MARUDHAR KESARI JAIN COLLEGE FOR WOMEN (AUTONOMOUS)

Vaniyambadi – 635 751

PG & Research Department of Physics

for

Postgraduate Programme

Master of Physics

From the Academic Year 2025-2026

CONTENT

LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK FOR UNDERGRADUATE AND POSTGRADUATE EDUCATION

1. **Preamble**

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

PROGRAMME OUTCOMES (PO)

Programme	**M.Sc., Physics**
Programme Code	**PS07**
Duration	**2Years[PG]**
Programme Outcomes	**PO1:** Acquire knowledge in Physics to apply the knowledge in their day-to-day life for betterment of self and society. **PO2:** Develop critical, analytical thinking and problem-solving skills **PO3:** Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data. **PO4:** Address and develop solutions for societal and environmental needs of local regional and national development. **PO5:** Work independently and engage in lifelong learning and enduring proficient progress. **PO6:** Provoke employability and entrepreneurship among students along with ethics andcommunication skills. **PO7:** Understand the importance of ethical behavior in business contexts and be able to recognize and address ethical dilemmas they may encounter in their professional careers. **PO8:** Prepared for lifelong learning and professional development, including the ability to adapt to changes in technology, business practices, and economic conditions throughout their careers.
Programme Specific Outcomes:	**PSO1: Placement**: Acquire the ability to critically analyze complex real life problems using the laws of Physics with appropriate mathematical tools and thereby preparing the students to face various state/national level competitive exams. **PSO2: Entrepreneur:** Acquire employability and entrepreneurial skills through hands-on training in basic as well as advanced areas of Physics and to develop innovative scientific solutions for industrial and societal needs at local, regional, national and global levels. **PSO3: Contribution to the Society:** Create skills required for identifying socially relevant research problems, collection of data, analyze and interpret data leading to knowledge enhancement in addressing the societal challenges.

Eligibility for Admission:

Candidates for admission to the first year of the Master of Physics course shall be required to have passed the Bachelor of Physics by the Government of Tamilnadu or any equivalent.

Methods of Evaluation and Assessment

Methods of Evaluation		
Internal Evaluation		25 Marks
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand / Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, short summary or overview	
Application (K3)	Suggest idea/concept with examples, suggest formulae, solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, finish a procedure in many steps, Differentiate Between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

Semester – I

Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PPHC11	CC - Mathematical Physics	5	1	0	0	4
24PPHC12	CC - Classical Mechanics and Relativity	5	1	0	0	4
24PPHP13P	CC – Analog and Digital Experiments Practical I	0	0	5	0	3
24PPHE11	DSEC - 1 Linear and Digital ICs and Applications	4	0	1	0	3
24PPHE12/ 24PPHE13	EC – 1. Crystal growth and Thin Films/ 2.Analysis of Crystal Structures	3	0	1	0	3
24PPHA11	AECC - Solar energy utilization	1	1	0	0	3
24PCHR11	VE - 1 Human Rights	1	1	0	0	3
TOTAL					**30**	**21**

Semester -II

Code	Course Title	Hours Distribution				C
		L	T	P	S	
24PPHC21	CC-Statistical Mechanics	5	0	0	0	4
24PPHC23	CC - Quantum Mechanics – I	5	0	0	0	4
24PPHC24	CC - Electromagnetic Theory	5	0	0	0	4
24PPHC22P	CC - Practical II - General Experiments	0	0	5	0	2
24PPHE21/ 24PPHE22	DSEC I 1. Advanced Optics 2. Plasma Physics	4	0	0	0	3
24PPHE23/ 24PPHE24	DSEC II – 1. Physics of Nanoscience and Technology 2. Bio Physics	4	0	0	0	3
24PPHS21	SEC /NM- Renewable Energy and Energy Harvesting	2	0	0	0	2
TOTAL					**30**	**22**

Semester – III

24PPHC31	CC - Quantum Mechanics-II	5	1	0	0	5
24PPHC32	CC - Condensed Matter Physics	5	1	0	0	5
24PPHC33P	CC – Practical-III Microprocessor and Programming in C	0	0	5	0	4
24PPHC34	CC - Numerical Methods and Programming in C	3	1	0	0	3
24PPHE31 /24PPHE32	EC – 1. Microprocessor 8085 and Microcontroller 8051 2.Astro Physics	4	0	0	0	3
24PPHS31	SEC - Electrical Circuit Network Skills	1	1	0	0	2
24PPHIN31	Internship	0	0	3	0	2
					30	**24**

Semester - IV

24PPHC41	CC - Spectroscopy	5	1	0	0	6
24PPHC42P	CC - Practical IV Advanced General Experiments	0	0	6	0	4
24PPHC43P	CC - Project	0	0	6	0	5
24PPHE41 / 24PPHE42	EC – 1. Nuclear and Particle Physics 2.Characterization of Materials	5	1	0	0	4
24PPHP41	PEC – Sewage and Waste Water Treatment & Reuse	1	1	0	0	2
24PPHL41	SLC – Solid Waste Management	0	0	0	4	2
					30	**23**
	Total Credits	**90+2***				

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmudalvan within the fifth semester. Additionally, engaging in a specified Self-learning Course is mandatory to qualify for the degree, and successful participation will be acknowledged with an extra credit of 2*.

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC31	QUANTUM MECHANICS-II	Core	5	1	0	0	5	6	25	75	100

Learning Objectives

LO1	To familiarize the students with the crucial concepts of scattering theory such as partial wave analysis and Born approximation.
LO2	To understand time-dependent Perturbation theory and its application to study of interaction of an atom with the electromagnetic field
LO3	To comprehend the concepts of relativistic equations in quantum mechanics.
LO4	To give the students a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts
LO5	To introduce the concept of classical field in quantum mechanics.

Unit	Content	Hours
1	**SCATTERING THEORY:** Scattering amplitude – Cross sections – Born approximation and its validity– Yukawa potential – Partial wave analysis – Scattering length and Effective range theory for s wave – Optical theorem – Transformation from centre of mass to laboratory frame.	15
2	**PERTURBATION THEORY:** Time dependent perturbation theory – Constant and harmonic perturbations – Fermi Golden rule – Transition probability Einstein's A and B Coefficients – Adiabatic approximation – Sudden approximation – Semi – classical treatment of an atom with electromagnetic radiation – Selection rules for dipole radiation	15
3	**RELATIVISTIC QUANTUM MECHANICS:** Klein – Gordon Equation – Charge and Current Densities – Dirac Matrices –Plane Wave Solutions – Interpretation of Negative Energy States – Antiparticles – Spin of Electron – Magnetic Moment of An Electron Due to Spin	15
4	**DIRAC EQUATION:** Dirac Equation – Covariant form of Dirac Equation – Properties of the gamma matrices – Traces – Relativistic invariance of Dirac equation – Probability Density – Current four vector – Bilinear covariant – Feynman's theory of positron (Elementary ideas only without propagation formalism)	15
5	**CLASSICAL FIELDS & SECOND QUANTIZATION:** Classical fields – Euler Lagrange equation – Hamiltonian formulation – Noether's theorem – Quantization of real and complex scalar fields – Creation, Annihilation and Number operators– Second Quantization of K-G field.	15

CO	Course Outcomes The student will be able to
CO1	Describe the concept of scattering theory such as partial wave analysis and Born approximation
CO2	Explain the relativistic quantum mechanics, with emphasis on perturbation theory.
CO3	Discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac matrices its phenomena accounted by them like electron spin and magnetic moment
CO4	Examine the concept of covariance and the use of Feynman graphs for depicting different interactions
CO5	Analyse the classical fields and second quantization
Textbooks:	
1	P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics,2nd Edition, Tata McGraw-Hill, New Delhi, 2010.
2	G. Aruldhas, Quantum Mechanics, 2nd edition, Prentice Hall of India, New Delhi, 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	Noureddine Zettili, Quantum mechanics concepts and applications, 2nd Edition, Wiley, 2017
Reference Books:	
1	P. A. M. Dirac, The Principles of Quantum Mechanics, 4th Edition, Oxford University Press, London, 1973.
2	B.K. Agarwal & HariPrakash, Quantum Mechanics, 7th reprint, PHI Learning Pvt. Ltd., New Delhi, 2009.
3	Deep Chandra Joshi, Quantum Electrodynamics and Particle Physics,1 stedition,I.K. International Publishing house Pvt. Ltd., 2006
4	Ghatak and S. Loganathan, Quantum Mechanics: Theory and Applications, 4th Edition, Macmillan India, New Delhi.
5	E. Merzbacher, Quantum Mechanics, 2nd edition, John Wiley and Sons, New York, 1970
Web resources:	
1	http://www.thphys.nuim.ie/Notes/MP463/MP463_Ch1.pdf
2	http://hep.itp.tuwien.ac.at/~kreuzer/qt08.pdf
3	https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf
4	https://web.mit.edu/dikaiser/www/FdsAmSci.pdf
5	https://ocw.mit.edu/courses/physics/8-05-quantum-physics-ii-fall-2013/lecture notes/MIT8_05F13_Chap_09.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	3	3	3
CO2	3	3	3	3	3	2	3	2	3	3	3
CO3	2	3	3	2	3	2	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3
CO5	3	3	3	2	3	2	3	3	3	3	3
Total	14	15	15	13	15	10	15	12	15	15	15
Average	**2.8**	**3**	**3**	**2.6**	**3**	**2**	**3**	**2.4**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC32	CONDENSED MATTER PHYSICS	Core	5	1	0	0	5	6	25	75	100

Learning Objectives

LO1	To understand the basics of crystal and describe various crystal structures, symmetry and to analyze allowed rotation , crystal binding differentiate different types of bonding
LO2	To understand reciprocal space, understand the lattice dynamics, evaluate phase and group velocities and apply it to concept of specific heat.
LO3	To critically assess various theories of electrons in solids and their impact in distinguishing solids.
LO4	To outline different types of magnetic materials and explain the underlying phenomena.
LO5	To elucidate concepts of superconductivity, and the underlying theories to relate to current areas of research.

Unit	Content	Hours
1	**CRYSTAL PHYSICS:** Introduction about crystal,lattice and their Types of lattices - Miller indices – Symmetry elements and allowed rotations - Simple crystal structures – Atomic Packing Factor- Crystal diffraction - Diffraction Conditions -Bragg's law – Laue equations- Scattered Wave Amplitude - Atomic form factor- Structure factor- Reciprocal Lattice (sc, bcc, fcc), Brillouin zone. Structure and properties of liquid crystals. Inert gas crystals - Cohesive energy of ionic crystals - Madelung constant - Types of crystal binding (general ideas).	15
2	**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 – specific heat capacity, Einstein and Debye's theory of lattice heat capacity - Umklapp processes.	15
3	**FREE ELECTRON THEORY OF METALS AND SEMICONDUCTORS:** Drude – Lorentz theory of electrical conduction-Electrical conductivity- Thermal conductivity - Wiedemann-Franz law - Free electron gas in three dimensions - Band theory of metals and semiconductors - Bloch theorem - Kronig-Penney model - Semiconductors - Intrinsic carrier concentration - Mobility - Impurity conductivity – Impurity states - Hall effect – Fermi surfaces and construction - Experimental methods in Fermi surface studies - de Hassvan Alphen effect .	15
4	**MAGNETISM:** Magnetic materials and their types - Diamagnetism - Quantum theory of paramagnetism - Rare earth ion Hund's rule - Quenching of orbital angular momentum - Adiabatic demagnetization - Quantum theory of ferromagnetism - Domain theory of ferromagnetic theory - Heisenberg's interpretation of Weiss field Ferromagnetic domains - Bloch wall - Spin waves - Quantization Magnons - Thermal excitation of magnons - Curie temperature and	15

	susceptibility of ferrimagnets - Theory of anti-ferromagnetism - Neel temperature	
5	**SUPERCONDUCTIVITY:** Experimental facts: Occurrence - Effect of magnetic fields - Meissner effect – Critical field – Critical current – Thermodynamic properties of 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 - Josephson tunneling - DC and AC Josephson effects - High temperature Superconductors – SQUIDS.	15

CO	**Course Outcomes** Student will be able to
CO1	Describe the types and explain the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure
CO2	Visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids.
CO3	Examine the process of heat conduction in solids and semiconductors
CO4	Analyse, compare and contrast the different types of magnetic materials.
CO5	Conceptualize the idea of superconductivity and their applications
Textbooks:	
1	C. Kittel, 1996, Introduction to Solid state Physics, 7th Edition, Wiley, New York.
2	Rita John, Solid State Physics, Tata Mc-Graw Hill Publication
3	A. J. Dekker, Solid State Physics, Macmillan India, New Delhi.
4	M. Ali Omar, 1974, Elementary Solid State Physics – Principles and Applications, Addison – Wesley
5	H.P. Myers, 1998, Introductory Solid State Physics, 2nd Edition, Viva Book, New Delhi.
6	Solid State Physics , R L Singhal, Kedarnath Ram Nath& Co., Meerut (2003)
Reference Books:	
1	J. S. Blakemore, 1974, Solid state Physics, 2nd Edition, W.B. Saunder, Philadelphia
2	H. M. Rosenburg, 1993, The SolidState, 3rd Edition, Oxford University Press, Oxford.
3	J. M. Ziman, 1971, Principles of the Theory of Solids, CambridgeUniversity Press, London
4	C. Ross-Innes and E. H. Rhoderick, 1976, Introduction to Superconductivity, Pergamon, Oxford
5	J. P. Srivastava, 2001, Elements of Solid State Physics, Prentice-Hall of India, New Delhi.

	S. O. Pillai - Solid State Physics, Narosa publication
	Raghavan - Materials science and Engineering, PHI
Web resources:	
1	https://archive.nptel.ac.in/courses/115/105/115105099/
2	http://www.digimat.in/nptel/courses/video/115105099/L75.html
3	https://archive.nptel.ac.in/content/storage2/courses/downloads_new/115105099/noc19_ph14_assignment_Week_1.pdf
4	http://www.digimat.in/nptel/courses/video/115102026/L01.html
5	https://nptel.ac.in/downloads/115105099/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	3	2	3	3
CO2	3	3	3	3	3	3	2	3	2	2	3
CO3	3	3	3	3	3	2	2	3	3	3	3
CO4	3	3	3	3	2	2	2	3	3	3	3
CO5	3	3	2	3	2	3	2	3	3	2	2
Total	15	15	14	15	13	13	10	15	13	13	14
Average	**3**	**3**	**2.8**	**3**	**2.6**	**2.6**	**2**	**3**	**2.6**	**2.6**	**2.8**

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC33P	**Practical-III Microprocessor and Programming in C**	Practical	0	0	5	0	4	5	25	75	100

Learning Objectives

LO	To understand the theory and working of optical interferometry experiments, Microprocessor, Microcontroller and their applications

	Content **(Minimum 10 Experiments from the list)**	Hours
	1. Lagrange interpolation with Algorithm, Flow chart and output. 2. Newton forward interpolation with Algorithm, Flow chart and output. 3. Newton backward interpolation with Algorithm, Flow chart and output. 4. Curve-fitting: Least squares fitting with Algorithm, Flow chart and output. 5. Numerical integration by the trapezoidal rule with Algorithm, Flow chart and output. 6. Numerical integration by Simpson's rule with Algorithm, Flow chart and output. 7. Numerical solution of ordinary first-order differential equations by the Runge- Kutta method with Algorithm, Flow chart and output. 8. Finding Roots of a Polynomial - Newton Raphson Method – 9. Solution of Simultaneous Linear Equation by Gauss elimination method. 10. Solution of Ordinary Differential Equation by Euler **Microprocessor Experiments** 1) (a) Clock program- 12/24 hours- six digits - Decimal Counters using microprocessor 8085. (b) Interfacing of seven segment display using microprocessor 8085 2) (a) Sum of a set of N data (8-bit number) and search of an element in an array using 8085. (b) Interfacing of DC stepper motor – clockwise, anti-clockwise, required angle and wiper action using microprocessor 8085. 3) (a) Code conversion-8-bit number: (a) Binary to BCD (b) BCD to Binary using microprocessor 8085 (b) Interfacing using DAC with IC 0800 – Wave form generation – Square, Triangular and Saw tooth wave using microprocessor 8085 4) (a) 8 bit Addition, subtraction, multiplication and division using Microcontroller – 8051 (b) Ascending/ descending order - Linear sort using microcontroller 8051. 5) (a) Block transfer using 8051 microcontroller. (b) Interfacing of HEX keyboard using microcontroller 8051.	60

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC34	NUMERICAL METHODS AND PROGRAMMING IN C	Core	3	1	0	0	3	4	25	75	100

Learning Objectives	
LO1	To understand the methods of finding the root of algebraic equations.
LO2	To study the multiple methods of solving simultaneous equations.
LO3	To understand the interpolation and curve fittings
LO4	To study the numerical solutions of integration and solutions of differential equations.
LO5	To understand the basics of programming with C

Unit	Content	Hours
1	**UNIT I: SOLUTIONS OF EQUATIONS** Roots of equation- Linear, Non-linear algebraic equation. Roots of polynomials, nonlinear algebraic equations and transcendental equations - Newton Raphson method. Convergence of solutions in Newton-Raphson methods – Limitations of Newton-Raphson methods.	15
2	**UNIT II: LINEAR SYSTEM OF EQUATIONS** Simultaneous linear equations and their matrix representation– Inverse of a Matrix – Gaussian elimination method – Gauss Jordan method –Eigen values and eigenvectors of matrices – Direct method – Power Method.	15
3	**UNIT III: INTERPOLATION AND CURVE FITTING** **Interpolation:** 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 Straight Line and exponential curves.	15
4	**UNIT IV: DIFFERENTIATION, INTEGRATION & SOLUTION OF DIFFERENTIAL EQUATIONS** Numerical differentiation – Numerical integration – Trapezoidal rule – Simpson's rule – Error estimates – Gauss-Legendre, Gauss-Laguerre, Gauss-Hermite and Gauss-Chebyshev quadrature–solution of ordinary differential equations – Euler and Runga Kutta methods.	15
5	**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/non-linear equations by the Newton-Raphson method, (b) Newton's forward and backward interpolation, Lagrange Interpolation,(c) Trapezoidal and Simpson's Rules, (d) Solution of first order differential equations by Euler's method.	15

CO	Course Outcomes Student will be able to
CO1	Recall the transcendental equations and analyze the different root finding methods. Explain the basic concept involved in root finding procedure such as Newton Raphson methods.
CO2	Relate Simultaneous linear equations and their matrix representation and distinguish between various methods of solving simultaneous linear equations.
CO3	Apply the use of, interpolation will be used in various realms of physics and Apply to some simple problems with respect to newton forward and backward interpolation
CO4	Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simson's method of numerical integration
CO5	Demonstrate the basics of C-programming and conditional statements.
Textbooks:	
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	E. Balagurusamy, *Problem solving and Python Programming*, McGraw Hill Education (India) Pvt Ltd.,
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 & 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 Programming in C*, PHI, New Delhi
Web resources:	
1	https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-VRajaRaman
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

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	3	2	3	2	2
CO2	3	2	3	2	2	2	3	2	3	2	2
CO3	3	2	3	2	2	2	3	2	2	3	2
CO4	3	2	3	2	2	2	3	2	2	3	2
CO5	3	2	3	2	2	2	3	2	2	2	2
Total	15	10	15	10	10	10	15	10	12	12	10
Average	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2.4**	**2.4**	**2**

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE31	MICROPROCESSOR 8085 AND MICROCONTROLLER 8051	Ele- I	4	0	0	0	3	4	25	75	100

Learning Objectives

LO1	To understand the architecture and programming of the 8085 microprocessor and learn to write assembly language programs for the 8085 microprocessor.
LO2	To study the concepts of interfacing various devices with the 8085 microprocessor and learn to design and develop interfacing circuits for various applications.
LO3	To learn about the various components of the 8051 microcontroller, including the CPU, memory, and I/O ports and to Understand the different types of memory used in the 8051 microcontroller, including internal RAM, external RAM, and ROM.
LO4	To comprehend the 8051 instruction set architecture and the different types of instructions and learn to write assembly language programs for the 8051 microcontroller.
LO5	To explain the concept of interrupts and interrupt programming in microcontrollers and also understand the concept of interrupt priority and interrupt nesting.

Unit	Content	Hours
1	**8085 PROGRAMMING, PERIPHERAL DEVICES AND THEIR INTERFACING:** Instruction set - Addressing modes - Memory and I/O interfacing - Data transfer schemes - Interrupts of 8085 - Programmable peripheral interface 8255 (PPI) - Programmable interrupt controller (PIC) 8259 - Programmable communication interface 8251 - Programmable counter /interval timer 8253.	12
2	**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 and strain).	12
3	**8051 MICROCONTROLLER HARDWARE:** Introduction – Features of 8051 – 8051 Microcontroller Hardware: Pin-out 8051, Central Processing Unit (CPU), internal RAM, Internal ROM, Register set of 8051 – Memory organization of 8051 – Input/Output pins, Ports and Circuits – External data memory and program memory: External program memory, External data memory.	12
4	**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	12
5	**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, Hex key interface.	12

CO	Course Outcomes Students will be able to
CO1	Apply knowledge of 8085 microprocessor programming and interfacing to solve real-world problems in areas such as embedded systems, robotics, and automation.
CO2	Design and develop interfacing circuits for various devices such as keyboards, displays, printers, and sensors using the 8085 microprocessor and also write programs to interface devices with the 8085 microprocessor using assembly language.
CO3	Design and implement simple digital systems using the 8051 microcontroller and also write programs to interface the 8051 microcontroller with external devices, such as LEDs, switches, and LCD displays.
CO4	Explain the 8051 instruction set architecture and the different types of instructions and also write assembly language programs for the 8051 microcontroller to perform simple tasks.
CO5	Explain the concept of interrupts and interrupt programming in microcontrollers and implement interrupt priority and interrupt nesting in microcontroller-based systems.
Textbooks:	
1	V.Vijayendran,2005, "*Fundamentals of Microprocessor-8085"*, 3rd Edition S.Visvanathan Pvt. Ltd.
2	Ramesh Gaonkar, *Microprocessor Architecture, Programming and Applications with8085*, Penram International Publishing (2013).
3	A. Nagoor Kani, *Microprocessors & Microcontrollers*, RBA Publications (2009).
4	A. P. Godse and D. A. Godse, *Microprocessors*, Technical Publications, Pune (2009).
5	B.Ram, *Fundamentals of Microprocessors & Microcontrollers*, Dhanpat Rai publications New Delhi (2016).
Reference Books:	
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, The 8051 Microcontroller and Embedded Systems, Pearson Education (2008).
Web resources:	
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/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	3	2	3	3	3
CO2	2	2	2	2	2	2	3	2	3	3	3
CO3	2	2	3	2	2	3	3	2	3	3	3
CO4	2	3	2	3	2	2	3	2	3	3	3
CO5	3	3	2	2	2	3	3	2	3	3	3
Total	12	13	12	11	10	12	15	10	15	15	15
Average	**2.4**	**2.6**	**2.4**	**2.2**	**2**	**2.4**	**3**	**2**	**3**	**3**	**3**

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE32	**ASTRO PHYSICS**	Elective	3	1	0	0	3	4	25	75	100

Learning Objectives

LO1	To gain knowledge on the physical universe and its evolution.
LO2	To study the constituents and dynamics of galaxies.
LO3	To study electromagnetic radiation from stars, atomic spectra and classification of stars.
LO4	To learn the properties and the evolution of stars.
LO5	To understand fundamental principles and techniques of astronomy and astrophysics.

Unit	Content	Hours
1	**COSMOLOGY:** Galaxies and the expanding Universe; Hubble's Law; the age of the Universe; the Big Bang; cosmic microwave background; big bang nucleosynthesis (cosmic abundances, binding energies, matter & radiation); introductory cosmology cosmological models; dark energy and the accelerating Universe.	12
2	**GALAXIES:** Constituents of galaxies; stellar populations; the interstellar medium; HII regions; 21cm line; spirals and ellipticals; galactic dynamics; galaxy rotation curves and dark matter; active galaxies and quasars.	12
3	**PROPERTIES OF STARS:** Brightness (luminosities, fluxes and magnitudes); colours (black body radiation, the Planck, Stefan-Boltzmann and Wien's laws, effective temperature, interstellar reddening); spectral types; spectral lines (Bohr model, Lyman & Balmer series); Hertzprung-Russell diagram; the main sequence (stellar masses, binary systems, Kepler's laws, mass-luminosity relations); distances to stars (parallax, standard candles, P-L relationships, ms-fitting etc.).	12
4	**THE LIFE AND DEATH OF STARS:** Energy source (nuclear fusion, p-p chain, triple-alpha, CNO cycle, lifetime of the Sun); solar neutrinos; basic stellar structure hydro static equilibrium, equation of state; evolution beyond the main sequence; formation of the heavy elements; supernovae; stellar remnants (white dwarfs, neutron stars, black holes, degeneracy pressure, Swarszchild radius, escape velocities).	12
5	**OBSERVATIONAL ASTRONOMY:** The electromagnetic spectrum; geometrical optics (ray diagrams, focal length, magnification etc.); diffraction (resolving power, Airy disc, diffraction limit etc.); telescopes (reflecting, refracting, multi wavelength)	12

CO	Course Outcomes
CO1	Recall and understand the electromagnetic radiation from celestial objects. Analyze the wave nature of light in the form of ray diagram.
CO2	Correlate luminosity, flux and magnitude, related to the brightness of a star. Analyze the evolution of stars using HR diagram.
CO3	Define nuclear fusion, which is the fundamental energy source of stars. Analyze how neutrinos are born during the process of nuclear fusion in the sun.
CO4	Remember and illustrate the structure of our Milky way galaxy. Classify the types of galaxies.
CO5	Explain cosmology, a branch of astronomy that involves the origin and evolution of the universe, from the Big Bang to today and on into the future.
Textbooks:	
1	Zeilik& Gregory, Introductory Astronomy & Astrophysics,4thedition (Saunders College Publishing)
2	Morison,I.,IntroductiontoAstronomyand Cosmology, (Wiley)
3	Kutner,M.L., Astronomy: A Physical Perspective (Cambridge University Press)
4	Green,S.F.& Jones,M.H.,An Introduction to the Sun and Stars (Cambridge University Press)
Reference Books:	
1	Jones, M.H.& Lambourne, R.J.A., An Introduction to Galaxies & Cosmology (Cambridge University Press)
2	Carroll, B.W. &Ostlie, D.A., An Introduction to Modern Astrophysics (Pearson)
3	Shu, F.H.,The Physical Universe, An Introduction to Astronomy, (University Science Books)
4	Motz, L.&Duveen,A.,The, A.,The Essentials of Astronomy, (Colombia University Press)
Web resources:	
1	https://r.search.yahoo.com/_ylt=Awrx_5JxP6RnKQIAuIy7HAx.;_ylu=Y29sbwNzZzMEcG9zAzUEdnRpZAMEc2VjA3Ny/RV=2/RE=1740026994/RO=10/RU=https%3a%2f%2fwww.physics.utoronto.ca%2f~phy224_324%2fLabManuals%2fBlackbodyRadiation.pdf/RK=2/RS=fYcBR3Ni7GtwWIO4M7ZiN0Ojx2Q-
2	https://web.astro.princeton.edu/academic/undergraduate-program/introduction-astrophysics

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	3	3	3	3
CO2	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
Total	15	15	15	12	15	15	15	15	15	15	15
Average	**3**	**3**	**3**	**2.4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHS31	ELECTRICAL CIRCUIT NETWORK SKILLS	SEC	2	0	0	0	2	2	25	75	100

Learning Objectives	
LO1	To introduce the basic principle of electrical circuits.
LO2	To learn electrical drawing symbols, colour coding and circuit designing.
LO3	To understand the functions of electric motors & solid state devices
LO4	To introduce the concepts of electrical protection
LO5	To learn about proper electrical wiring

Unit	Content	Hours
1	**UNIT I: Basic Electricity Principles & Electrical Circuits** **Basic Electricity Principles**: Voltage, Current, Resistance, and Power. Ohm's law. AC Electricity and DC Electricity. Familiarization with millimeter, voltmeter and ammeter **Electrical Circuits**: Main electric circuit elements and their combination. Rules to analyze DC sourced and AC sourced electrical circuits. Current and voltage drop across the DC circuit elements. Single – phase and three – phase alternating current sources. Power factor. Saving energy and money	6
2	**UNIT II: Electrical Drawing and Symbols & Generators and Transformers** **Electrical Drawing and Symbols**: Drawing symbols. Reading Schematics. Ladder diagrams. Electrical Schematics. Power circuits. Control circuits. Tracking the connections of elements and identify current flow and voltage drop **Generators and Transformers**: DC Power sources. AC/DC generators. Inductance, capacitance and impedance. Operation of transformers	6
3	**UNIT III: Electric Motors & Solid-State Devices** **Electric Motors**: Single-phase, three-phase & DC motors. Basic design. Interfacing DC or AC sources to control heaters & motors. Speed & power of ac motor. **Solid-State Devices**: Resistors, inductors and capacitors. Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources	6
4	**UNIT IV: Electrical Protection** **Electrical Protection**: Relays. Fuses and disconnect switches. Circuit breakers. Overload devices. Ground-fault protection. Grounding and isolating. Phase reversal. Surge protection. Interfacing DC or AC sources to control elements (relay protection device)	6
5	**UNIT V: Electrical Wiring** **Electrical Wiring**: Different types of conductors and cables. Basics of wiring- Star and delta connection. Voltage drop and losses across cables and conductors. Instruments to measure current, voltage, power in DC and AC circuits. Insulation. Solid and stranded cable. Splices: wire nuts, crimps, terminal blocks, split bolts, and solder. Preparation of extension board	6

CO	Course Outcomes Students will be able to
CO1	Explain the components of basic electrical circuits
CO2	Illustrate various types of electrical drawings and symbols
CO3	Demonstrate the principal and working of electrical motors
CO4	Evaluate the various types of electrical protection elements
CO5	To analyse and apply different types of electrical wiring and splices elements
Textbooks:	
1	A text book in Electrical Technology – B L Theraja – S Chand &Co.
2	A text book of Electrical Technology – A K Theraja
Reference Books:	
1	Dr D M Marathe, Dr K G Kolhe, Dr M S Kale, Dr R B Waghulde, Dr S D Chavhan, Dr S R Gosavi, Dr S V Borse, Prof Dr R S Khadayate" Electrical Circuits and Network Skills" ISBN:9789389501407
2	Performance and design of AC machines-M G Say ELBS Edn
Web resources:	
1	https://www.coursera.org/courses?query=circuit%20analysis
2	https://onlinecourses.nptel.ac.in/noc23_ee81/preview
3	https://www.udemy.com/topic/electrical-circuits/?srsltid=AfmBOoqH8g8PJOyRf6KfOpfBkdQz578bFZOUGWbSRXmCJcKhHQzAe8nT
4	https://www.engineeringdevotion.com/electric-circuit-lectures.html
5	https://www.classcentral.com/subject/electric-circuits

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	2	2	1	2	2	2
CO2	2	2	2	3	2	2	2	2	2	2	2
CO3	2	2	2	3	2	2	2	2	1	3	2
CO4	3	2	2	2	3	2	2	2	2	2	3
CO5	3	2	2	2	3	2	2	2	2	2	3
Total	13	10	10	12	12	10	10	9	9	11	12
Average	**2.6**	**2**	**2**	**2.4**	**2.4**	**2**	**2**	**1.8**	**1.8**	**2.2**	**2.4**

2nd YEAR: THIRD SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHIN31	Internship	SEC	0	0	2	0	2	3	**25**	**75**	**100**

Learning Objectives	
LO1	Introduce the Working Ambience, Attitude, Adaptability, Problem Solving Ability, Ability to work with Supervisor, Ability to take Directions, etc..
LO2	Expose on the different phases of Developing a Computer Solution with Team Spirit.
LO3	Learn about Problem Solving Skills, Soft Skills and other related Skills required for the industry.
LO4	To develop skill competencies specific to an occupation or profession..
LO5	To acquire additional interpersonal communication and interaction skills

S.No	REGULATIONS	Hour
I	1. The students have to undergo 30 hours/15 days of Internship/ Industrial Training in the Industry during the holidays of the Second Semester. 2. The Candidates need to get a Project, Analyze, learn the various stages of Developing a solution, Test, Validate and carryout the other related requirements. 3. During the Third Semester, candidates are required to refine the work completed during their industry internship by incorporating constructive feedback received from the industry and/or the institution during reviews, and by further developing the project to meet industry standards. 4. The Candidates have to prepare and submit the manuscript of the Internship experience as a Report as per the requirements of the Department for Evaluation. 5. The submission of the Internship Report will be done at the end of the Third Semester for Presentation and Viva-Voce during the Practical Examinations of the Semester. 6. The Passing Minimum for Internship is 50%. 7. If the Candidate fails to score 50% in the Internship, the Candidate has to improve it during the next attempt. 8. A Faculty Member from the Department will act as a Guide to Supervise/Monitor the progress of the Candidates. 9. The Faculty Member will act as the Internal Examiner during the course of Internship as well as at the time of conducting the Viva-Voce Examination. 10. The Internal Marks for the Internship will be awarded by the concerned Guide /Internal Examiner. 11. The Internal and External Examiners shall both evaluate the Internship Report, Presentation and conduct the Viva-Voce Examination.	30

CO	Course Outcomes Students will able to
CO1	Find the specific areas of interest, refine their skills and abilities.
CO2	Show a greater sense of self-awareness and appreciation for others.
CO3	Develop work habits and attitudes that are essential to succeed in the workplace.
CO4	Discover the importance of communication, interpersonal and other critical skills.
CO5	Discover the importance of communication, interpersonal and other critical skills

INTERNAL MARKS AWARDED FOR THE INTERNSHIP -25 Marks
✓ Internship Review 1 (During the beginning of the Semester) - 5 Marks ✓ Internship Review 2 (During the end of the Semester)- 5 Marks ✓ Progress of the Internship by the Candidate's active Participation- 15 Marks
EXTERNAL MARKS AWARDED FOR THE INTERNSHIP -75 Marks
✓ Evaluation of the Internship Report - 50 Marks ✓ Presentation & Viva-Voce Examination- 25 Marks

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC41	**Spectroscopy**	Core	5	1	0	0	6	6	25	75	100

Learning Objectives	
LO1	To understand the theory behind microwave spectroscopy
LO2	To know the working principles along with an overview of construction of different types of spectrometers involved
LO3	To explore various applications of these techniques in R &D.
LO4	Apply spectroscopic techniques for the qualitative and quantitative analysis of various chemical compounds
LO5	Understand this important analytical tool

Unit		**Hours**
1	**MICROWAVE SPECTROSCOPY:** Rotational spectra of diatomic molecules - Rigid Rotor (Diatomic Molecules)- reduced mass – rotational constant - Effect of isotopic substitution - Non rigid rotator – centrifugal distortion constant- Intensity of Spectral Lines- Polyatomic molecules – linear – symmetric asymmetric top molecules - Hyperfine structure and quadrupole moment of linear molecules - Instrumentation techniques – block diagram -Rotational Spectra- Stark effect.	15
2	**INFRA-RED SPECTROSCOPY:** Vibrations of simple harmonic oscillator – zero-point energy- Anharmonic oscillator - Diatomic Vibrating Rotator- Fundamental modes of vibration of H_2O and CO_2 -Introduction to application of vibrational spectra- IR Spectrophotometer Instrumentation (Double Beam Spectrometer) – Fourier Transform Infrared Spectroscopy - Interpretation of vibrational spectra– remote analysis of atmospheric gases like N_2O using FTIR by National Remote Sensing Centre (NRSC).	15
3	**RAMAN SPECTROSCOPY:** Theory of Raman Scattering - Classical theory – molecular polarizability – polarizability ellipsoid - Quantum theory of Raman effect - rotational Raman spectra of linear molecule - symmetric top molecule – Stokes and anti-stokes line- SR branch -Raman activity of H_2O and CO_2 -Mutual exclusion principle- determination of N_2O structure -Instrumentation technique and block diagram - structure determination of planar and non-planar molecules using Raman techniques - FT Raman spectroscopy.	15
4	**RESONANCE SPECTROSCOPY:** Nuclear and Electron spin-Interaction with magnetic field - Population of Energy levels - Larmor precession- Relaxation times - Double resonance- Chemical shift and its measurement - NMR of Hydrogen nuclei - Indirect Spin -Spin Interaction - Instrumentation techniques of NMR spectroscopy – NMR in Chemical industries- MRI Scan / Electron Spin Resonance: Basic principle –Total Hamiltonian (Direct Dipole-Dipole interaction and Fermi Contact Interaction) –	15

	Hyperfine Structure (Hydrogen atom) – ESR Spectra of Free radicals –g-factors – Instrumentation - Medical applications of ESR	
5	**UV SPECTROSCOPY:** Origin of UV spectra - Laws of absorption – Lambert Bouguer law / Beer law - molar absorptivity – transmittance and absorbance - Color in organic compounds- Absorption by organic Molecule -Chromophores -Effect of conjugation on chromophores - Choice of Solvent and Solvent effect - Absorption by inorganic systems - Instrumentation - double beam UV-Spectrophotometer -Simple applications	15

CO	**Course Outcomes** The student will be able to
CO1	Understand fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret their behaviour. Able to quantify their nature and correlate them with their characteristic properties.
CO2	Understand the working principles of spectroscopic instruments and theoretical background of IR spectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules.
CO3	Interpret structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool
CO4	Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances
CO5	Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.
Textbooks:	
1	D.N. Satyanarayana, 2001, Vibrational Spectroscopy and Applications, New Age International Publication
2	G Aruldhas, 1994, Molecular Structure and Molecular Spectroscopy, Prentice–Hall of India, New Delhi.
3	C N Banwell and E M McCash, 1994, Fundamentals of Molecular Spectroscopy, 4th Edition, Tata McGraw–Hill, New Delhi
4	B.K. Sharma, 2015, Spectroscopy, Goel Publishing House Meerut.
5	Kalsi.P.S, 2016, Spectroscopy of Organic Compounds (7th Edition), New Age International Publishers.
Reference Books:	
1	J L McHale, 2008, Molecular Spectroscopy, Pearson Education India, New Delhi.
2	J M Hollas, 2002, Basic Atomic and Molecular Spectroscopy, Royal Society of Chemistry, RSC, Cambridge.
3	B. P. Straughan and S. Walker, 1976, Spectroscopy Vol. I, Chapman and Hall, New York.
Web resources:	
1	https://www.youtube.com/watch?v=0iQhirTf2PI
2	https://www.coursera.org/lecture/spectroscopy/introduction-3N5D5

3	https://www.coursera.org/lecture/spectroscopy/infrared-spectroscopy-8jEee
4	https://onlinecourses.nptel.ac.in/noc20_cy08/preview
5	https://www.coursera.org/lecture/spectroscopy/nmr-spectroscopy-introduction-XCWRu

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	2	2	3	3	3	3	3
CO2	3	2	3	3	2	2	3	2	3	3	3
CO3	3	2	3	3	2	2	2	2	3	3	3
CO4	3	2	3	3	2	2	2	2	3	3	3
CO5	3	2	3	3	2	2	2	3	3	3	3
Total	14	15	15	13	15	10	15	12	15	15	15
Average	**2.8**	**3**	**3**	**2.6**	**3**	**2**	**3**	**2.4**	**3**	**3**	**3**

3 – Strong, 2- Medium, 1- Low

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC42P	Practical IV- Advanced General Experiments	Core	0	0	6	0	4	6	25	75	100

Learning Objectives	
LO1	To understand the concept of mechanical behavior of materials and calculation of same using appropriate

Unit	Content (any Eight Experiments)	Hours
1	1. Determination of Thickness of air film. - Solar spectrum – Hartmann's formula. Edser and Butler fringes. 2. Determination of Solar constant 3. Determination of velocity and compressibility of a liquid using ultrasonic Interferometer 4. Determination of Diffraction pattern of light with circular aperture using Diode / He-Ne laser. 5. Determination of Thickness of thin film. - Michelson Interferometer 6. Determination of wavelength –Michelson Interferometer 7. Measurement of Magnetic Susceptibility - Guoy's method 8. GM counter – Absorption coefficient – Maximum range of β rays 9. GM counter – Feather's analysis: Range of Beta rays 10. Study the beam divergence, spot size and intensity profile of Diode / He-Ne laser. 11. Determination of Refractive index of liquids using diode Laser / He–Ne Laser 12. Arc spectrum – Iron. 13. Molecular spectra – CN bands 14. Determination of Planck Constant – LED Method 15. B-H curve using CRO 16. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility 17. Verification of Beer Lambert's Law using Spectrophotometer.	75

CO	Course Outcomes Student will be able to
CO1	Acquire knowledge of thermal behavior of the materials and theoretical principles of magnetism

Textbooks:	
1	R.Srinivasan K.R Priolkar, Kit Developed for doing experiments in Physics-Instruction manual, Indian Academy of Sciences

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC43P	**Project**	Core	0	0	6	0	5	6	25	75	100

Preamble

The concept of introducing the project will help the student community to learn 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. She may even do experimental /theoretical work in her college and submit a dissertation report with a minimum of 40 pages not exceeding 50 pages.

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 (12 Font size, Times new Roman with double line spacing)
7. List of Figures/ Exhibits/Charts
8. List of tables
9. Symbols and notations/ abbreviations
10. Chapters
11. References

Distribution of marks for Dissertation: (Internal: 25+External: 75 = 100 Marks)

External: 75 Marks - Distribution

a. For Organization and presentation of Thesis - 40 marks

b. For the novelty /Social relevance -10 marks

c. Viva voce - Preparation & Presentation of work - 10 marks

   a. Response to questions -10 Marks

d. Participation / Presentation of paper in the National or State level Seminar/Conference/ Workshop/publication - 5 marks

Internal: 25 Marks – Distribution

   a. Review : 1 – 5 marks

   b. Review: 2 – 10 Marks

   c. Review: 3 – 10 marks

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE41	**Nuclear and Particle Physics**	Elective	5	1	0	0	4	6	25	75	100

Learning Objectives

LO1	To inculcate students to different nuclear models of the nucleus
LO2	Imparts an in-depth knowledge on the nuclear force.
LO3	Provides students to understand different nuclear phenomena and the concept of resonances
LO4	Provides students with details of nuclear decay with relevant theories
LO5	Exposes students to the Standard Model of Elementary Particles and Higgs boson

Unit	Content	Hours
1	**NUCLEAR MODELS**: Liquid drop model – Weizacker mass formula – Mirror nuclei- Bohr Wheeler theory of fission – shell model – spin-orbit coupling – magic numbers – angular momenta and parity of ground states – magnetic moment – Schmidt model – electric Quadrapole moment - Bohr and Mottelson collective model – rotational and vibrational bands.	15
2	**NUCLEAR FORCES:** Nucleon – nucleon interaction – Tensor forces – properties of nuclear forces – ground state of deuteron – Exchange Forces - Meson theory of nuclear forces – Yukawa potential – nucleon-nucleon scattering - effective range theory – spin dependence of nuclear forces– charge independence and charge symmetry – isospin formalism.	15
3	**NUCLEAR REACTIONS:** Kinds of nuclear reactions – Reaction kinematics – Q-value – Partial wave analysis of scattering and reaction cross section – scattering length – Compound nuclear reactions – Reciprocity theorem – Resonances – Breit Wigner one level formula – Direct reactions - Nuclear Chain reaction – four factor formula.	15
4	**NUCLEAR DECAY:** Beta decay – Continuous Beta spectrum – Fermi theory of beta decay - Comparative Half-life –Fermi Kurie Plot – allowed and forbidden decay -neutrino physics -mass of neutrino –- Helicity -Parity violation Gamma decay –multipole radiations – Angular Correlation - internal conversion – nuclear isomerism – angular momentum and parity selection rules.	15
5	**ELEMENTARY PARTICLES:** Classification of Elementary Particles – Types of Interaction and conservation laws – Families of elementary particles – Isospin – Quantum Numbers – Strangeness – Hypercharge and Quarks –SU (2) and SU (3) groups– Gell Mann Okuba Mass formula-Quark Model– Higgs boson.	15

CO	Course Outcomes Student will be able to
CO1	Understand the different the different nuclear models
CO2	Knowledge of fundamental aspects of the nuclear forces.
CO3	Use the different nuclear models to explain different nuclear phenomena and the concept of resonances.
CO4	Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion.
CO5	Summarize and identify conservation laws of the elementary particles.
Textbooks:	
1	D. C. Tayal – Nuclear Physics – Himalaya Publishing House (2011)
2	K. S. Krane – Introductory Nuclear Physics – John Wiley & Sons (2008)
3	R. Roy and P. Nigam – Nuclear Physics – New Age Publishers (1996)
4	S.Glasstone–Source Book of Atomic Energy –Van Nostrand Reinhold Inc.,U.S.- 3rd Revised edition (1968)
5	S. B. Patel – Nuclear Physics – An introduction – New Age International Pvt Ltd Publishers (2011)
Reference Books:	
1	L.J. Tassie–The Physics of elementary particles–Prentice Hall Press 1973.
2	H.A. Enge – Introduction to Nuclear Physics – Addison Wesley, Publishing Company. Inc. Reading. New York, (1974).
3	Kaplan – Nuclear Physics – 1989 – 2nd Ed. – Narosa (2002)
4	Bernard L Cohen – Concepts of Nuclear Physics – McGraw Hill Education (India) Private Limited; 1 edition (2001)
5	B.L. Cohen, 1971, Concepts of Nuclear Physics, TMCH, New Delhi.
Web resources:	
1	http://bubl.ac.uk/link/n/nuclearphysics.html
2	http://www.phys.unsw.edu.au/PHYS3050/pdf/Nuclear_Models.pdfhttp://www.scholarpedia.org/article/Nuclear_Forces
3	https://www.nuclear-power.net/nuclear-power/nuclear-reactions/
4	http://labman.phys.utk.edu/phys222core/modules/m12/nuclear_models.
5	https://www.ndeed.org/EducationResources/HighSchool/Radiography/radioactivedecay.

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	2	2	3	3	2
CO2	2	3	3	3	1	2	1	2	3	3	3
CO3	2	3	3	3	1	2	1	2	3	3	3
CO4	2	3	3	3	2	3	2	2	3	3	2
CO5	2	3	3	3	2	3	2	3	3	3	3
Total	15	10	15	10	10	10	15	10	12	12	10
Average	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2.4**	**2.4**	**2**

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE42	**Characterization of Materials**	**Elective**	5	1	0	0	4	6	25	75	100

Learning Objectives	
LO1	To learn about important thermal analysis techniques TGA, DTA, DSC and TMA.
LO2	To understand the theory of image formation in an optical microscope and other specialized microscopic techniques.
LO3	To know the working principle of electron microscopes and scanning probe microscopes.
LO4	To understand importance of electrical and optical characterization techniques for semiconducting materials.
LO5	To understand basics spectroscopic characterization technique diffraction techniques.

Unit	Content	Hours
1	**THERMAL ANALYSIS**: Introduction – Thermo gravimetric analysis (TGA)– HPTGA instrumentation –determination of weight loss and decomposition products – Differential thermal analysis (DTA) - cooling curves – Differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements. determination of thermo mechanical parameters.	15
2	**MICROSCOPIC METHODS:** Optical Microscopy: optical microscopy techniques – Bright field optical-microscopy – Dark field optical microscopy – Dispersion staining microscopy - phase contrast microscopy –differential interference contrast microscopy - confocal microscopy - digital holographic microscopy.	15
3	**ELECTRON MICROSCOPY AND SCANNING PROBE MICROSCOPY**: SEM, EDAX, and TEM: working principle and Instrumentation – sample preparation – Data collection, processing and analysis- Scanning tunneling microscopy (STEM) - Atomic force microscopy (AFM).	15
4	**ELECTRICAL METHODS AND OPTICAL CHARACTERIZATION:** Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations. Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.	15
5	**X RAY AND SPECTROSCOPIC METHODS**: Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy,NMR, XPS, and SIMS- Proton Induced X- ray Emission spectroscopy (PIXE) –Rutherford Back Scattering (RBS) analysis-application - Powder diffraction - Powder diffractometer -interpretation of diffraction patterns - indexing - phase identification - Particle size - X-ray fluorescence spectroscopy - uses.	15

CO	Course Outcomes Students will be able to
CO1	Describe the TGA, HPTGA, DSC and TMA thermal analysis techniques and make interpretation of the results
CO2	The concept of image formation in Optical microscope, developments in other specialized Microscopes and their applications.
CO3	The working principle and operation of SEM, TEM, STM and AFM.
CO4	Understood Hall measurement, four –probe resistivity measurement, C-V, I-V, Electrochemical, Photoluminescence and electroluminescence experimental techniques with necessary theory.
CO5	The theory and experimental procedure for important spectroscopic techniques and their applications.
Textbooks:	
1	R. A. Stradling and P. C. Klipstain. Growth and Characterization of semiconductors. Adam Hilger, Bristol, 1990.
2	J. A. Belk. Electron microscopy and microanalysis of crystalline materials. Applied Science Publishers, London, 1979.
3	Lawrence E. Murr. Electron and Ion microscopy and Microanalysis principles and Applications. Marcel Dekker Inc., New York, 1991
4	D. Kealey and P. J. Haines. Analytical Chemistry. Viva Books Private Limited, New Delhi, 2002.
5	Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press,(2008).
Reference Books:	
1	Cullity,B.D & Stock,R.S "Elements of X-Ray Diffraction", Prentice-Hall, (2001).
2	Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging,Wiley-Liss, Inc. USA, (2001).
3	Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009).Volumes 49 – 51, (2009).
4	Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986).
5	Wachtman,J.B., Kalman,Z.H., Characterization of Materials, Butterworth Heinemann, (1993)
Web resources:	
1	https://cac.annauniv.edu/uddetails/udpg_2015/77.%20Mat%20Sci(AC).pdf
2	http://www.digimat.in/nptel/courses/video/113106034/L11.html
3	https://nptel.ac.in/courses/104106122
4	https://www.sciencedirect.com/journal/materials-characterization

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	3	3	3
CO2	3	3	3	3	2	2	2	2	3	3	3
CO3	3	3	3	3	2	2	2	1	3	3	3
CO4	3	3	3	3	2	2	2	2	3	3	3
CO5	3	3	3	3	2	2	2	1	3	3	3
Total	12	13	12	11	10	12	15	10	15	15	15
Average	**2.4**	**2.6**	**2.4**	**2.2**	**2**	**2.4**	**3**	**2**	**3**	**3**	**3**

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHP41	**Sewage and Waste Water Treatment & Reuse**	PEC	1	1	0	0	2	2	25	75	100

Learning Objectives	
LO1	To gain basic knowledge in sewage and waste water Treatment procedures
LO2	To gain industry exposure and basic knowledge for disinfections.
LO3	To gain in-depth knowledge about chemical disinfections
LO4	To understand the basic knowledge of physical disinfection
LO5	To summarize the sewage and waste water management through industrial visit.

Unit	Content	Hours
1	**PLANNING AND DESIGN OF SEWERAGE SYSTEM** Characteristics and composition of sewage— Sewer materials — Hydraulics of flow in sanitary sewers — Sewer design — Storm drainage-Storm runoff estimation — sewer appurtenances — corrosion in sewers — prevention and control — sewage pumping-drainage in buildings-plumbing systems for drainage.	6
2	**RECOVERY & REUSE OF WATER** Recovery & Reuse of water from Sewage and Waste water: Methods of recovery: Flocculation - Sedimentation - Filtration - sand filters - pressure filters - vector control measures in industries - chemical and biological methods of vector eradication	6
3	**DISINFECTION** Disinfection: Introduction to disinfection and sterilization: Disinfectant - UV radiation - Chlorination - Antisepsis - Sterilant - Aseptic and sterile Bacteriostatic and Bactericidal - factors affecting disinfection.	6
4	**CHEMICAL DISINFECTION** Chemical Disinfection: Introduction - Theory of Chemical Disinfection - Chlorination Other Chemical Methods - Chemical Disinfection Treatments Requiring - Electricity - Coagulation/Flocculation Agents as Pretreatment - Disinfection By-Products(DBPs)	6
5	**PHYSICAL DISINFECTION** Physical Disinfection: Introduction - Ultraviolet Radiation - Solar Disinfection - Heat Treatment - Filtration Methods - Distillation - Electrochemical Oxidation Water Disinfection by Microwave Heating.	6

CO	Course Outcomes Students will able to
CO1	Understand the basic knowledge of recovery and reuse of water
CO2	Explore the basic disinfections and its usages
CO3	Understood the chemical disinfections and its treatment
CO4	Analysis the methods of physical disinfections
CO5	Adequaltely sensitize in managing solid waste in and around locality
Textbooks:	
1	Drinking water and disinfection technique, Anirudhha Balachandra. CRC press (2013)
2	Design of Water and Wastewater Treatment Systems (CV-424/434), Shashi Bushan, Jain Bros (2015)
3	Integrated Water Resources Management, Sarbhukan M M, CBS PUBLICATION (2013)
4	C.S. Rao, Environmental Pollution Control Engineering, New Age International, 2007
5	S.P. Mahajan, Pollution control in process industries, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
Reference Books:	
1	Handbook of Water and Wastewater Treatment Plant Operations, Frank. R Spellman, CRC Press, 2020
2	Wastewater Treatment Technologies, MritunjayChaubey, Wiley, 2021.
3	Metcalf and Eddy, Wastewater Engineering, 4th ed., McGraw Hill Higher Edu., 2002.
4	W. Wesley Eckenfelder, Jr., Industrial Water Pollution Control, 2nd Edn., McGraw Hill Inc., 1989
5	Lancaster, Green Chemistry: An Introductory Text, 2nd edition, RSC publishing, 2010.
Web resources:	
1	https://www.epa.gov/waterreuse/basic-information-about-water-reuse
2	https://www.meripustak.com/Integrated-Solid-Waste-Management EngineeringPrinciples- And-Management-Issues-125648?
3	https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALwwcB
4	https://www.meripustak.com&gclid=Cj0KCQjwuuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	3	3	3	3
CO2	3	2	3	3	2	3	3	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	3	3
CO4	3	2	3	3	2	2	3	3	3	3	3
CO5	3	2	3	3	2	3	3	3	3	3	3
Total	15	15	15	12	15	15	15	15	15	15	15
Average	**3**	**3**	**3**	**2.4**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

2nd YEAR: FOURTH SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHL41	**Solid Waste Management**	SLC	0	0	0	4	2	4	25	75	100

Learning Objectives

LO1	To gain basic knowledge in solid waste management procedures
LO2	To understand the characteristics and factors of solid waste
LO3	To equip the techniques in solid waste
LO4	To analyze the economic development in solid waste management.
LO5	To analysis the solid waste management through nearby locality

Unit	Content	Hours
1	**SOLID WASTE MANAGEMENT**: Introduction - Definition of solid waste - Types – Hazardous Waste: Resource conservation and Renewal act – Hazardous Waste: Physical and chemical characteristics of Municipal Solid waste and non-municipal solid waste.	12
2	**SOLID WASTE PROCESSING METHODS:** Describe processing steps of residential, commercial and industrial site - Processing of solid waste at residence - Storage, conveying, compacting, Shredding, pulping, granulating.- Processing of solid waste at commercial and industrial site.	12
3	**SOLID WASTE CHARACTERISTICS** Solid Waste Characteristics: Physical and chemical characteristics - SWM hierarchy - factors affecting SW generation	12
4	**TOOLS AND EQUIPMENT**: Tools and equipment - Transportation - Disposal techniques -Composting and land filling technique, advantages and disadvantage of land fill method, Recycling of municipal solid waste	12
5	**ECONOMIC DEVELOPMENT**: SWM for economic development and environmental protection Linking SWM and climate change and marine litter.	12

CO	Course Outcomes Students will be able to
CO1	Understand the knowledge in solid waste management
CO2	Analyze the characteristics and factors of solid waste
CO3	Comprehend the techniques in solid waste management
CO4	Interpret economic development in solid waste management
CO5	Observe and summarize the report based on solid waste management.
Textbooks:	
1	Handbook of Solid Waste Management /Second Edition, George Tchobanoglous, McGraw Hill (2002).
2	Prospects and Perspectives of Solid Waste Management, Prof. B BHosett, New Age International (P) Ltd (2006).
3	Solid and Hazardous Waste Management, Second Edition, M.N Rao, BS Publications/ BSPBooks (2020).
4	Integrated Solid Waste Management Engineering Principles and Management, Tchobanoglous, McGraw Hill (2014).
5	Solid Waste Management (SWM), Vasudevan Rajaram, PHI learning private limited, 2016
Reference Books:	
1	Municipal Solid Waste Management, Christian Ludwig, Samuel Stucki, Stefanie Hellweg, Springer Berlin Heisenberg, 2012
2	Solid Waste Management Bhide A. D Indian National Scientific Documentation Centre, New Delhi Edition 1983 ASIN: B0018MZ0C2
3	Solid Waste Techobanoglous George; Kreith, Frank McGraw Hill Publication, New Delhi 2002, ISBN 9780071356237
4	Environmental Studies Manjunath D. L. Pearson Education Publication, New Delhi, 20061SBN-I3: 978-8131709122
5	Solid Waste Management Sasikumar K. PHI learning, New Delhi, 2009 ISBN 8120338693
Web resources:	
1	https://www.britannica.com/technology/solid-waste-management
2	https://2ch458npc.wordpress.com/wp-content/uploads/2014/12/3-properties-of-solid-waste.pdf
3	https://www.tpsmfg.com/solid-waste-management-machinery-equipments.php
4	http://www.sandeeonline.org/uploads/documents/publication/839_PUB_Economics_of_SWM.pdf
5	https://eacpm.gov.in/wp-content/uploads/2024/05/Solid_Waste_management_Updated.pdf

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	2	3	3	3	3	3
CO2	3	2	3	3	3	2	3	3	3	3	3
CO3	3	2	3	3	3	2	3	3	3	3	3
CO4	3	2	3	3	3	2	3	3	3	3	3
CO5	3	2	3	3	3	2	3	3	3	3	3
Total	13	10	10	12	12	10	10	9	9	11	12
Average	**2.6**	**2**	**2**	**2.4**	**2.4**	**2**	**2**	**1.8**	**1.8**	**2.2**	**2.4**