



**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 2024-25

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1. Preamble

Physics is the most of basic of sciences. It seeks to understand natural phenomena in a quantitative manner, and to answer some of the oldest and deepest questions ever asked by human beings: What are things made of? Is there a limit to the smallest things that we can think of? Did the world have a beginning? Will it have an end? At the same time, it provides the base of much of the technology that we take for granted in the 21st century: computers, artificial satellites, mobile phones, TV, microwave oven. Indeed, it will not be an exaggeration to say that modern human life is shaped by technologies that are largely based on a foundation of physics. Physics as a discipline has existed for three hundred years and has a large 'core' body of knowledge. Our M.Sc. programme lays emphasis on the courses that constitute this core component, while providing students with a bouquet of optional papers covering almost all branches of physics. Those who wish to pursue higher studies in the subject are thereby well equipped to choose their branch of study. The programme also aims at equipping future teachers (at college as well school level) with a thorough grounding in the subject. Since physics is the base of much of modern technology, the programme also gives adequate hands-on experience to students who may go on to work in applied fields. Finally, viewing physics as a training ground for the mind the programme also aims to equip those who go into other fields of work with logical thinking and a critical attitude.

PROGRAMME OUTCOMES (PO)

Programme	M.Sc., Physics
Programme Code	PS07
Duration	2 Years[PG]
Programme Outcomes	<p>PO1: Acquire knowledge in Physics to apply the knowledge in their day-to-day life for betterment of self and society.</p> <p>PO2: Develop critical, analytical thinking and problem-solving skills</p> <p>PO3: Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data.</p> <p>PO4: Address and develop solutions for societal and environmental needs of local regional and national development.</p> <p>PO5: Work independently and engage in lifelong learning and enduring proficient progress.</p> <p>PO6: Provoke employability and entrepreneurship among students along with ethics and communication skills.</p> <p>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.</p> <p>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.</p>
Programme Specific Outcomes:	<p>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.</p> <p>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.</p> <p>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.</p>

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							Semester - II								
Code	Course Title	Hours Distribution				C	Code	Course Title	Hours Distribution				C		
		L	T	P	S				L	T	P	S			
24PPHC11	CC - Mathematical Physics	4	1	0	0	4	24PPHC21	CC-Statistical Mechanics	5	0	0	0	4		
24PPHC12	CC - Classical Mechanics and Relativity	4	1	0	0	4	24PPHC23	CC - Quantum Mechanics – I	5	0	0	0	4		
24PPHC13P	CC – Practical I – Analog and Digital Experiments	0	0	5	0	3	24PPHC24	CC - Electromagnetic Theory	5	0	0	0	4		
24PPHE11	DSEC - 1 Linear and Digital ICs and Applications	3	0	1	0	3	24PPHC22P	CC - Practical II - General Experiments	0	0	5	0	2		
24PPHE12	EC – 1. Crystal growth and Thin Films/ 2. Analysis of Crystal Structures	3	0	1	0	3	24PPHE21	DSEC I - Advanced Optics	4	0	0	0	3		
24PPHA11	AECC - Solar energy utilization	1	1	0	0	3	24PPHE22	DSEC II - Physics of Nanoscience and Technology	4	0	0	0	3		
24PCHR11	VE - 1 Human Rights	1	1	0	0	3	24PPHS21	SEC /NM- Renewable Energy and Energy Harvesting	2	0	0	0	2		
TOTAL						30	21	TOTAL						30	22

L-Lecture T-Tutorial P-Practical S-Seminar C-Credit

Students must complete at least one online course (MOOC) from platforms like SWAYAM, NPTEL, or Nanmulalvan 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*.

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC11	MATHEMATICAL PHYSICS	Core	4	1	0	0	4	6	25	75	100
Learning Objectives											
LO1	To equip students with the mathematical techniques needed for understanding theoretical treatment in different courses taught in their program.										
LO2	To extend their manipulative skills to apply mathematical techniques in their fields.										
LO3	To help students apply Mathematics in solving problems of Physics.										
LO4	To give a basic idea about different methods of mathematics, used in Physics.										
LO5	To Understand the linear equations, vector spaces, matrices, linear transformations, determinants, eigen values, eigen vectors, etc.										
Unit	Content										Hours
1	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.										15
2	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.										15
3	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.										15
4	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 –										15

	Differentiation and integration of transforms - Dirac delta functions - Application - Laplace equation: Potential problem in a semi - infinite strip.	
5	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.	15

CO	Course Outcomes
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.
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.
CO3	Analyze characteristics of matrices and their different types, and the process of diagonalization.
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.
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.

Textbooks:

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	Satyaprakash, Mathematical Physics -Sultan Chand & sons, New Delhi, 2016.
4	B.D. Gupta, Mathematical Physics (4th edition) 2009, Vikas Publishing House, New Delhi.
5	K. Dass and Dr. Rama Verma, Mathematical Physics, 2014, 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, 6th Edition, International Edition, McGraw-Hill, New York.

Web resources:	
1	www.khanacademy.org
2	https://youtu.be/LZnRIOA1_2I
3	http://hyperphysics.phy-astr.gsu.edu/hbase/hmat.html#hmath
4	https://www.youtube.com/watch?v=_2jymuM7OUU&list=PLhkiT_RYTEU27vS_SIED56gNjVJGO2qaZ
5	https://archive.nptel.ac.in/courses/115/106/115106086/

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	3	2	3	3	3
CO2	2	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	2	2	3	3	2	3	3	3
CO4	3	3	3	3	2	3	3	2	3	3	3
CO5	3	2	3	3	2	3	3	2	3	3	3
Total	13	14	15	14	12	15	15	10	15	15	15
Average	2.6	2.8	3	2.8	2.4	3	3	2	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC12	CLASSICAL MECHANICS AND RELATIVITY	Core	5	1	0	0	4	6	25	75	100
Learning Objectives											
LO1	To understand fundamentals of Classical Mechanics.										
LO2	To understand Lagrangian formulation of mechanics and apply it to solve equation of motion.										
LO3	To understand Hamiltonian formulation of mechanics and apply it to solve equation of motion.										
LO4	To discuss the theory of small oscillations of a system.										
LO5	To learn the relativistic formulation of mechanics of a system.										
Unit	Content										Hours
1	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.										15
2	D'Alembert's principle – Lagrangian equations of motion for conservative systems – applications: (i) simple pendulum (ii) Atwood's machine (iii) projectile motion.										15
3	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.										15
4	Formulation of the problem – transformation to normal coordinates – frequencies of normal modes – linear triatomic molecule.										15
5	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.										15

CO	Course Outcomes
CO1	Understand the fundamentals of classical mechanics.
CO2	Apply the principles of Lagrangian and Hamiltonian mechanics to solve the equations of motion of physical systems.
CO3	Students learn about motion of a particle under central force field.
CO4	Analyze the small oscillations in systems and determine their normal modes of oscillations.
CO5	Understand and apply the principles of relativistic kinematics to the mechanical systems.
Textbooks:	
1	H. Goldstein, 2002, Classical Mechanics, 3rd Edition, Pearson Edu.
2	J. C. Upadhyaya, Classical Mechanics, Himalaya Publishing. 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 resources:	
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/lecturenotes/
5	https://www.britannica.com/science/relativistic-mechanics

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	3	3	3	3
CO2	2	3	3	3	2	2	2	3	2	3	3
CO3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3	3
CO5	2	3	3	3	2	2	2	3	3	2	3
Total	10	15	15	15	10	10	10	15	14	14	15
Average	2	3	3	3	2	2	2	3	2.8	2.8	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC13P	Analog and Digital Experiments	PP-C	0	0	5	0	3	5	25	75	100
Learning Objectives											
LO1	To observe the applications of FET and UJT.										
LO2	To study the different applications of operational amplifier circuits.										
LO3	To learn about Combinational Logic Circuits and Sequential Logic Circuits										
LO4	To study the applications of Timer IC										
LO5	Exposure to digital ICs										
Unit	Content										Hours
	<p style="text-align: center;">(Minimum of Ten Experiments from the list)</p> <ol style="list-style-type: none"> 1. Construction of (a) Relaxation oscillator using UJT (2N2646), (b) FET as amplifier using (BFW10/BFW11) - Frequency response curve. 2. To study (a) The important electrical characteristics of IC 741 (i/p and o/p impedance, Voltage Gain, CMRR). (b) V-I Characteristics of different colours of LED. 3. Study of attenuation characteristics of Wien's bridge network and design of Wien's bridge oscillator using Op-Amp. 4. Study of attenuation characteristics of phase shift network and design of phase shift oscillator using Op-Amp. 5. Construction of Schmidt triggers circuit using IC 741 for a given hysteresis (both AC & DC Mode) - Application as squarer. 6. Construction of square wave and triangular wave generator using IC741 7. Construction of pulse generator using the IC741–Application as frequency Divider Study of (a) Arithmetic operations using IC 7483- 4-bit binary addition & subtraction and (b) Arithmetic Logic Unit using IC 74181. 8. Construction of current to voltage and voltage to current conversion using IC741. 9. Realization of analog to digital converter (ADC) using 4-bit DAC and synchronous counter IC74193 10. Construction of Schmidt trigger circuit using IC 555 for a given hysteresis (both AC & DC Mode)– Application as Squarer 11. Construction of pulse generator using the IC 555–Application as frequency divider 										60

	<p>12. Study of 4-bit binary Up / Down counters, Ring counter and Johnson counter- IC 7476/IC 7473</p> <p>13. IC 7490 as scalar /Modulus counter and seven segment display using IC 7447 / IC 7448</p> <p>14. Solving simultaneous equations – IC 741/ IC LM 324</p> <p>15. Op-Amp–Active filters: Butter worth filter Low pass, High pass and band pass filters (2ndorder)</p> <p>16. Construction of Op-Amp-4-bit D/A converter (Binary weighted and R-2R Ladder type)</p> <p>17. Construction of square wave generator using IC 555–Study of VCO</p> <p>18. Study of asynchronous parallel 4-bit binary Up/Down counter using IC 7493</p> <p>19. Construction of multiplexer and demultiplexer using ICs.</p>	
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CO	Course Outcomes
CO1	Understand the applications of FET and UJT.
CO2	Apply the applications of operational amplifier circuits.
CO3	Analysis the Combinational Logic Circuits and Sequential Logic Circuits
CO4	Understand the apply the applications of Timer IC
CO5	Analysis the digital ICs
Textbooks:	
1	R.Srinivasan K.R Priolkar, Kit Developed for doing experiments in Physics Instruction manual, Indian Academy of Sciences.
2	S. Poornachandra, B.Sasikala,Electronic Laboratory Primer a design approach, Wheeler Publishing, New Delhi.
3	K ANavas Electronic lab manual Vol I, Rajath Publishing.
4	K ANavas, Electronic lab manual Vol II, PHI eastern Economy Edition
Reference Books:	
1	Ramakanth A Gaykwad, Op-Amp and linear integrated circuit, Eastern Economy Edition.
2	R.S. Sirohi, A course on experiment with He-Ne Laser, John Wiley & Sons (Asia) Pvt. Ltd.
3	Kuriachan T.D, Syam Mohan, Electronic lab manual Vol II, Ayodhya Publishing.

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	3	3	3	3
CO2	2	3	3	3	2	2	2	3	2	3	3
CO3	2	3	3	3	2	2	2	3	3	3	3
CO4	2	3	3	3	2	2	2	3	3	3	3
CO5	2	3	3	3	2	2	2	3	3	2	3
Total	10	15	15	15	10	10	10	15	14	14	15
Average	2	3	3	3	2	2	2	3	2.8	2.8	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE11	LINEAR AND DIGITAL ICs AND APPLICATIONS	DS EC	4	0	1	0	3	5	25	75	100
Learning Objectives											
LO1	To introduce the basic building blocks of linear integrated circuits.										
LO2	To teach the linear and non-linear applications of operational amplifiers.										
LO3	To introduce the theory and applications of PLL.										
LO4	To introduce the concepts of waveform generation and introduce one special function ICs.										
LO5	Exposure to digital ICs										
Unit	Content										Hours
1	Introduction, Classification of ICs, basic information of Op-Amp 741 and its features, the ideal Operational amplifier, Op-Amp internal circuit. Characteristics and parameters, Inverting and Non-inverting amplifier, adder, subtraction, differentiator and Integrator.										12
2	Linear Applications of Op-Amp: Solution to simultaneous 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, Comparators, Schmitt trigger, Multivibrators, Triangular and Square waveform generators.										12
3	Active Filters: Introduction, Butterworth filters – 1st order, 2nd order low pass and high 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, voltage-controlled oscillator (IC 566), applications of PLL										12
4	Voltage Regulator: Introduction, Series Op-Amp regulator, IC Voltage Regulators, Switching Regulator. D To A And A To D Converters: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, A to D converters - counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.										12
5	Cmos Logic: CMOS logic levels, MOS transistors, Basic CMOS Inverter, NAND and NOR gates. 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).										12

CO	Course Outcomes
CO1	Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems.
CO2	Develop skills to design linear and non-linear applications circuits using Op-Amp and design the active filters circuits.
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.
CO4	Learn about various techniques to develop A/D and D/A converters.
CO5	Acquire the knowledge about the CMOS logic, combinational and sequential circuits.
Textbooks:	
1	D. Roy Choudhury, Shail B. Jain (2012), Linear Integrated Circuit, 4th edition, New Age International Pvt. Ltd., New Delhi, India
2	Ramakant A. Gayakwad, (2012), OP-AMP and Linear Integrated Circuits, 4th edition, Prentice Hall / Pearson Education, New Delhi.
3	V. Vijayendra, 2008, Introduction to Integrated electronics (Digital & Analog), S. Viswanathan Printers & Publishers Private Ltd, Reprint. V.
4	D. Roy Choudhary, Sheil B. Jani, "Linear Integrated Circuits", II edition, New Age, 2010.
5	David A. Bell, "Op-amp & Linear ICs", Prentice Hall of India, 5th edition, 1998.
Reference Books:	
1	B. L. Theraja and A. K. Theraja, 2004, A textbook of electrical technology, S. Chand & Co
2	V. K. Mehta and Rohit Mehta, 2008, Principles of Electronics, S. Chand & Co, 12th Edition.
3	Malvino and Leach (2005), Digital Principles and Applications 5th Edition, Tata McGraw Hill, New Delhi.
4	Floyd, Jain (2009), Digital Fundamentals, 8th edition, Pearson Education, New Delhi.
5	Integrated Electronics, Millman & Halkias, Tata McGraw Hill, 17th Reprint (2000).
Web resources:	
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-effectcontrolled-thyristors/
4	https://www.electrical4u.com/applications-of-op-amp/
5	https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

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	3	3	3	3	3
CO2	3	3	3	3	1	3	3	3	2	3	3
CO3	3	3	3	3	1	3	3	3	3	3	3
CO4	3	3	3	3	1	3	3	3	3	3	3
CO5	3	3	3	2	1	1	2	3	3	2	2
Total	15	15	15	14	6	12	14	15	14	14	14
Average	3	3	3	2.8	1.2	2.4	2.8	3	2.8	2.8	2.8

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE12	CRYSTAL GROWTH AND THIN FILMS	ELE - II	4	0	1	0	3	5	25	75	100
Learning Objectives											
LO1	To acquire the knowledge on Nucleation and Kinetics of crystal growth.										
LO2	To understand the Crystallization Principles and Crystal Growth techniques.										
LO3	To study various methods of Crystal growth techniques.										
LO4	To understand the thin film deposition methods.										
LO5	To understand the different characterization techniques.										
Unit	Content										Hours
1	Introduction to crystal growth – Solubility – Unsaturation - Saturation – Supersaturation –Metastable Zone width – Nucleation – homogeneous and heterogeneous nucleation – Classical theory of nucleation: Gibbs Thomson equation for Vapour - Gibbs Thomson equation for solution – Energy of formation of a nucleus – Spherical nucleus – Cylindrical nucleus – Cap-Shaped nucleus - BCF theory.										12
2	Crystal Growth Mechanisms – Solid phase – Liquid Phase and Vapour Phase crystal growth - Bridgman technique - Czochralski method – zone melting - Skull Melting process - Verneuil technique –Methods of Crystallization: Slow cooling method – Slow evaporation method – Temperature gradient method - Gel growth – Vapour growth: PVD – CVD – Epitaxial Techniques: LPE - MOCVD – MBE – Hydrothermal Growth.										12
3	Symmetry operations, elements – Combination of symmetry elements (Point group) –Symmetry properties of the energy function – Common crystal structures – Voids in close packing - Pauling’s rule - Defects in crystals – Polycrystalline - Amorphous - Polymorphism.										12
4	Thin Films – Basic of Thin films and Nanostructures: Chemical deposition – Spin coating – Electron beam gun - Spray pyrolysis - Sputtering – RF Sputtering - Reactive Sputtering - Cathodic arc deposition - Pulsed Laser Deposition Technique - Ion implantation.										12
5	Powder X – Ray Diffraction (XRD) – Single crystal XRD – Laue pattern – Spectrometry: UV-Vis-NIR Spectrometer - Fourier transform Infrared analysis (FT-IR) – Elemental analysis: Nuclear Magnetic Resonance (NMR) – Elemental dispersive X-ray analysis (EDAX) - Scanning Electron Microscopy (SEM) – Transmission Electron Microscopy (TEM) – Atomic Force Microscopy (AFM) – Luminescence: Thermo Luminescence – Photoluminescence – Etching Studies (Chemical) – Micro hardness tests – Vickers – Brinells– TGA – DTA - Dielectric studies –SHG tests.										12

CO	Course Outcomes
CO1	Acquire the Basic Concepts, Nucleation and Kinetics of crystal growth.
CO2	Understand the Crystallization Principles and Growth techniques.
CO3	Study various methods of Crystal growth techniques.
CO4	Understand the Thin film deposition methods.
CO5	Apply the techniques of Thin Film Formation and thickness Measurement.
Textbooks:	
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	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 resources:	
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/

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	3	2	2	3	2	1
CO2	3	3	1	3	1	2	3	2	3	3	1
CO3	3	2	1	3	1	2	3	3	3	2	1
CO4	3	2	1	2	1	2	3	3	3	2	1
CO5	2	3	3	3	1	3	3	3	2	3	3
Total	14	12	7	13	5	12	14	13	14	12	7
Average	2.8	2.4	1.4	2.6	1	2.4	2.8	2.6	2.8	2.4	1.4

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHA11	SOLAR ENERGY UTILIZATION	AEC	1	1	0	0	2	2	25	75	100
Learning Objectives											
LO1	To impart fundamental aspects of solar energy utilization.										
LO2	To give adequate exposure to solar energy related industries.										
LO3	To harness entrepreneurship skills.										
LO4	To understand the different types of solar cells and channelizing them to the different sectors of society.										
LO5	To develop an industrialist mindset by utilizing renewable source of energy.										
Unit	Content										Hours
1	Conduction, Convection and Radiation – Solar Radiation at the earth’s surface - Determination of solar time – Solar energy measuring instruments.										6
2	Physical principles of conversion of solar radiation into heat flat plate collectors - General characteristics – Focusing collector systems – Thermal performance evaluation of optical loss.										6
3	Types of solar water heater - Solar heating system – Collectors and storage tanks – Solar ponds – Solar cooling systems.										6
4	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.										6
5	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.										6

CO	Course Outcomes
CO1	Gained knowledge in fundamental aspects of solar energy utilization
CO2	Equipped to take up related job by gaining industry exposure.
CO3	Develop entrepreneurial skills.
CO4	Skilled to approach the needy society with different types of solar cells.
CO5	Gained industrialist mindset by utilizing renewable source of energy.
Textbooks:	
1	Solar energy utilization -G.D. Rai –Khanna publishers – Delhi 1987.
2	Maheshwar Sharon, Madhuri Sharon, Carbon “Nano forms and Applications”, Mc Graw-Hill, 2010.
3	Soteris A. Kalogirou, Solar Energy Engineering: Processes and Systems“, 92
4	Tiwari G.N, “Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002
5	Sukhatme S.P. Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
Reference Books:	
1	Energy – An Introduction to Physics – R.H.Romer, W.H.Freeman.(1976)
2	Solar energy thermal processes – John A.Drife and William. (1974)
3	John W. Twidell& Anthony D.Weir, ‘Renewable Energy Resources,2005
4	John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, John Wiley and Sons, 2013
5	Edition, John Wiley and Sons, 2013 5. Duffie, J.A., Beckman, W.A. , “Solar Energy Thermal Process”, John Wiley and Sons,2007.
Web resources:	
1	https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb
2	https://books.google.vg/books?id=l-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read
3	www.nptel.ac.in/courses/112105051
4	www.freevideolectures.com
5	http://www.e-booksdirectory

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	2	2	1	2	2	2
CO2	2	3	3	2	2	2	2	1	2	2	2
CO3	2	3	2	2	2	2	2	2	2	2	2
CO4	1	3	2	3	2	3	2	2	2	2	2
CO5	2	3	2	2	2	2	2	2	2	2	2
Total	9	15	12	11	10	11	10	8	10	10	10
Average	1.8	3	2.4	2.2	2	2.2	2	1.6	2	2	2

3 – Strong, 2- Medium, 1- Low

1st YEAR: FIRST SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PCHR101	HUMAN RIGHTS	COMPULSORY	1	1	0	0	2	2	25	75	100

Learning Objectives

LO1	To provide a comprehensive idea of English literature and language over the ages										
LO2	To help student trace English literature dating from seventh century to present era										
LO3	To help them to understand the structural development of the English language										
LO4	To inform them about the various external linguistic influences										
LO5	To create the ability of critically examining a text										
Unit	Content										Hours
1	Human rights- Concepts and Nature										6
2	Human Rights – The International Perspective International human rights										6
3	Regional Human Rights										6
4	Human Rights in India										6
5	Human Right Violations and Redressal Mechanism										6

CO	Course Outcomes
CO1	The student will be able to know the nature of human rights its origin, the theories, the movements in the march of human rights and the facets of future of human rights.
CO2	The student will be able to know the international dimension of human rights, the role of UN and the global effort in formulating conventions and declarations
CO3	The student will be able to Perceive the regional developments of human rights in Europe, Africa and Asia and the enforceable value of human rights in international arena.
CO4	The student will be able to have knowledge on the human rights perspectives in India, more developed by its constitution and special legislations
CO5	The student will be able to know the redressal mechanism made available in case of human rights violation confined to India.

Textbooks:	
1	Human Rights Lalit Parmar, Anmol Publications Pvt. Limited, 1998
2	Alston, Philip, And Frederic Megret, Eds. The United Nations And Human Rights: A Critical Appraisal. Second Edition. Oxford University Press, 2014.
3	Rebecce Wallace, International Human Rights, Text And Materials 1997
4	Human Rights Bharatiya Values, Mandagadde Rama Jois, Bharatiya Vidya Bhavan, 2015
5	G S Bhargave and R M Pal Human Rights of Dalit Societal Violation 1999

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	3	3	3	2
CO2	2	3	3	2	2	3	2	2	2	3	2
CO3	3	3	2	2	3	2	3	2	3	2	2
CO4	3	3	3	3	2	3	3	2	3	2	2
CO5	3	2	3	3	3	3	2	2	2	3	3
Total	14	14	14	13	13	13	13	11	13	13	11
Average	2.8	2.8	2.8	2.6	2.6	2.6	2.6	2.2	2.6	2.6	2.2

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC21	STATISTICAL MECHANICS	Core	5	0	0	0	4	5	25	75	100
Learning Objectives											
LO1	To acquire the knowledge of thermodynamic potentials and to understand phase transition in thermodynamics										
LO2	To identify the relationship between statistic and thermodynamic quantities										
LO3	To comprehend the concept of partition function, canonical and grand canonical ensembles										
LO4	To grasp the fundamental knowledge about the three types of statistics										
LO5	To get in depth knowledge about phase transitions and fluctuation of thermodynamic properties that vary with time										
Unit	Content										Hours
1	Phase transitions - Conditions for phase equilibrium - Clausius Clayperon equation - Gibbs Phase rule - order parameters - Landau theory - critical indices. Thermodynamic potentials, Maxwells relations, chemical potential -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 transformation and dimensional analysis.										15
2	Foundations of statistical mechanics -- micro and macro 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.										15
3	Trajectories and density of states - Liouville's theorem – Canonical and grand canonical ensembles - canonical distribution - Partition function - Calculation of statistical quantities - Energy and density fluctuations.										15
4	Density matrix - Statistics of ensembles - Statistics of indistinguishable particles - Postulates of classical Statistics - Maxwell-Boltzmann statistics - Postulates of quantum statistics Fermi-Dirac statistics – Ideal Fermi gas – Degeneracy - Bose-Einstein statistics – Plank radiation formula - Ideal Bose gas - Bose-Einstein condensation.										15
5	Cluster expansion for a classical gas - Virial equation of state – Calculation of the first Virial coefficient in the cluster expansion - Ising model – definition - Mean-field theories of the Ising model in three, two and one dimensions - Exact solutions in one dimension. Correlation of space-time dependent fluctuations - Fluctuations and transport phenomena - Brownian motion - Langevin's theory – Fluctuation dissipation theorem - The Fokker-Planck equation										15

CO	Course Outcomes
CO1	To examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition
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
CO3	Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermodynamical quantities and partition function
CO4	To recall and apply the different statistical concepts to analyze the behaviour of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics
CO5	To discuss and examine the thermodynamical behaviour of gases under fluctuation and also using Ising model
Textbooks:	
1	S. K. Sinha, 1990, Statistical Mechanics, Tata McGraw Hill, New Delhi.
2	Sathya Prakash and J.P Agarwal, Statistical Mechanics, 7th Edition, Kedar Nath and Ram Nath& Co, Meerut, 1994
3	B. K. Agarwal and M. Eisner, 1998, Statistical Mechanics, Second Edition New Age International, New Delhi.
4	J. K. Bhattacharjee, 1996, Statistical Mechanics: An Introductory Text, Allied Publication, New Delhi.
5	F. Reif, 1965, Fundamentals of Statistical and Thermal Physics, McGraw -Hill, New York.
Reference Books:	
1	R. K. Pathria, 1996, Statistical Mechanics, 2nd edition, Butter Worth Heinemann, 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	M. K. Zemansky, 1968, Heat and Thermodynamics, 5th edition, McGraw-Hill New York.
5	W. Greiner, L. Neiseand H.Stoecker, Thermodynamics and Statistical Mechanics, Springer Verlang, New York.
Web resources:	
1	https://byjus.com/chemistry/third-law-of-thermodynamics/
2	https://web.stanford.edu/~peastman/statmech/thermodynamics
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

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	2	3	1	3	3	3
CO2	3	3	3	1	1	2	3	1	3	3	3
CO3	3	3	3	1	1	2	3	2	3	3	3
CO4	3	3	3	1	1	2	3	2	3	3	3
CO5	3	3	3	1	1	2	3	1	3	3	3
Total	15	15	15	5	5	10	15	7	15	15	15
Average	3	3	3	1	1	2	3	1.4	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC23	Quantum Mechanics -I	CC	5	0	0	0	4	5	25	75	100
Learning Objectives											
LO1	To develop the physical principles and the mathematical background important to quantum mechanical descriptions.										
LO2	To describe the propagation of a particle in a simple, one-dimensional potential.										
LO3	To formulate and solve the Schrodinger's equation to obtain eigenvectors and energies for particle in a three-dimensional potential.										
LO4	To explain the mathematical formalism and the significance of constants of motion, and see their relation to fundamental symmetries in nature.										
LO5	To discuss the Approximation methods like perturbation theory, Variational and WKB methods for solving the Schrödinger equation.										
Unit	Content										Hours
1	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 – Uncertainty relation.										15
2	Square – well potential with rigid walls – Square well potential with finite walls – Square potential barrier – Alpha emission – 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.										15
3	Dirac notation – Equations of motions – Schrodinger representation – Heisenberg representation – Interaction representation – Coordinate representation – Momentum representation – Symmetries and conservation laws – Unitary transformation.										15
4	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 - WKB quantization – Application to simple harmonic oscillator.										15
5	Eigen value spectrum of general angular momentum – Ladder operators–Matrix representation–Spin angular momentum–Addition of angular momenta–CG Coefficients–Symmetry and anti-symmetry of wave functions–Pauli's exclusion principle.										15

CO	Course Outcomes
CO1	Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics.
CO2	Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems.
CO3	Can discuss the various representations, space time symmetries and formulations of time evolution.
CO4	Can formulate and analyze the approximation methods for various quantum mechanical problems.
CO5	To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.
Textbooks:	
1	P. M. Mathews and K. Venkatesan, A Text book of Quantum Mechanics, 2 nd 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, 1 st Edition, S. Chand & Co., New Delhi, 1982.
5	Sathya prakash & Swati saluja, Quantum Mechanics edition 2013.
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, NewDelhi, 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 resources:	
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

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	3	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	3	3	3	3	3	3
Total	14	15	15	13	15	12	15	12	15	15	15
Average	2.8	3	3	2.6	3	2.4	3	2.4	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC24	Electromagnetic Theory	CC	5	0	0	0	4	5	25	75	100
Learning Objectives											
LO1	To acquire knowledge about boundary conditions between two same media or different media and the technique of method of separation of variables										
LO2	To understand Biot – Savart’s law , Ampere’s circuital law and Magnetic induction										
LO3	To comprehend the physical ideas contained in Maxwell’s equations, Coulomb & Lorentz gauges, conservation laws										
LO4	To assimilate the concepts of propagation, polarization, reflection and refraction of electromagnetic waves										
LO5	To grasp the concept of plasma as the fourth state of matter and Debye shielding										
Unit	Content										Hours
1	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, polarization vector, relation between polarisation vector and Electric field , displacement vectors - Boundary conditions – Dielectric sphere in a uniform field – Molecular polarizability and electrical susceptibility – Electrostatic energy in the presence of dielectric – Multipole expansion										15
2	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.										15
3	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 –conservation of energy - Lorentz force in the resence of electric field and magnetic field- Conservation laws for a system of charges and electromagnetic fields.										15
4	Plane waves in non-conducting media - Linear and circular polarization, reflection and refraction at a plane interface - Waves in a conducting medium - Propagation of waves in a rectangular wave guide. Inhomogeneous wave equation and retarded potentials - Radiation from a localized source - Oscillating electric dipole										15
5	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.										15

CO	Course Outcomes
CO1	Solve the differential equations using Laplace equation three dimensional as well as one dimension and to find solutions for boundary value problems
CO2	Use Biot-Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems
CO3	Apply Maxwell's equations to describe how electromagnetic field behaves in different media for example isotropic, dielectric and medium
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 and retarded potentials
CO5	Investigate the interaction of ionized gases with self-consistent electric and magnetic fields
Textbooks:	
1	D.J.Griffiths, Introduction to Electrodynamics, 2002, 3rd Edition, Prentice-Hall of India, New Delhi.
2	J. R. Reitz, F. J. Milford and R. W. Christy, 1986, Foundations of Electromagnetic Theory, 3rd edition, Narosa Publishing House, New Delhi.
3	B. Chakraborty, 2002, Principles of Electrodynamics, Books and Allied, Kolkata
4	P. Feynman, R. B. Leighton and M. Sands, 1998, The Feynman Lectures on Physics, Vols. 2, Narosa Publishing House, New Delhi.
5	Andrew Zangwill, 2013, Modern Electrodynamics, Cambridge University Press, USA.
Reference Books:	
1	W. Panofsky and M. Phillips, 1962, Classical Electricity and Magnetism, Addison Wesley, London.
2	J. D. Kraus and D. A. Fleisch, 1999, Electromagnetics with Applications, 5th Edition, WCB McGraw-Hill, New York
3	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 resources:	
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-andmagnetism/electrostatics

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	3	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	3	3	3	3	3	3
Total	14	15	15	13	15	12	15	12	15	15	15
Average	2.8	3	3	2.6	3	2.4	3	2.4	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHC22P	Practical II - General Experiments	CC - P	0	0	5	0	2	5	25	75	100
Learning Objectives											
LO1	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										
LO2	To describe the propagation of a particle in a simple, one-dimensional potential.										
LO3	To understand the working of LASER light										
LO4	Learn the principles of magneto-optic and electro-optic effects and its applications.										
LO5	To impart an extensive understanding of fiber and non-linear optics.										
Unit	Content										Hour
1	<p style="text-align: center;">(Minimum of Eight Experiments from the list)</p> <ol style="list-style-type: none"> 1. Determination of Young's modulus by Hyperbolic fringes-Cornu's Method 2. Determination of Young's modulus by Elliptical fringes - Cornu's Method 3. Determination of Viscosity of the given liquid – Meyer's disc 4. Measurement of Coefficient of linear expansion- Air wedge Method 5. Determination of Rydberg's Constant - Hydrogen Spectrum 6. Thickness of air film - FP Etalon 7. Measurement of Band gap energy- Thermistor 8. Determination of Specific charge of an electron – Thomson's method. 9. Determination of e/m - Millikan's method 10. Determination of Wavelength, Separation of wavelengths - Michelson Interferometer 11. Measurement of Resistivity/Conductivity - Four probe method. 12. Measurement of wavelength of Diode Laser / He – Ne Laser using Diffraction grating. 13. Determination of Stefan's constant of radiation from a hot body 14. Measurement of Susceptibility of liquid - Quincke's method 15. Determination of Numerical Apertures and Acceptance angle of optical fibers using Laser Source. 16. Determination of I-V Characteristics and efficiency of solar cell 										

CO	Course Outcomes
CO1	Understand the strength of material using Young's modulus
CO2	Acquire knowledge of thermal behavior of the materials
CO3	Understand theoretical principles of magnetism through the experiments.
CO4	Acquire knowledge about arc spectrum and applications of laser
CO5	Improve the analytical and observation ability in Physics Experiments
Textbooks:	
1	Gupta and Kumar, Practical Physics, Pragati Prakasan
2	R.Srinivasan K.R Priolkar, Kit Developed for doing experiments in Physics Instruction manual, Indian Academy of Sciences
Reference Books:	
1	D.Chattopadhyay, C.R. Rakshit, An advanced course in Practical Physics, New Central Book Agency Pvt. Ltd
2	S.P Singh, Advanced Practical Physics, Pragati Prakasan
3	R.S. Sirohi, A course on experiment with He-Ne Laser, John Wiley & Sons (Asia) Pvt.ltd.

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	3	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	3	3	3	3	3	3
Total	14	15	15	13	15	12	15	12	15	15	15
Average	2.8	3	3	2.6	3	2.4	3	2.4	3	3	3

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE21	Advanced Optics	DSEC	3	0	0	0	3	3	25	75	100
Learning Objectives											
LO1	To know the concepts behind polarization and could pursue research work on application aspects of laser.										
LO2	To impart an extensive understanding of fiber and non-linear optics.										
LO3	To study the working of different types of LASERS										
LO4	To differentiate first and second harmonic generation.										
LO5	Learn the principles of magneto-optic and electro-optic effects and its applications.										
Unit	Content										Hours
1	POLARIZATION AND DOUBLE REFRACTION: Classification of polarization –Polarizer and analyzer – Malus law – Production of polarized light – Polaroid – Polarization by reflection – Polarization by double refraction – Polarization by scattering – The phenomenon of double refraction –Quarter and half wave plates – Analysis of polarized light – Optical activity.										12
2	LASERS: Basic principles –Spontaneous and stimulated emissions –Types of lasers and its applications –Solid state lasers– Ruby laser –Nd:YAG laser –gas lasers –He-Ne laser – CO2 laser – Chemical lasers – HCl laser – Semiconductor laser										12
3	FIBER OPTICS: Introduction – Total internal reflection – The optical fiber – Glass fibers – The coherent bundle – The numerical aperture – Attenuation in optical fibers – Single and multi-mode fibers – Pulse dispersion in multimode optical fibers – Ray dispersion in multimode step index fibers – Parabolic-index fibers.										12
4	NON-LINEAR OPTICS : Basic principles – Harmonic generation – Second harmonic generation – Phase matching – Optical mixing – Parametric generation of light – Self-focusing of light										12
5	MAGNETOOPTICS AND ELECTRO-OPTICS: Magneto-optical effects– Zeeman effect–Inverse Zeeman effect–Faraday effect –Voigt effect–Cotton-mouton effect –Kerr magneto-optic effect – Electro-optical effects–Stark effect–Inverse stark effect–Electric double refraction –Kerr electro-optic effect.										12

CO	Course Outcomes
CO1	Discuss the transverse character of light waves and different polarization phenomenon
CO2	Discriminate all the fundamental processes involved in laser devices and to analyze the design and operation of the devices
CO3	Demonstrate the basic configuration of a fiber optic – communication system and advantages.
CO4	Identify the properties of nonlinear interactions of light and matter
CO5	Interpret the group of experiments which depend for their action on an applied magnetics and electric field
Textbooks:	
1	B. B. Laud, 2017, Lasers and Non – Linear Optics, 3rd Edition, New Age International (P) Ltd.
2	Ajoy Ghatak, 2017, Optics, 6th Edition, McGraw – Hill Education Pvt. Ltd.
3	William T. Silfvast, 1996, Laser Fundamentals Cambridge University Press, New York
4	J. Peatros, Physics of Light and Optics, a good (and free!) electronic book
5	B. Saleh, and M. Teich, Fundamentals of Photonics, Wiley-Interscience
Reference Books:	
1	F. S. Jenkins and H. E. White, 1981, Fundamentals of Optics, (4th Edition), McGraw – Hill International Edition.
2	Dieter Meschede, 2004, Optics, Light and Lasers, Wiley – VCH, Varley GmbH
3	Lipson, S. G. Lipson and H. Lipson, 2011, Optical Physics, 4th Edition, Cambridge University Press, New Delhi, 2011
4	Y. B. Band, Light and Matter, Wiley and Sons (2006)
5	R. Guenther, Modern Optics, Wiley and Sons (1990)
Web resources:	
1	https://www.youtube.com/watch?v=WgzynezPiyc
2	https://www.youtube.com/watch?v=ShQWwobpW60
3	https://www.ukessays.com/essays/physics/fiber-optics-and-it-applications.php
4	https://www.youtube.com/watch?v=0kEvr4DKGRI
5	http://optics.byu.edu/textbook.a

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

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHE22	Physics of Nanoscience and Technology	DSEC	4	0	1	0	3	4	25	75	100
Learning Objectives											
LO1	Physics of Nanoscience and Technology is concerned with the study, creation, manipulation and applications at nanometer scale.										
LO2	To provide the basic knowledge about nanoscience and technology.										
LO3	To learn the structures and properties of nanomaterials.										
LO4	To acquire the knowledge about synthesis methods and characterization techniques.										
LO5	To obtain the knowledge about the nanomaterials applications.										
Unit	Content										Hours
1	FUNDAMENTALS OF NANOSCIENCE AND TECHNOLOGY: Introduction of Nanoscience and Nanotechnology, Historical Perspective on Nanomaterial and Nanotechnology - Nanomaterials and its applications – Classification of nanoscale dimensions: 0D, 1D, 2D - Quantum dots – Quantum wires – Quantum wells - Classification of Metals, Semiconductors, and Insulators.										12
2	PROPERTIES OF NANOMATERIALS: Physical properties of Nanomaterials: Melting points, specific heat capacity and lattice constant - Mechanical behavior: Elastic properties – strength – ductility - Optical properties: Surface Plasmon Resonance - Electrical properties: Conductivity, Ferroelectrics and dielectrics Magnetic properties: Diluted magnetic semiconductor (DMS).										12
3	SYNTHESIS AND FABRICATION: Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - Electrochemical deposition method – Plasma arching - Electrospinning method - Ball milling technique – Nanolithography - Photolithography.										12
4	CHARACTERIZATION TECHNIQUES: Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibration sample magnetometer (VSM).										12
5	APPLICATIONS OF NANOMATERIALS: Sensors: Nanosensors – Different types of Nanosensors - Nano Electronics: Nanobots - Display screens - GMR read/write heads – Carbon Nanotube Emitters (CNT) – Photocatalytic application: Air purification, water purification - Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: Batteries - Fuel Cells - Electrochemical Capacitors										12

CO	Course Outcomes
CO1	Understand the basic of nanoscience and explore the different types of nanomaterials and Should comprehend the surface effects of the nanomaterials.
CO2	Explore various physical, mechanical, optical, electrical and magnetic properties nanomaterials.
CO3	Understand the process and mechanism of synthesis and fabrication of nanomaterials.
CO4	Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques.
CO5	Apply the concepts of nanoscience and technology in the field of sensors, robotics, purification of air and water and in the energy devices.
Textbooks:	
1	A textbook of Nanoscience and Nanotechnology, Pradeep.T, Tata McGraw-Hill Publishing Co. (2012).
2	Principles of Nanoscience and Nanotechnology, M.A.Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010).
3	Introduction to Nanoscience and Nanotechnology, K.K.Chattopadhyay and A.N.Banerjee, PHI Learning Pvt. Ltd., New Delhi, (2012).
4	Nanostructured Materials and Nanotechnology, Hari Singh Nalwa, Academic Press, (2002).
5	Nanotechnology and Nanoelectronics, D.P.Kothari, V.Velmurugan and Rajit Ram Singh, Narosa Publishing House Pvt. Ltd, New Delhi. (2018).
Reference Books:	
1	Nanostructures and Nanomaterials– HuozhongGao–Imperial College Press (2004).
2	Richard Booker and Earl Boysen, (2005) Nanotechnology, Wiley Publishing Inc. USA
3	Nano particles and Nano structured films; Preparation, Characterization and Applications, J.H.Fendler John Wiley and Sons. (2007)
4	Textbook of Nanoscience and Nanotechnology, B.S.Murty, et al., Universities Press. (2012)
5	The Nanoscope (Encyclopedia of Nanoscience and Nanotechnology), Dr. Parag Diwan and Ashish Bharadwaj (2005) Vol. IV - Nanoelectronics Pentagon Press, New Delhi.
Web resources:	
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

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	3	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3	2
CO4	3	3	3	2	1	1	3	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3	2
Total	15	15	13	10	5	5	15	15	15	15	13
Average	3	3	2.6	2	1	1	3	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low

1st YEAR: SECOND SEMESTER

Course Code	Course Name	Category	L	T	P	S	Credits	Hours	Marks		
									CIA	External	Total
24PPHS21	Renewable Energy and Energy Harvesting	SEC/ NM	2	0	0	0	2	2	25	75	100
Learning Objectives											
LO1	To learn about alternate sources of energy.										
LO2	To know the ways of effectively utilizing the solar energy.										
LO3	To study the method of harvesting wind energy and ocean energy.										
LO4	To learn the techniques useful for the conversion of hydro energy and piezo energy harvesting.										
LO5	To know about utilization of electromagnetic energy harvesting.										
Unit	Content										Hours
1	Fossil fuels and Alternate Sources of energy -Fossil fuels and nuclear energy, their limitation, need of renewable energy. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Thermal Energy Conversion, biomass, biochemical conversion, biogas generation, geo thermal energy.										6
2	Solar energy -Solar energy, its importance, storage of solar energy, solar pond, non-convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems.										6
3	Wind Energy harvesting: Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid inter connection topologies. Ocean Energy: Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass										6
4	Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources, Piezoelectric Energy harvesting: Introduction characteristic, parameter of piezoelectricity, materials and mathematical description of piezoelectricity, modeling piezoelectric generators, Piezoelectric energy harvesting applications										6
5	Electromagnetic Energy Harvesting: Linear generators, physics mathematical models, recent applications-Carbon captured technologies, cell, batteries, power consumption										6

CO	Course Outcomes
CO1	Explore the Principles, various types of renewable energy sources and technologies behind energy harvesting
CO2	Evaluate the economic factors influencing the adoption of renewable energy and energy harvesting, including cost-benefit analysis and return on investment.
CO3	Analyze the environmental benefits and challenges associated with different renewable energy technologies and energy harvesting methods.
CO4	Design integrated renewable energy systems that incorporate energy harvesting solutions for improved efficiency and sustainability.
CO5	Identify and analyze real-world applications of renewable energy and energy harvesting in various sectors, such as residential, commercial, and industrial.
Textbooks:	
1	Non-conventional energy sources-G. D Rai–Khanna Publishers ,New Delhi
2	Solar energy –MP Agarwal –S chand and Co.Ltd.
3	Solar energy - Suhas P Sukhative Tata Mc Graw-Hill Publishing Company Ltd.
4	Godfrey Boyle,“Renewable Energy ,Power for a sustainable future”,2004, Oxford University Press, in association with the Open University.
5	Dr. P Jayakumar, Solar Energy: ResourceAssesmentHandbook,2009
Reference Books:	
1	Energy – An Introduction to Physics – R.H.Romer, W.H.Freeman.(1976)
2	Solar energy thermal processes – John A.Drife and William. (1974)
3	John W. Twidell& Anthony D.Weir, ‘Renewable Energy Resources,2005
4	John A. Duffie, William A. Beckman, Solar Energy: Thermal Processes, 4th Edition, john Wiley and Sons, 2013
5	Duffie, J.A., Beckman, W.A. , “Solar Energy Thermal Process”, John Wiley and Sons,2007.
Web resources:	
1	https://pdfs.semanticscholar.org/63a5/a69421b69d2ce9f359bbfc86c63556f9a4fb
2	https://books.google.vg/books?id=l-XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read
3	www.nptel.ac.in/courses/112105051
4	www.freevideolectures.com
5	http://www.e-booksdirectory.com

Mapping with Programme Outcomes and Programme Specific Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	3	3	3	3	3
CO2	3	3	3	2	1	1	3	3	3	3	3
CO3	3	3	2	2	1	1	3	3	3	3	2
CO4	3	3	3	2	1	1	3	3	3	3	3
CO5	3	3	2	2	1	1	3	3	3	3	2
Total	15	15	13	10	5	5	15	15	15	15	13
Average	3	3	2.6	2	1	1	3	3	3	3	2.6

3 – Strong, 2- Medium, 1- Low



**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

1. Preamble

2. Programme Outcomes

3. Programme Specific Outcomes

4. Eligibility for Admission

5. Methods of Evaluation and Assessments

6. Skeleton & Syllabus

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	<p>PO1: Acquire knowledge in Physics to apply the knowledge in their day-to-day life for betterment of self and society.</p> <p>PO2: Develop critical, analytical thinking and problem-solving skills</p> <p>PO3: Develop research related skills in defining the problem, formulate and test the hypothesis, analyse, interpret, and draw conclusion from data.</p> <p>PO4: Address and develop solutions for societal and environmental needs of local regional and national development.</p> <p>PO5: Work independently and engage in lifelong learning and enduring proficient progress.</p> <p>PO6: Provoke employability and entrepreneurship among students along with ethics and communication skills.</p> <p>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.</p> <p>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.</p>
Programme Specific Outcomes:	<p>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.</p> <p>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.</p> <p>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.</p>

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						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
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						
Code	Course Title	Hours Distribution				C
		L	T	P	S	
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, 1st edition, 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	Ext ernal	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

Course Outcomes	
CO	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
	<ol style="list-style-type: none"> 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 <p>Microprocessor Experiments</p> <ol style="list-style-type: none"> 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 Runge 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, <i>Computer oriented Numerical Methods</i> , 3rd Edition. PHI, New Delhi
2	M.K. Jain, S.R. Iyengar and R. K. Jain, 1995, <i>Numerical Methods for Scientific and Engineering Computation</i> , 3rd Edition, New Age Intl, New Delhi
3	S.S. Sastry, <i>Introductory Methods of Numerical analysis</i> , PHI, New Delhi
4	F.Scheid,1998, <i>Numerical Analysis</i> , 2nd Edition, Schaum's series, McGraw Hill, New York
5	E. Balagurusamy, <i>Problem solving and Python Programming</i> , McGraw Hill Education (India) Pvt Ltd.,
Reference Books:	
1	S. D. Conte and C. de Boor, 1981, <i>Elementary Numerical analysis-an algorithmic approach</i> , 3rd Edition, McGraw Hill
2	B.F. Gerald, and P. O. Wheatley, 1994, <i>Applied Numerical analysis</i> , 5th Edition, Addison-Wesley, MA.
3	B.Carnagan, H.A.Luther & J.O.Wilkes, 1969, <i>Applied Numerical Methods</i> , Wiley, New York.
4	S. S. Kuo, 1996, <i>Numerical Methods and Computers</i> , Addison-Wesley.
5	V. Rajaraman, <i>Programming in Programming in C</i> , PHI, New Delhi
Web resources:	
1	https://www.scribd.com/doc/202122350/Computer-Oriented-Numerical-Methods-by-VRajaRaman
2	https://www.scirp.org/(S(lz5mqp453edsnp55rrgjt55))/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

Course Outcomes	
CO	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, “ <i>Fundamentals of Microprocessor-8085</i> ”, 3 rd Edition S.Visvanathan Pvt. Ltd.
2	Ramesh Gaonkar, <i>Microprocessor Architecture, Programming and Applications with8085</i> , Penram International Publishing (2013).
3	A. Nagoor Kani, <i>Microprocessors & Microcontrollers</i> , RBA Publications (2009).
4	A. P. Godse and D. A. Godse, <i>Microprocessors</i> , Technical Publications, Pune (2009).
5	B.Ram, <i>Fundamentals of Microprocessors & Microcontrollers</i> , Dhanpat Rai publications New Delhi (2016).
Reference Books:	
1	Douglas V. Hall, <i>Microprocessors and Interfacing programming and Hardware</i> , Tata Mc Graw Hill Publications (2008)
2	Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, <i>The 8051 Microcontroller and Embedded Systems</i> , Pearson Education (2008).
Web resources:	
1	https://www.tutorialspoint.com/microprocessor/microprocessor_8085_architecture.html
2	http://www.electronicengineering.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); Hertzsprung-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, Schwarzschild 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, 4th edition (Saunders College Publishing)
2	Morison, I., Introduction to Astronomy and 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 Essentials of Astronomy, (Columbia 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

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

Course Outcomes	
CO	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	<ol style="list-style-type: none"> The students have to undergo 30 hours/15 days of Internship/Industrial Training in the Industry during the holidays of the Second Semester. The Candidates need to get a Project, Analyze, learn the various stages of Developing a solution, Test, Validate and carryout the other related requirements. 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. 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. 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. The Passing Minimum for Internship is 50%. If the Candidate fails to score 50% in the Internship, the Candidate has to improve it during the next attempt. A Faculty Member from the Department will act as a Guide to Supervise/Monitor the progress of the Candidates. 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. The Internal Marks for the Internship will be awarded by the concerned Guide /Internal Examiner. 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
<ul style="list-style-type: none"> ✓ 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
<ul style="list-style-type: none"> ✓ 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 ₂ O 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 ₂ O 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 ₂ O and CO ₂ -Mutual exclusion principle-determination of N ₂ O 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 Aruldas, 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 Quadrupole 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

Course Outcomes	
CO	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.pdf http://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/radioactive_decay.

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

Course Outcomes	
CO	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=Cj0KCCQjwuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB
4	https://www.meripustak.com&gclid=Cj0KCCQjwuKXBhCRARIsACgM0iVpismAJN93CHA1sX6NuNeOKLXfQJjxHCOVH3QXjJ1iACq30KofoaAmFsEALw_wcB

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 Tchobanoglous George; Kreith, Frank McGraw Hill Publication, New Delhi 2002, ISBN 9780071356237
4	Environmental Studies Manjunath D. L. Pearson Education Publication, New Delhi, 2006 ISBN-13: 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_S_WM.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