different types of nuclear actions with necessary theories.
LO3	To educate the nuclear structure and nuclear forces through various models.
LO4	To discuss various theories involved in radioactive decays
LO5	To explain the fundamental principles and concepts governing nuclear and particle physics

UNIT-1: NUCLEARFORCES

Properties of nuclear forces –Binding energy – Exchange forces – Tensor forces – Charge independence and spin dependence of Nuclear forces –Theory of ground state of deuteron - Meson theory of nuclear forces –Yukawa potential –nucleon - nucleon scattering -Effective range theory of n-p scattering at low energies – Isospin formalism.

UNIT-II:NUCLEARREACTIONS

Types of nuclear reactions and conservation laws –Energetics of nuclear reactions– Q value equation–Partial wave analysis of nuclear reaction cross section – Level width – Compound nucleus theory – Formation and disintegration of energy levels- Resonance scattering –Breit Wignerone level dispersion formula –Absorption cross section at high energy -Direct nuclearreactions–Nuclearchainreactions– Fourfactor formula.

UNIT-III:NUCLEARMODELS

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 Quadra pole moment-Bohr and Mottelson collective model – rotational and vibrational bands.

UNIT-IV:NUCLEARDECAY

Alpha decay – Range and energy of alpha particles – Geiger Nuttall law for alpha emission – Alpha particle spectra – Gamow's theory of alpha decay -Beta decay – Neutrino Hypothesis– Fermi theory of beta decay –Beta energy spectrum – Helicity - Non conservation of parity in beta decay – Fermi- Kurie plots – Gamma decay – Multipole radiations – Angular correlation - Internal conversion – Nuclear isomerism.

UNIT-V:ELEMENTARYPARTICLES

Classification of elementary particles – Fundamental interactions – Conservation laws –Gell-Mann Nishijima relation –Invariance Principles - Invariance under charge, parity and time reversal – CP and CPT invariance – Elementary particle symmetries – Unitary symmetry [SU(2) Symmetry] –Eight fold way [SU(3) Symmetry] schemes for meson octet, baryon octet and baryon decuplet – Gell-mann and Okubo mass formula –Hypercharge and Quarks – Quarks Model.

TEXTBOOKS:

1. D.C. Tayal, *Nuclear Physics*, Himalaya Publishing House, New Delhi, 5th Edition, (2015).
2. S.N.Ghoshal,*NuclearPhysics*, Chand & Co.,NewDelhi,(2003).
3. K.Krane, *Introductory Nuclear Physics*, Wiley, NewYork,(1987).

SUPPLEMENTARYREADINGS:

1. M.L. Pandya and P.R.S. Yadav, *Elements of Nuclear Physics*, Kedarnath Ramnath Publications, Meerut,(2016).
2. D. Griffiths, *Introduction to Elementary Particle Physics*, Harper & Row, New York, (1987).
3. Irving Kaplan, *NuclearPhysics*,Narosa Publishing House, 2nd edition, (1962)

COURSEOUTCOMES

Learners will be able to

CO1	Summarize then unclear structure and nuclear for cesthrough various Models
CO2	State various types of nuclear reactions based on nuclear reaction Cross sections.
CO3	Understand various nuclear phenomena by applying nuclear models.
CO4	Discuss the theories involved indifferent types of radio active decays.
CO5	Explain elementary particles and discuss their classifications based son theoretical models.

COURSEOUTCOMEMAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**3**	**2**	**3**	**3**
CO2	**3**	**3**	**2**	**2**	**3**
CO3	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**2**	**2**	**3**
CO5	**3**	**3**	**3**	**3**	**2**

SEMESTER:IV	COURSECODE: 23PPHYC42	CREDITS 5
PART:A CORE: XIII	TITLE: SPECTROSCOPY	Hours/Week:6

Learning Objectives

LO1	To understand the basics of Atomic Spectroscopy and the interaction of matter and energy.
LO2	To familiarize with the basic principles of Micro wave and absorption Spectroscopic techniques and their applications.
LO3	To introduce Raman Spectroscopy and learn the determination of atomic structure, chemical composition and physical properties of materials from Raman Spectrum.
LO4	To know the basics and applications of Nuclear Magnetic Resonance and Nuclear Quadrupole Resonance spectroscopies.
LO5	To learn the principles of ESR and Mass bauer Spectroscopies

UNIT-I:ATOMICSPECTROSCOPY

Quantum states of an electron in a tom–Hydrogenatomspectrum– Electron spin – Stern - Gerlach experiment – Spin-orbit interaction – Two electron system-LS-**JJ** coupling schemes–Spectroscopic terms and selection rules - Hyperfine structure – Zeeman and Paschen - Back effect of one and two electron systems – Selection rules – Stark effect.

UNIT-II:MICROWAVE ANDINFRAREDABSORPTION SPECTROSCOPIES

Microwave Spectroscopy: Rotation of diatomic molecules–Rotational spectra of polyatomic molecules – Spectrum of non-rigid rotator – Experimental technique – Polyatomic molecules – Linear, symmetric top and asymmetric top molecules.

Infrared Absorption Spectroscopy - Vibrating diatomic molecule –Anhar monic oscillator – Diatomic vibrating rotator – Normal modes of vibrationincrystals– Characteristicandgroupfrequencies-FTtechniques.

UNIT-III:RAMANSPECTROSCOPY

Raman effect and Raman lines - Classical theory of Raman effect - Quantum theory of Raman effect – Pure rotational Raman spectra – Linear molecules – Symmetric top molecules – Vibration Raman spectra – Rotational fine structure – Structural determination – Raman spectra – Instrumentation – Raman effect and molecular structure – Raman activity of molecular vibrations - Surface enhanced Raman spectroscopy.

UNIT-IV :NMRANDNQRSPECTROSCOPIES

Nuclear Magnetic Resonance: Basic principles of NMR- Bloch equations and solutions–Shielding and deshielding effects–Chemical shift–Spin lattice and spin - spin relaxation – Coupling constants – Experimental technique–Double coil method–Structural diagnosis by NMR imaging.

Nuclear Quadrupole Resonance: Basic theory – Nuclear electric quadrupole interaction–energy levels–Transition frequency–Excitation and Detection – effect of magnetic field – Instrumentation and application.

UNIT–V:ESRANDMASSBAUERSPECTROSCOPIES

ESR: Theory of ESR–Resonance conditions –Experimental study– ESR spectrometer – Crystalline solids and free radicals in solution – Determination of g factor.

Moss Bauer: Mossbauer effect - recoilless emission and absorption – hyper fine inter action-chemical isomer shift –magnetic hyper fine and electric quadruple interactions – ` Instrumentation – applications.

Course Out comes:

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

CO1	Understand the basics of Atomic Spectroscopy and the interaction of Matter and energy.
CO2	Know the basic principles of Microwave and absorption spectroscopic Techniques and their applications.
CO3	Apply Raman Spectroscopy in the determination of atomic structure, chemical composition and physical properties of materials from Raman Spectrum.
CO4	Know the basics and applications of Nuclear Magnetic Resonance and Nuclear Quadrupole Resonance spectroscopies.
CO5	Understand the principles of ESR and Mossbauer Spectroscopies

TEXTBOOKS:

- C.N.Banwell ,*Fundamentals of Molecular Spectroscopy* McGraw Hill, New York (1981).
- G.Aruldhas, *Molecular Structure and Spectroscopy* Prentice Hall, New Delhi. (2006).
- D.N. Sathyanarayana, *Vibrational Spectroscopy* New Age International,New Delhi(2015).
- Gupta Kumar Sharma, *Elements of spectroscopy* Pragati Prakashan, Meerut. (2003)

SUPPLEMENTARYREADINGS

- J.Michael Hollas, *Modern Spectroscopy* Wiley India, New Delhi. (2004).
- B.P. Straughan and S. Walker, *Spectroscopy Volumes I--III* Chapman andHall,NewYork.(1976).

COURSEOUTCOMEMAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	3	3	3	2	3
CO3	3	3	2	2	3
CO4	3	2	2	2	2
CO5	3	2	2	3	3

SEMESTER:**IV**	COURSECODE: **23PPHYD43**	CREDITS **:7**
PART:**Project**	TITLE:**PROJECT WITH VIVA VOCE**	Hours/Week: **8**

Preamble

The concept to introducing the project will help the student community to learn and apply the principles of Physics and explore the new research avenues.

In the course of the project the student will refer books, Journals or collect literature /data by the way of visiting research institutes/ industries. He/she Cando experimental/theoretical work in his/her college and submit a dissertation report with a minimum of 70 pages not exceeding 80 pages in back to back printouts.

Format for Preparation of Dissertation

The sequence in which the dissertation should be arranged and bound should be as follows

1. Cover Page and title Page
2. Declaration
3. Certificate
4. Abstract(not exceeding one page)
5. Acknowledgement(not exceeding one page)
6. Contents(12Fontsize,TimesnewRomanwithdoublelinespacing)
7. List of Figures/Exhibits/Charts
8. List of tables
9. Symbols and notations
10. Chapters
11. References

Distribution of marks for Dissertation: (100Marks)

Review :

Progress and periodical reporting (R1+R2) -25Marks

ESE:

a) Organization and presentation of Thesis -40marks

b) For the Novelty/Social relevance -10marks

c) Viva voce(Preparation, Presentation of Work and Response to questions) -25mar

(Refer to the regulations for additional information)

SEMESTER:**IV**	COURSECODE: **23PPHYE44**	CREDITS **:3**
PART : A **ELECTIVE V**	**NUMERICAL METHODS AND COMPUTER PROGRAMMING (C)**	Hours/Week **: 6**

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. studentswiththenumericalmethodsusedincomputationandprogrammingusinganyhigh level language such as C ➢ To equip the computational skill using various mathematical tools. ➢ To apply the software tools to explore the concepts of physical science. ➢ Toapproachtherealtimeactivitiesusingphysicsandmathematicalformulations.

Course Details

(Any Twelve Experiments)

1. Lagrange interpolation with Algorithm, Flowchart and output.
2. Newton forward interpolation with Algorithm, Flowchart and output.
3. Newton back ward interpolation with Algorithm, Flowchart and output.
4. Curve-fitting: Least squares fitting with Algorithm, Flowchart and output.
5. Numerical integration by the trapezoidal rule with Algorithm, Flowchart and output.
6. Numerical integration by Simpson'srule with Algorithm, Flowchart 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. RungeKuttaFourthOrderMethodforsolvingfirstorderOrdinaryDifferentialEquations
14. Newton's cotes formula
15. Trapezoidal rule
16. Simpson's1/3rule
17. Simpson's3/8rule
18. Boole's rule
19. Gaussian quadrature method(2pointand3pointformula)
20. Giraffe's roots quare method for solving algebraic equation

TEXTBOOKS	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 ScientificandEngineeringComputation, 3rdEd. 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.deBoor,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, 5thEdition, Addison Wesley, Reading, MA. 3.B.Carnahan,H.A.LutherandJ.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.

COURSEOUTCOMES:

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 inde scribing/solving physics problems.	K4
CO3	Solve problem, critical thinking and analytical reasoning as applied to scientific problems.	K5
CO4	Toenhancetheproblem-solvingaptitudesofstudentsusingvariousnumericalmethods.	K5
CO5	To apply various mathematical entities, facilitate to visualize any complicate tasks.	K3
CO6	Process,analyzeandplotdatafromvariousphysicalphenomenaandinterprettheirmeaning	K4
CO7	Identifymodernprogrammingmethodsanddescribetheextentandlimitationsofcomputational Methods in physics	K1
CO8	Workoutnumericaldifferentiationandintegrationwheneverroutinearenotapplicable.	K5
CO9	Apply various interpolation methods and finite different concepts.	K4
CO10	Understandandapplynumericalmethodstofindoutsolutionofalgebraicequationusing Different methods under different conditions, and numerical solution of system of alsgebraic equation.	K1, K4
K1-Remember;K2–Understand;K3-Apply;K4-Analyze;K5–Evaluate		

MAPPINGWITHPROGRAMOUTCOMES:

Map course outcomes **(CO)** for each course with program outcomes **(PO)** and program specific outcomes**(PSO)** inthe 3-pointscale 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

	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	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

SKILL ENHANCEMENT COURSE/PROFESSION COMPETENCY SKILL:

Subject Code	Subject Name	Category	L	T	P	Credits	Inst. Hours	Marks
23PPHYS45	**NUMERICAL METHODS AND COMPUTER PROGRAMMING**					2	4	75

Pre-Requisites

Prior knowledge on computer and basic mathematics

Learning Objectives

- 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	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	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 – 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)

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

	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

SEMESTER:**IV**	COURSECODE: **23PPHYX46**	CREDITS:**1**
PART :	**EXTENSION ACTIVITY**	Hours/Week: --

Extension Activities aims at enabling our student to develop social responsibility and learning by doing. Service attitude is essential for any professional to flourish in his/her job. Extension activities in the neighbourhood community in terms of impact and sensitizing students to social issues and holistic development.

Extension activities has multiple dimensions such as Red Ribbon Club, Elecstrol Literacy Club, Road Safety Club, Unnat Bharat Abiyan, Swachh Bharath Abiyan, Jalshakthi Abiyan etc.

Students should enroll themselves in anyone of the activities and regularly attend the activity related to this continuously, for the two years of study.

Students must submit the certificate of any one of the extension activities to the Class In-charge /Head of the Department. Depending on the involvement of the students in the activities they (Class In-charge /Head of the Department) may evaluate the candidate and submit the marks.

(For additional information refer to the regulations)