

PKR Arts College for Women (Autonomous), Gobichettipalayam
M.Sc., Physics 2025-2026

P.K.R. ARTS COLLEGE FOR WOMEN

(Re-Accredited with 'A' grade by NAAC)

**Autonomous Institution- Affiliated to Bharathiar University, Coimbatore
No. 127, Pariyur Road, Gobichettipalayam – 638 476.**

DEPARTMENT OF PHYSICS MASTER OF SCIENCE IN PHYSICS



SYLLABUS

***(For the candidates admitted from the Academic Year 2025-2026 and
onwards)***

Under CBCS PATTERN

PG SCHEME OF EXAMINATIONS 2025-26



**P.K.R ARTS COLLEGE FOR WOMEN (Autonomous)
GOBICHETTIPALAYAM – 638476
MASTER OF SCIENCE IN PHYSICS
Programme Scheme and Scheme of Examinations
(For students admitted from 2025-26 & onwards)**

Scholastic Courses:

Category (Part)	Component	Course Code	Course Title	Contact Hrs/ week	Exam Duration hrs.	Max.Marks			Credits
						CIA	ESE	Tot al	
SEMESTER – I									
Part III	Core: I	25PHP01	Classical Mechanics	5	3	25	75	100	4
Part III	Core :II	25PHP02	Mathematical Physics -I	5	3	25	75	100	4
Part III	Core : III	25PHP03	Quantum Mechanics – I	5	3	25	75	100	4
Part III	Core : IV	25PHP04	Advanced Electronics	5	3	25	75	100	4
Part III	****	****	Advanced Physics Practical-I	3	-	-	-	-	-
Part III	****	****	General Electronics Practical-I	3	-	-	-	-	-
Part III	Core : V Elective: I	25PHP05A / 25PHP05B / 25PHP05C	Crystal Growth and Thin Films / Industrial Electronics / Programming in Python	4	3	25	75	100	3
			TOTAL	30				500	19
SEMESTER – II									
Part III	Core : VI	25PHP06	Mathematical Physics -II	5	3	25	75	100	4
Part III	Core : VII	25PHP07	Quantum Mechanics – II	5	3	25	75	100	4
Part III	Core : VIII	25PHP08	Numerical Methods & MATLAB Programming	5	3	25	75	100	3

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Part III	Core : IX	25PHP09	Advanced Physics Practical-I	5	5	40	60	100	4
Part III	Core : X	25PHP10	General Electronics Practical-I	5	5	40	60	100	4
Part III	Core : XI Elective : II	25PHP11A/ 25PHP11B/ 25PHP11C	Physics of Nanoscience and Technology / Solar Energy Utilization / Fundamentals of Data Sciences	3	3	25	75	100	3
Part IV	Ability Enhancement	25AEP01	Cyber Security	2	3	100	-	100	2
			TOTAL	30				700	24
SEMESTER – III									
Part III	Core : XII	26PHP12	Atomic and Molecular Spectroscopy	5	3	25	75	100	4
Part III	Core :XIII	26PHP13	Nuclear & Particle Physics	5	3	25	75	100	4
Part III	Core : XIV	26PHP14	Electromagnetic Field Theory	5	3	25	75	100	4
Part III	Core : XV	25PHP15A/ 25PHP15B/ 25PHP15C	Institutional Training/Intrustrial training/Internship	-	-	100	-	100	1
Part III	****	****	Advanced Physics Practical-II	4	-	-	-	-	-
Part III	****	****	General Electronics Practical-II	4	-	-	-	-	-
Part III	Core :XVI Open Elective	****	Offered for students of other programmes / departments	3	3	25	75	100	2
Part III	Core :XVII Elective: III	25PHP16A / 25PHP16B / 25PHP16C	Characterizat on of Materials / Medical Physics / Cloud computing	4	3	25	75	100	3
Part V	Proficiency Enhancement	25PEPHP01	Astrophysics (Self – Study)	-	3	-	100	100	2
			TOTAL	30				700	20

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SEMESTER – IV									
Part III	Core :XVIII	25PHP17	Condensed Matter Physics	5	3	25	75	100	4
Part III	Core: XIX	25PHP18	Thermodynamics and Statistical Mechanics	5	3	25	75	100	4
Part III	Core :XX	25PHP19	Electronic Communication Systems	5	3	25	75	100	4
Part III	Core : XXI	25PHP20	Advanced Physics Practical-II	5	6	40	60	100	4
Part III	Core : XXII	25PHP21	General Electronics Practical-II	5	6	40	60	100	4
Part III	Core : XXIII	25PHP22	Project Work & Viva Voce	5	3	20	80	100	3
			TOTAL	30				600	23
Part V	Competency Enhancement	Online Course / Learning Object Repository (LOR)		SEMSTER I – IV					2
		Certificate Course		SEMESTER I - IV					2
Total Credits									90

***Credit Transfer for all courses from UGC SWAYAM / MOOC Courses.**

Total Marks: 2500

Total credits: 90

Chair Person
Name, Designation
College Name – Full address

SEMESTER-I

Category	Course Type	Course Code	Course Title			Contact Hours	Credit (C)
Part III	Core: I	25PHP01	Classical Mechanics			60	4
Contact hours per week: 5							
Year		Semester		Internal Marks	External Marks	Total Marks	
I		I		25	75	100	
PREAMBLE: The aim is to provide students with knowledge and understanding of the fundamental concepts in the dynamics of particles, rigid body motion, and the Lagrangian and Hamiltonian formulation of mechanics. It also introduces variation principles, normal modes, and basics of relativity							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	Recall the fundamental principles of Newtonian mechanics, rigid body motion, Lagrangian and Hamiltonian dynamics, Poisson brackets, and relativity.					K1	
CO2	Explain the physical meaning and mathematical formulation of motion under various forces, conservation laws, oscillatory systems, and relativistic transformations.					K2	
CO3	Apply Newton’s laws, Lagrange’s and Hamilton’s equations, canonical transformations, and Lorentz transformations to model and solve classical mechanical systems.					K3	
CO4	Analyze the dynamics of single/multiple particles, rigid bodies, small oscillations, and relativistic effects using appropriate mathematical tools.					K4	
CO5	Evaluate the use of conservation laws, Poisson brackets, and symmetry properties to derive solutions and assess system behavior under constraints or external influences.					K5	
CO6	Construct mechanical models using advanced formulations (Lagrangian, Hamiltonian, H-J equations) and solve complex dynamical systems including central force motion and relativity.					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	3	1
CO2	9	9	9	9	9	3	1

CO3	9	9	9	3	3	3	1
CO4	9	9	9	3	3	3	1
CO5	9	9	3	1	3	1	1
CO6	9	3	3	1	1	1	1
Total Contribution of COs to POs	54	48	42	26	28	14	6
Weighted Percentage of COs Contribution to POs	6.37	6.38	7.22	5.32	6.43	3.70	2.29

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

UNIT I Mechanics of Single and Systems of Particles (12 Hours)

Newton's laws of motion - Mechanics of a particle - Equation of motion of a particle - Motion of a charged particle in electromagnetic field - law of gravitational and electrostatic forces - Mechanics of systems of particles - Angular momentum of the system - Potential and kinetic energies of the system- Degrees of freedom - Constraints - Motion in a central force field - Motion of two particles equivalent to single particle - Motion in an inverse-square law force field - equation of the orbit - differential equation of trajectory - Kepler's Law of planetary motion.

UNIT II Collisions of Particles and Motion of Rigid Body (12 Hours)

Elastic and inelastic scattering - Laboratory and center of mass systems - Relations between different quantities in the laboratory and center of mass systems - Kinematics of elastic scattering in the laboratory system - Inelastic scattering in the laboratory frame - Motion of a rigid body - Euler's theorem - Angular momentum and kinetic energy - Inertia tensor - Euler's equation of motion - Torque Free Motion - Euler's angles

UNIT III Lagrangian and Hamiltonian Formulations (12 Hours)

Generalized coordinates - D'Alembert's principle - Lagrange's equations of motion - Conservation theorems and symmetry properties - Cyclic coordinates - Application of Lagrange's equation; Linear harmonic oscillator, particle moving under a central force, Atwood's machine - Hamilton's Principle - Hamilton's equations of motion - Application of Hamiltonian's equations of motion- Particle moving in an electromagnetic field - Phase space - Principle of Least action.

UNIT IV Canonical Transformations and Poisson Brackets (12 Hours)

Canonical transformations - Generating function - Properties of canonical transformations- condition for a transformation to be canonical - Poisson brackets - Properties of Poisson brackets - Equations of motion in Poisson bracket - Angular momentum and Poisson brackets - Invariance of Poisson bracket under canonical transformation - Liouville's theorem - Hamilton Jacobi Equation - Principal and characteristic function - Solution of harmonic oscillation problem by H-J method - Action and angle variables.

UNIT V Small Oscillations and Relativity (12 Hours)

Small oscillations - Stable and unstable equilibrium - Lagrange's equation of motion for small oscillations - Normal coordinates and normal frequencies - Small oscillations of particles on string - Free vibrations of a linear triatomic molecule – Double pendulum. Postulates of special theory of relativity- Lorentz transformation - Time dilation – Length contraction- Mass energy equivalence – Minkowski space – Four vectors

TEXT BOOKS:

1. **Classical Mechanics**, S.L.Gupta, V. Kumar & H. V. Sharma, 2015, PragatiPrakashan, Meerut (Unit-I-V)
2. **Classical Mechanics**, J.C. Upadhyaya, Himalaya Publishing House, 2005(Unit-I-V)
3. **Introduction to Classical Mechanics**, R. G. Takwale and P. S. Puranik, Tata McGraw-Hill, 2006

REFERENCE BOOKS:

1. **Classical Mechanics**, G. Aruldass, PHI Learning Private Ltd, 2009
2. **Classical Mechanics**, H. Goldstein, C. Poole and J. Safko, Pearson 3rd Edition 2014

WEB REFERENCES:

1. Selected topics in Lecture series on Classical Physics by Prof. V. Balakrishnan, IIT Madras (NPTEL)
2. Selected topics in Lecture series on Classical Physics by Prof. Shiva Prasad, Department of Physics, IIT Bombay (NPTEL)
3. Lecture series of Classical Physics by Prof. Mukunda, IISC, Bangalore

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core: II	25PHP02	Mathematical Physics -I	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	I	25	75	100	
PREAMBLE: The aim is to equip students with the mathematical techniques required to solve differential equations and analyze special functions, Laplace and Fourier transforms, and partial differential equations relevant to physical systems					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall fundamental definitions, formulas, and classifications related to differential equations, special functions, Laplace and Fourier transforms, and partial differential equations.				K1
CO2	Explain the theoretical foundations and properties of differential equations, special functions, Laplace/Fourier methods, and PDE classifications with their physical				K2

	significance.	
CO3	Apply mathematical techniques to solve first and second-order differential equations, evaluate special functions, compute transforms, and solve standard PDEs.	K3
CO4	Analyze different solution methods, compare transformation techniques, and assess the structure of special functions and PDEs in various physical contexts.	K4
CO5	Evaluate solutions of DEs, transforms, and PDEs under given conditions using appropriate mathematical tools like orthogonality, inverse transforms, and boundary conditions.	K5
CO6	Construct and model physical systems using advanced mathematical tools such as differential equations, special functions, Laplace/Fourier analysis, and PDEs for real-world applications.	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	3	3	3	1
CO2	9	9	9	3	3	3	1
CO3	9	9	9	3	3	1	1
CO4	9	9	3	3	3	1	1
CO5	9	3	3	3	1	1	1
CO6	9	3	3	1	1	1	1
Total Contribution of COs to POs	54	42	36	16	14	10	6
Weighted Percentage of COs Contribution to POs	6.37	5.58	6.19	3.27	3.21	2.64	2.29

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

UNIT I Solving of differential equations	(12 Hours)
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Order and degree of a Differential Equation – Solution of first order differential equation – Equations solvable by separation of the variables – Homogeneous equations – Linear equations of the first order – Exact differential Equation - Solution of second order

differential equation with constant coefficients – Method for finding the complementary function – Rules to find particular Integral

UNIT II Special Functions (12 Hours)

Gamma and beta functions-properties and some basic relations- Legendre Functions – Legendre equation, polynomials, Rodrigue's formula, Generating Function, Recurrence formulae and Orthogonality – Bessel Functions - Bessel equation, Recurrence formulae, Generating Function and Orthogonality - Hermite Functions - Hermite Equation, Generating Function, Recurrence formulae and Orthogonality - Laguerres function

UNIT III Laplace Transforms (12 Hours)

Laplace transform: Properties of Laplace transforms – first shifting theorem - Laplace Transform of the Derivative of $f(t)$ - Laplace Transform of the Derivative of Order n - Laplace Transform of the Integral of $f(t)$ - Laplace Transform of $t \cdot f(t)$ - Laplace Transform of $1/t \cdot f(t)$ – unit step function - second shifting theorem- Periodic Functions.

Inverse Laplace transform: first and second shifting property, Convolution property

UNIT IV Fourier Series and Integrals (12 Hours)

Fourier series- Dirichlet's condition – Euler's Formula - Half-Range Series – Fourier Integral- Even and Odd Functions - Complex form of Fourier integral – uses of Fourier series

UNIT V Partial differential equations (PDEs) (12 Hours)

Partial differential equations in Physics – Order of a Partial Differential equation - Solution of Partial Differential Equation - Laplace equation - Dirichlet Boundary Condition - Neumann or second type boundary condition Robin's type condition - Solution of 2D Laplace equation with Boundary Condition - Wave Equation - Heat equation

Text Books:

1. **Mathematical Physics, H.K. Dass & Rama Verma**, 8th edition, 2022 (Unit – I,II, III)
2. **Mathematical Physics**, SathyaPrakash, 2002, Sultan Chand & Sons. [ISBN: 81-7014-925-8] (Unit – IV)
3. **Mathematical methods for Physics**, G. Arfken Elsevier, 6th edition, 2010 (Unit – V)

Reference books:

1. **Mathematical Physics**, B.D.Gupta, Vikas Publishing House, 4th edition, 2010.
2. **Advanced Engineering Mathematics**, Erwin Kreyszig, 10th Edition, John Wiley & Sons, inc
3. **Mathematical Methods in the Physical Sciences**, Mary L. Boas

Web Reference:

1. Ordinary and partial differential equations and applications by Prof. P.N.Agarwal, D.N. Pandey, IIT Roorkee, Swayam
2. [Selected topics in mathematical Physics](#), Prof. V. Balakrishnan, IIT Madras (NPTEL)

Category	Course Type	Course Code	Course Title			Contact Hours	Credit (C)
Part III	Core: III	25PHP03	Quantum Mechanics – I			60	4
Contact hours per week: 5							
Year		Semester		Internal Marks	External Marks	Total Marks	
I		I		25	75	100	
PREAMBLE: The aim is to provide students with a fundamental understanding of the formal structure of quantum mechanics, energy eigenvalue problems, angular momentum, and approximation methods. It develops the ability to analyze quantum systems using various representations and perturbation techniques							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	Recall key concepts of quantum mechanics such as vector spaces, operators, eigenvalues, postulates, angular momentum, and perturbation theories.					K1	
CO2	Explain foundational principles and interpretations of quantum mechanics including formalism, energy quantization, angular momentum theory, and time-dependent phenomena.					K2	
CO3	Apply quantum mechanical postulates and approximation methods to solve physical systems like potential wells, hydrogen atom, and perturbed systems.					K3	
CO4	Analyze quantum systems using commutation relations, perturbative approaches, angular momentum algebra, and representations like Schrödinger and Heisenberg pictures.					K4	
CO5	Evaluate results using tools such as matrix representations, variation method, WKB approximation, and selection rules to assess quantum transitions and measurements.					K5	
CO6	Construct models for real quantum systems using Dirac notation, Clebsch-Gordan coefficients, perturbation theory, and time evolution operators under various approximations.					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	3
CO2	9	9	9	9	9	3	3
CO3	9	9	9	3	3	3	1
CO4	9	9	3	1	1	3	1

CO5	9	3	3	1	1	1	1
CO6	9	3	3	1	1	1	1
Total Contribution of COs to POs	54	42	36	24	24	20	10
Weighted Percentage of COs Contribution to POs	6.37	5.58	6.19	4.91	5.51	5.29	3.83

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

UNIT I General formalism of Quantum Mechanics (12 Hours)

Linear Vector Space- Linear Operator- Eigen functions and Eigenvalues- Hermitian Operator- Postulates of Quantum Mechanics- Simultaneous Measurability of Observables- General Uncertainty Relation- Dirac's Notation- Equations of Motion; Schrodinger, Heisenberg and Dirac representation- momentum representation- Density Matrix and its limitation.

UNIT II Energy Eigenvalue problems (12 Hours)

Particle in a box – Linear Harmonic oscillator- Tunnelling through a barrier- particle moving in a spherically symmetric potential- System of two interacting particles-Rigid rotator- Hydrogen atom: Separation of the center of mass motion-solution to radial equation

UNIT III Angular Momentum (12 Hours)

Orbital Angular Momentum Operator -Spin Angular Momentum-Stern-Gerlach Experiment and the Evidence for Spin Quantization- Total Angular Momentum Operators-Commutation Relations of Total Angular Momentum with Components- Ladder operators- Commutation Relation of J_z with J_+ and J_- - Eigen values of J^2 , J_z - Matrix representation of J^2 , J_z , J_+ and J_- - Addition of angular momenta- Clebsch-Gordon Coefficients: recursion relations-computation of Clebsch-Gordon Coefficients - selection rules

UNIT IV Time Independent Approximation Methods (12 Hours)

Time-Independent Perturbation Theory in Non-Degenerate Case - Anharmonic Oscillator: First order Correction- The ground state of Helium- Degenerate Case - Stark Effect in Hydrogen atom – Spin-orbit interaction - Variation Method – Born-Oppenheimer approximation - WKB Approximation and its validity

Unit:5 Time Dependent Perturbation Theory (12 Hours)

Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-selection rules - Harmonic Perturbation- Collision-Adiabatic and Sudden Approximation- A Charged Particle in an Electromagnetic Field.

TEXT BOOKS:

1. **Quantum Mechanics**, G. Aruldas, Prentice Hall of India, 2013 (Unit- I,IV,V)
2. **Quantum Mechanics**, Satyaprakash & Swati Satya:KedarNath Ram Nath & Co, 2006 – (Unit-II,III)

REFERENCE BOOKS:

1. **Introduction to Quantum Mechanics** –David J Griffiths– Pearson- 2nd edition- 2016. [ISBN: 978-93-325-4289-1]
2. **Quantum Mechanics**, V. Devanathan, 2005, Narosa Publishing House, New Delhi.

WEB REFERENCE:

1. <https://nptel.ac.in/courses/122/106/122106034/>
2. <https://nptel.ac.in/courses/115/103/115103104/>
3. <https://nptel.ac.in/courses/115/101/115101107/>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core: IV	25PHP04	Advanced Electronics	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	I	25	75	100	
PREAMBLE: The aim is to provide a comprehensive understanding of semiconductor devices, analog and digital electronics, and the basics of microprocessors and microcontrollers, enabling students to analyze, design, and troubleshoot electronic circuits and systems					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall the characteristics and functions of semiconductor devices, transistors, amplifiers, registers, counters, op-amps, and microcontrollers.				K1
CO2	Describe the working principles of analog and digital circuits, operational amplifier applications, FET/MOSFET behaviors, and microprocessor instructions.				K2
CO3	Apply circuit concepts to design and implement amplifiers, signal conditioners, counters, A/D-D/A converters, and microprocessor-based programs.				K3
CO4	Analyze complex electronic circuits for amplification, switching, signal conversion, and digital logic control.				K4
CO5	Evaluate the performance and efficiency of analog/digital devices and embedded systems through parameter testing and comparison.				K5
CO6	Create and optimize analog/digital systems and embedded applications using semiconductors, operational amplifiers, registers, and microcontrollers.				K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	3	3
CO2	9	9	9	9	9	3	3
CO3	9	9	9	9	3	3	3
CO4	9	9	9	3	3	1	1
CO5	9	9	3	3	1	1	1
CO6	9	9	3	3	1	1	1
Total Contribution of COs to POs	54	54	42	36	26	12	12
Weighted Percentage of COs Contribution to POs	6.37	7.18	7.22	7.37	5.97	3.17	4.59
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs							
COURSE CONTENT							
UNIT I Semiconductor Devices (12 Hours) Semiconductor devices- homo and hetro junction devices- p-n junctions- Zener diode - light emitting diode - Tunnel diode – Photodiode - Solar cell IMPATT diodes - clipping circuits – comparator - voltage regulator - frequency dependence and application of devices.							
UNIT II Transistors and amplifier (12 Hours) Transistors - Transistor as an amplifier, low frequency transistor, equivalent circuits, switching behaviour of transistor, biasing schemes, Feed back in amplifiers with example - FET, static and dynamic characteristics for smaller drain voltage and larger drain voltages, FET amplifier, MOSFET, drain and transfer characteristics Amplifier; Q – point, AC load line. Depletion and enhancement mode							
UNIT III Operational Amplifier (12 Hours) Operational Amplifier Stages - Parameters - Frequency Response - Op-Amp Applications - Differential amplifier - adder, subtractor; comparator; logarithmic amplifiers. multiplier; divider; differentiator, integrator; analog computer; wave shapers - High resistance DC voltmeter, Universal high resistance voltmeter - Light Emitting diode tester, Current Amplifier, phase shifter							
UNIT IV Registers, counters and Data converters (12 Hours) Registers: Serial in-Serial out, Serial in-Parallel out, Parallel in-Serial out, Parallel in-parallel out-shift registers. Counters: binary and decade counters ring counters, ripple and							

synchronous type- Up-down counters, A/D and D/A converters

UNIT V Microprocessor and Microcontroller

(12 Hours)

Microprocessor: Architecture and its operations, instruction set and Data format, Input and Output (I/O) Devices. Simple programs: Addition, Subtraction, Multiplication, Division with 8 bit numbers.

Microcontroller: Architecture and its operations of Intel 8051 microcontroller – 8051 MC Hardware -PIN diagram- ports and circuits- external memory- counters and timers- Instruction types: arithmetic, logical, data transfer, Boolean and program branching instructions- simple programs.

TEXT BOOKS :

1. **Electronic Devices and Circuits**, S Salivahanan and N Suresh Kumar, 5 th edition, 2022, McGraw Hill (Unit-II)
2. **Physics of Semiconductors Devices**, s. M. Sze & m. K. Lee, 3 rd edition, 2006, John wiley & sons, inc.(Unit-I)
3. **Op-Amps and Linear Integrated Circuits** ,Ramakant A.Gayakwad Fourth Edition ,2015,(Unit-III)
4. **Digital Fundamentals**, Thomas L. Floyd, Eleventh edition, 2015(Unit-IV)
5. **The 8051 microcontroller, architecture, programming and application** ,Kenneth J.Ayala, Penram International Publishers, Mumbai, (2003)
6. **The 8051 Microcontroller** ,I. Scott MacKenzie, Raphael C.-W. Phan, , (4th edition), Pearson Education, (2008)- (Unit-V)

REFERENCE BOOKS:

1. **Principles of Electronics** -V.K.Mehta, Rohit Mehta, S.Chand and Company Pvt Ltd,[ISBN: 81-219-2450-2]
2. **Modern Physics** -R.Murugesan, (2013), S.Chand and Compant Pvt Ltd.
3. **Integrated electronics** - Jacob Millman, Christos Halkias, Chetan D Parikh, Second Edition, Tata McGraw hill
3. **Digital Circuits and Design** -S.Salivahanan, S.Arivazhagan, Third Edition, Vikas Publishing house Pvt Ltd

WEB REFERENCES:

1. http://web.pdx.edu/~pmoeck/books/Tipler_Llewellyn.pdf
2. <https://dokumen.tips/documents/integrated-electronics-jacob-millman-and-christos-hallkiaspdf.html>

Category	Course Type	Course Code	Course Title			Contact Hours	Credit (C)
Part III	Core: V Elective I	25PHP05A	Crystal Growth and Thin Films			48	3
Contact hours per week: 4							
Year		Semester	Internal Marks	External Marks	Total Marks		
I		I	25	75	100		
PREAMBLE: The aim is to equip students with an understanding of the principles, techniques, and mechanisms involved in crystal growth kinetics, crystallization, and thin film deposition, with a focus on applying these methods to various material growth processes and their characterization.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	Recall the basic concepts, principles, and techniques of crystal growth kinetics, crystallization, gel, melt, and vapour growth methods, and thin film deposition techniques.					K1	
CO2	Describe the principles behind nucleation, crystal growth, crystallization, and thin film formation, including methods like Czochralski growth, chemical vapour deposition, and physical vapour deposition.					K2	
CO3	Apply the different growth techniques (gel, melt, vapour) and thin film deposition methods (e.g., thermal evaporation, electron beam evaporation, sputtering, sol-gel) in material synthesis and fabrication.					K3	
CO4	Analyze various crystal growth processes, including epitaxial growth, and thin film formation mechanisms such as nucleation, structure formation, and thickness measurement techniques.					K4	
CO5	Evaluate the performance of different crystal growth methods (e.g., melt growth, Czochralski, hydrothermal) and thin film deposition techniques (e.g., sputtering, CVD, PVD) based on material quality and application suitability.					K5	
CO6	Create a systematic approach for selecting appropriate crystal growth and thin film deposition methods, considering material properties, deposition conditions, and characterization techniques.					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7

CO1	9	9	9	9	9	3	3
CO2	9	9	9	3	3	3	3
CO3	9	9	9	9	3	2	3
CO4	9	9	9	3	3	2	3
CO5	9	9	3	3	2	1	3
CO6	9	9	3	3	3	3	1
Total Contribution of COs to POs	54	54	42	30	23	14	16
Weighted Percentage of COs Contribution to POs	3.33	3.91	6.08	3.86	2.03	1.52	2.22

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

UNIT I : Crystal Growth Kinetics
(9 Hours)

Basic Concepts, Nucleation and Kinetics of growth Ambient phase equilibrium - super saturation - equilibrium of finite phases equation of Thomson - Gibbs - Types of Nucleation - Formation of critical Nucleus - Classical theory of Nucleation - Homo and heterogeneous formation of 3D nuclei - rate of Nucleation - Growth from vapour phase solutions, solutions and melts - epitaxial growth - Growth mechanism and classification - Kinetics of growth of epitaxial films

UNIT II: Crystallization Principles (9 Hours)

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

UNIT III: Gel, Melt And Vapour Growth (10 Hours)

Gel, Melt and Vapour growth techniques Principle of Gel techniques - Various types of Gel - Structure and importance of Gel - Methods of Gel growth and advantages - Melt techniques -

Czochralski growth - Floating zone - Bridgeman method - Horizontal gradient freeze - Flux growth - Hydrothermal growth - Vapour phase growth - Physical vapour deposition - Chemical vapour deposition - Stoichiometry.

UNIT IV: Thin Film Deposition Methods (10 Hours)

Thin film deposition methods of thin film preparation, Thermal evaporation, Electron beam evaporation, pulsed LASER deposition, Cathodic sputtering, RF Magnetron sputtering, MBE, chemical vapour deposition methods, Sol Gel spin coating, Spray pyrolysis, Chemical bath deposition.

UNIT V: Thin Film Formation (10 Hours)

Thin Film Formation and thickness Measurement Nucleation, Film growth and structure - Various stages in Thin Film formation, Thermodynamics of Nucleation, Nucleation theories, Capillarity model and Atomistic model and their comparison. Structure of Thin Film, Roll of substrate, Roll of film thickness, Film thickness measurement - Interferometry, Ellipsometry, Micro balance, Quartz Crystal Oscillator techniques.

TEXT BOOKS:

1. **Crystal growth for beginners:** Fundamentals of Nucleation, Crystal Growth and Epitaxy (2004), V. Markov, 2nd edition (Unit-I,II,III)
2. **Thin Film Fundamentals** (New Age, New Delhi, 2008), A. Goswami (UNIT – IV,V)
3. **Modeling of Crystal Growth Rates from Solution**, M. Ohora and R. C. Reid.
4. **Crystal Growth from High Temperature Solution**, D. Elwell and H. J. Scheel
5. **Crystal Growth in Gels**, Cambridge University Press. USA, Heinz K. Henish, 1973.

REFERENCE BOOKS:

1. **Crystal Growth Process**, J.C. Brice (John Wiley, New York, 1986)
2. **UGC Summer School Notes** P. Ramasamy and F. D. Gnanam, 1983.
3. **Crystal Growth Processes**, KRU Publications, P. Santhana Raghavan and P. Ramasamy.
4. **Crystal Growth**, H.E. Buckley, 1951, John Wiley and Sons, New York
5. **Crystal Growth**, B.R. Pamplin, 1980, Pergman Press, London.

WEB REFERENCES:

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/>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core: V Elective I	25PHP05B	Industrial Electronics	48	3
Contact hours per week: 4					
Year	Semester	Internal Marks	External Marks	Total Marks	

I	I	25	75	100			
PREAMBLE: The aim is to provide an in-depth understanding of power electronic devices, circuits, applications, sensors in robotics, and concepts in medical electronics, focusing on their operation, control, and real-world applications.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement			Knowledge Level			
CO1	Recall the basic concepts, construction, and operation of power electronic devices (SCR, UJT, DIAC, TRIAC, IGBT, SSR), and their characteristics. Understand the working principles of circuits such as rectifiers, inverters, and converters.			K1			
CO2	Explain the working of various power electronic devices and circuits used in DC drives, stepper motors, and uninterruptible power supplies (UPS). Describe the role of sensors in robotics, including tactile, proximity, and range sensors.			K2			
CO3	Apply the concepts of power electronics in the design of circuits like one-quadrant choppers, cycloconverters, and inverters for real-world applications such as DC motor drives, BLDC motors, and UPS systems.			K3			
CO4	Analyze the operational characteristics of power electronic circuits like SCR DC drives, multi-level inverters, and matrix converters. Investigate the role of machine vision and sensors in robotic systems for practical tasks.			K4			
CO5	Evaluate the effectiveness and limitations of different power electronic devices in motor drives and UPS systems. Assess the design and functionality of sensors and medical electronics like ECG, EEG, and MRI systems.			K5			
CO6	Design solutions for power electronic circuits, sensor integration in robotics, and medical imaging systems. Evaluate the performance and impact of these technologies in real-world applications such as automation, healthcare, and power management.			K6			
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	3	3
CO2	9	9	9	3	3	3	3
CO3	9	9	9	9	3	2	3
CO4	9	9	9	3	3	2	3
CO5	9	9	3	3	2	1	3

CO6	9	9	3	3	3	3	1
Total Contribution of COs to POs	54	54	42	30	23	14	16
Weighted Percentage of COs Contribution to POs	3.33	3.91	6.08	3.86	2.03	1.52	2.22

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

UNIT:1- Power Electronic Devices (9 Hours)

Construction, operation and I-V characteristics: Silicon controlled rectifiers (SCR) – Unijunction transistors (UJT) – Diode for alternating current (DIAC) – Triode for alternating current (TRIAC); Insulated gate bipolar junction transistor (IGBT); Solid state relay (SSR): SSR working concept using MOSFET – Main features and advantages.

UNIT:2- Power Electronic Circuits and Controls (9 Hours)

Converters: One quadrant choppers – Two quadrant choppers – Four quadrant choppers – Cycloconverters – Matrix converters; Rectifiers: Single-phase half-wave rectifiers – Single-phase full-wave rectifiers; Inverters: Single-phase inverters – Three-phase inverters – Multilevel inverters – Line-commutated inverters.

UNIT:3 - Applications of Power Electronic Devices (10 Hours)

DC motor basics – DC drive basics – SCR DC drives – Three phase brushless (BLDC) motor – Machine construction– Types and operation of Step Motors: Variable reluctance step motor – Drive circuits for variable reluctance step motors – Permanent magnet step motor – Control of step motor; Uninterruptible power supplies (UPS): UPS functions – Static UPS topologies – Rotary UPS.

UNIT:4 - Sensors in Robotics (10 Hours)

Transducers and sensors – Tactile sensors: Touch sensors – Force sensors (Stress sensors) – Tactile array sensors –Proximity and range sensors – Uses of sensors in robotics – Machine vision: Functions of a machine vision – Sensing and digitizing function: Imaging devices – Lighting techniques.

UNIT:5- Concepts of Medical Electronics (10 Hours)

Bioelectric signals and electrodes: Electrocardiogram (ECG) – Electroencephalogram (EEG) – Electromyogram (EMG); Electrode-tissue interface; Electrodes for ECG – Electrodes for EEG – Electrodes for EMG – Electrical conductivity of electrode gels and creams; Biomedical imaging system: Principle and Working of – X-ray machine, Computed tomography (CT) and Magnetic resonance imaging (MRI).

TEXT BOOKS

- 1. Industrial Electronics – Circuits, Instruments, and Control Techniques** by Terry Bartelt, Cengage Learning India Pvt. Ltd, New Delhi, 1st Indian Reprint: 2009.(Unit-I)
- 2. The Power Electronics Handbook** – Industrial Electronics Series Edited by Timothy L. Skvarenina, CRC press LLC, USA: 2002.(Unit-I,II,III)
- 3. Industrial Robotics**–Technology, Programming and Applications by Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Tata McGraw Hill Education Pvt Ltd,

New Delhi, Edition 2008, Ninth reprint: 2011.-(Unit-IV)

4. **Handbook of Biomedical Instrumentation**, R.S. Khandpur, Tata McGraw-Hill Publishing Company Ltd, New Delhi, Second edition: 2003(Unit-V)

REFERENCE BOOKS

1. **Modern Industrial Electronics** by Timothy J. Maloney, Prentice Hall, New Jersey, Third Edition: 1996.

2. **Electronic Devices and Circuits** by Anil K. Maini, Varsha Agrawal, Wiley India Pvt. Ltd., New Delhi, 1st Edition: 2009.

3. **Biomedical Instrumentation** by M. Arumugam, Anuradha Publications, Chennai, 10th Reprint: 2006.

WEB REFERENCES

1. Power Electronic Devices: <https://nptel.ac.in/courses/108/105/108105066/>

2. Power Electronics <https://nptel.ac.in/courses/108/102/108102145/>

3. Sensors and Controls in Robots: <https://nptel.ac.in/courses/112/101/112101098/>

4. Medical Image Analysis: <https://nptel.ac.in/courses/108/105/108105091/>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core: V Elective I	25PHP05C	Programming in Python	48	3
Contact hours per week: 4					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	I	25	75	100	
PREAMBLE: The Paper offers the understanding of basic principles in python and skills to create computer programs for small scale usage.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall syntax and semantics of various programming constructs.				K1
CO2	Illustrate the process of structuring data using lists, tuples, and dictionaries				K2
CO3	Identify appropriate programming structure for a given problem.				K3
CO4	Convert an algorithm into a python program				K4
CO5	Analyze the concepts of list and Dictionaries, Tuples				K5
CO6	Infer the object-oriented concepts in python				K6
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate					

CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	3	3
CO2	9	9	9	3	3	3	3
CO3	9	9	9	9	3	2	3
CO4	9	9	9	3	3	2	3
CO5	9	9	3	3	2	1	3
CO6	9	9	3	3	3	3	1
Total Contribution of COs to POs	54	54	42	30	23	14	16
Weighted Percentage of COs Contribution to POs	3.33	3.91	6.08	3.86	2.03	1.52	2.22
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs							
COURSE CONTENT							
UNIT I - Basics and Functions (9 Hours) The way of the program: What is a program? - Running Python. - The I program. - Arithmetic operators - Values and types - Variables, expressions and statements: Assignment statements - Variable names - Expressions and statements - Script mode - Order of operations - String operations Comments – Debugging. Functions: Function calls - Math functions - ComCOS - POSition – Adding new functions – Definition and uses - Flow of execution - Parameters and arguments- Variables and parameters are local - Fruitful functions and void functions - Why functions?							
UNIT II - Conditionals, Recursion, Iteration, Strings (9 Hours) Conditionals and Recursion: Floor division and modulus - Boolean expressions - Logical operators - Conditional execution - Alternative execution - Chained conditionals - Nested conditionals Recursion - Infinite recursion – Keyboard input. Fruitful functions: Return values Incremental development- ComCOS - POSition - Boolean functions. Iteration: Reassignment - Updating variables - The while statement - break -square roots - Strings: String is a sequence - Traversal with a for loop - String slices - Strings are immutable - Searching - Looping and counting -String methods- The in operator - String comparison.							
UNIT III - Lists (10 Hours) Lists: A list is a sequence - Lists are mutable - Traversing a list - List operations - List slices - List methods - Map, filter and reduce Deleting elements - Lists and strings Objects and values - Aliasing - List arguments							
UNITIV - Dictionaries, Tuples (10 Hours)							

Dictionaries: A dictionary is a mapping Dictionary as a collection of counters - Looping and dictionaries - Reverse lookup Dictionaries and lists - Memos - Global variables.
Tuples: Tuples are immutable - Tuple assignment - Tuples as return values - Variable length argument tuples - Lists and tuples . Dictionaries and tuples.

UNIT V - Oops Concept (10 Hours)

Object oriented Programming : Introduction to classes and objects- define class- object- encapsulation – inheritance-Internet Client Programming : Internet Clients – Transferring files – Network news- E- mail- Related modules

TEXT BOOKS:

1. **Murach's Python programming** ,Michel urban, Joel Murach, Mike Murach& Associates, I Indian Reprint , 2017-(Unit-I,II)
2. **Core PYTHON Applications programming**, Wesley J. Chun, Prentice Hall, Third Edition, 2013-(Unit-III,IV)
3. **Think Python: How to Think Like a Computer Scientist** ,Allen B. Downey, 2nd Edition 2012, O'Reilly-(Unit-V)

REFERENCE BOOKS:

1. **learning Python** ,Mark Lutz, O ' Reily media , Fifth Edition, 2013
2. **Fundamentals of Python I Programs** ,Kenneth A. Lambert,II Edition
3. **Use of Python**, Rashi Gupta, "Makinf", Willey publishing Inc

SEMESTER-II

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : VI	25PHP06	Mathematical Physics -II	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	II	25	75	100	
PREAMBLE: The aim is to provide students with mathematical tools such as vector analysis, group theory, complex variables, and tensor analysis essential for advanced studies in physical sciences. It also builds proficiency in matrix theory and probability distributions used in physical and statistical modeling					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall the key concepts in vector analysis, matrix algebra, group theory, complex variables, and tensor analysis.				K1
CO2	Understand mathematical structures such as groups, vector operations, and tensor notation used in physical problems.				K2

[illegible]

Normal distributions -central limit theorem

UNIT III - Group Theory (12 Hours)

Concept of a Group - Abelian group - Cyclic group - Unitary Group - Rearrangement theorem - Subgroups and Cosets - Conjugate elements and Classes - Isomorphism and Homomorphism-

Representation of Groups – Reducible and Irreducible Representation - Orthogonality theorem – Character of a Representation – Character Table

UNIT IV- Complex Variables (12 Hours)

Analytic Function-Cauchy-Riemann Equation-C-R in polar form-complex Integration-Cauchy integral Theorem-Cauchy integral formula- Taylor's Series and Laurent's Series-singular points and their classification- Cauchy-Residue theorem – Residue – Calculation of residue at simple poles and poles of higher order- Evaluation of definite integrals – Integration around unit circle – Rectangular Contour

UNIT V - Tensor Analysis (12 Hours)

Tensors – Co- ordinate Transformation – Summation Convention – Algebraic Operations on Tensors -Quotient law- Symmetric and Antisymmetric Tensors- Kronecker Tensor – Contravariant, Covariant and Mixed tensors - Invariant Tensor - Levi-Civita symbol- Christoffel's 3-Index Symbols –Geodesics

Text Books:

1. **Mathematical Physics**, SathyaPrakash, 2002, Sultan Chand & Sons. [ISBN: 81-7014-925-8] (Unit I, III, V)
2. **Mathematical Physics**, H.K. Dass & Rama Verma, 8th edition, S.Chand publishing, 2022 – (Unit II, IV, V)
3. **Elements of group theory for Physicists**, A.W. Joshi, -Wiley Eastern, 2002

Reference books:

1. **Mathematical Physics**, B.D.Gupta, Vikas Publishing House, 4th edition, 2010
2. **Advanced Engineering Mathematics**, Erwin Kreyszig, 10th Edition, John Wiley & Sons, inc
3. **Mathematical methods for Physics**, G. Arfken Elsevier, 6th edition, 2010
4. **Mathematical Methods in the Physical Sciences**, Mary L. Boas

WEB REFERENCES:

1. Ordinary and partial differential equations and applications by Prof. P.N.Agarwal, D.N. Pandey, IIT Roorkee, Swayam
2. [Selected topics in mathematical Physics](#), Prof. V. Balakrishnan, IIT Madras (NPTEL)

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : VII	25PHP07	Quantum Mechanics – II	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	II	25	75	100	

PREAMBLE: The aim is to develop students' conceptual and mathematical understanding of many-electron systems, scattering theory, radiation processes, relativistic quantum mechanics, and quantum field theory. It builds skills for analyzing and quantizing physical systems beyond non-relativistic quantum mechanics

COURSE OUTCOME: On the successful completion of the course, students will be able to

COs	Course Statement	Knowledge Level
CO1	Recall the key concepts of many-electron atoms, scattering theory, semi-classical theory of radiation, relativistic wave equations, and quantization of fields.	K1
CO2	Illustrate the Pauli principle, Hartree-Fock method for many-electron systems, Born approximation, and the use of Maxwell's equations in absorption and emission phenomena.	K2
CO3	Apply models like the Born approximation, transition probability in semi-classical theory, and the Dirac equation for relativistic particles, with relevant examples.	K3
CO4	Analyze the impact of relativistic wave equations and quantization techniques on the behavior of particles, including applications in scattering and field theory.	K4
CO5	Evaluate the applications of the Klein-Gordon and Dirac equations, and analyze field quantization, including Bose and Fermi statistics, in the context of quantum systems.	K5
CO6	Formulate advanced applications of scattering theory, radiation theory, and field quantization to solve complex problems in many-electron systems and quantum field theory.	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	3	9	9
CO2	9	9	9	9	9	3	3
CO3	9	9	9	9	9	3	3
CO4	9	9	9	9	9	3	3
CO5	9	9	9	9	3	3	1
CO6	9	9	3	3	3	1	1
Total Contribution of COs to	54	54	48	48	36	22	20

COURSE CONTENT	
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Indistinguishable particles – Pauli principle - Inclusion of spin – spin functions for two-electrons- The Helium Atom – Central Field Approximation - Thomas-Fermi model - Hartree - Fock method for many electron system

Scattering cross section - Scattering Amplitude – Green's Functions - Born Approximation
– validity of Born Approximation - Partial wave analysis – Asymptotic Solution - Phase
Shifts - Optical theorem – Breit – Wigner Formula

Absorption and Induced Emission: Maxwell's equations - Plane electromagnetic waves - Use of perturbation theory - Transition probability - Interpretation in terms of absorption and emission - Electric dipole transitions - Forbidden transitions.

Spontaneous Emission: Classical radiation field – Asymptotic form – Radiated Energy – Dipole radiation – Angular momentum – Dipole case – Conversion from classical to quantum theory – Planck distribution formula – Line breadth.

Klein-Gordon Equation-Plane Wave Solution-Charge and Current Densities – Interaction with Electromagnetic Fields - Dirac Relativistic Equation for a Free Particle - Dirac Matrices - Negative Energy States- Dirac Equation in Electromagnetic Field

Quantization of Wave Fields – Quantisation Procedure for particles – Lagrangian formulation – Hamiltonian formulation – Quantum field equations – Quantisation of Schrodinger equation – creation, Annihilation and Number operators – Bose statistics – Fermi statistics

1. **Quantum Mechanics**, G. Aruldas, Prentice Hall of India, 2013 (Unit I)
2. **Quantum Mechanics** (III ed.), Schiff, L.I.: McGraw Hill, 2010, ISBN-0-07-085643-5 (Unit III)
3. **Quantum Mechanics**, Satyaprakash & Swati Satya: Kedar Nath Ram Nath & Co, 2006 (Unit IV)
4. **A Text Book of Quantum Mechanics**, Mathews, P.M. & Venkatesan, K., Tata McGraw Hill, 1978, ISBN 0-07-096510-2. (Unit II, IV)
5. **Quantum Mechanics**, Dr.S.L.Gupta, Jai Prakash Nath Publications 2018 (Unit IV, V)

1.Introduction to Quantum Mechanics –David J Griffiths– Pearson- 2nd edition- 2016.
[ISBN: 978-93-325-4289-1]

2.Quantum Mechanics, V. Devanathan, 2005, Narosa Publishing House, New Delhi.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/115/103/115103104/>
2. <https://nptel.ac.in/courses/115/106/115106065/>
3. <https://nptel.ac.in/courses/115/106/115106065/>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : VIII	25PHP08	Numerical Methods & MATLAB Programming	60	3
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	II	25	75	100	
PREAMBLE: This course aims to equip students with a solid foundation in numerical methods including interpolation, differentiation, integration, and MATLAB programming.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall fundamental concepts of interpolation and finite differences including Newton’s, Stirling’s, and Lagrange’s methods.				K1
CO2	Explain numerical methods for solving equations and differential equations such as Bisection, Newton-Raphson, Euler, and Runge-Kutta methods.				K2
CO3	Apply appropriate numerical integration techniques (Trapezoidal, Simpson’s rules, Gaussian quadrature) to estimate definite integrals..				K3
CO4	Analyze MATLAB’s computational environment to perform arithmetic operations, function plotting, and basic data processing.				K4
CO5	Evaluate numerical algorithms through MATLAB programming using control structures, I/O commands, and graphical visualization techniques.				K5
CO6	Create MATLAB programs to solve practical problems involving interpolation, integration, and differential equations, and generate 2D/3D visual outputs.				K6
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate					
CO-PO MAPPING (COURSE ARTICULATION MATRIX)					

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	3	9	9
CO2	9	9	3	9	3	9	9
CO3	9	9	3	3	9	9	9
CO4	9	3	3	3	3	3	9
CO5	9	3	3	3	3	3	3
CO6	0	3	3	3	1	3	3
Total Contribution of COs to POs	45	36	24	30	22	36	42
Weighted Percentage of COs Contribution to POs	5.31	4.78	4.13	6.14	5.05	9.52	16.09

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

UNIT I - Interpolation & Finite Differences	(12 Hours)
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Interpolation-Newton's formula for equal intervals-Central difference Interpolation formulae-Gauss's Interpolation formula-Stirling's formula, Bessel's formula & Everett's formula-Lagrange's formula for unequal intervals -Inverse Interpolation-Extrapolation-Finite difference-difference table-Forward, Backward & Central Differences.

UNIT II - Numerical Differentiation (12 Hours)

Finding Roots of a Polynomial-Bisection Method-Newton Raphson Method-Solution of Simultaneous Linear Equation by Gauss Elimination Method (includes inverse of matrices)-Solution of Ordinary Differential Equation by Euler, Runge-Kutta Fourth Order Method for solving I order Ordinary Differential Equations.

UNIT III - Numerical Integration (12 Hours)

Newton's cotes formula-Trapezoidal rule-Simspon's 1/3 rule- Simspson's 3/8 rule -Gaussian quadrature method-(2 point and 3 point formulae)-Giraffe's root square method for solving algebraic equation.

UNIT IV - Matlab Fundamentals (12 Hours)

Introduction-MATLAB Features-Desktop windows: Command, Workspace, Command History, Array Editor and Current Directory -MATLAB Help and Demos- MATLAB Functions, Operators and Commands. Basic Arithmetic in MATLAB-Basic Operations with Scalars, Vectors and Arrays -MATLAB Built-In Functions- Saving and loading data – Plotting simple graphs- Illustrative Examples.

UNIT V - Matlab Programming & Graphics (12 Hours)

Control Flow Statements: if, else, else if, switch Statements-for, while Loop Structures-break Statement- Input/output Commands -Controlling Output –Applications – (Numerical

Integration – Ordinary differential equations)-2D Plots-Planar Plots, Log Plots, Scatter Plots, Contour Plots- Using subplot to Layout multiple graphs-Titles, Labels, Text in a Graph- Line Types, Marker types, Colors-3D Graphics-Curve Plots-Mesh and Surface Plots- Errors - Illustrative Examples.

TEXT BOOKS:

1. **Numerical methods** - Kandasamy. P, Thilagavathi. K, Volume I and II, 2004, S. Chand and Company Ltd, New Delhi. (Units I-III)
2. **Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers**, RudraPratap, 2003, Oxford University Press. (Units IV & V)
3. **MATLAB An Introduction with Applications** - Amos Gilat, 2007, John Wiley & Sons, Inc., U.K. [ISBN: 978-81-26511394-9] (Units IV & V)

REFERENCE BOOKS:

1. **Numerical methods in Science and Engineering**, M.K. Venkataraman, 1996, National Publishing Co. Madras.
2. **Engineering and Scientific Computations Using MATLAB**, Sergey E. Lyshevski, 2003, JohnWiley&SonsInc, publication. [ISBN 0-471-46200-4]
3. **Numerical Methods Using Matlab**, John Mathews & Kurtis Fink, 2006, Prentice Hall, New Jersey.
4. **Introductory Methods of Numerical Analysis**, S.S. Sastry, 2005, Prentice Hall.
5. **Introduction to MATLAB 7 for Engineers**, William John Palm, 2005, McGraw, Hill Professional.
6. **Introduction to MATLAB 7**, Dolores M. Etter, David C. Kuncicky, 2004, Prentice Hall.

WEB REFERENCES:

1. <http://demo.prahu-hub.com/A2C1ED269A17F/numerical-methods-by-kandasamy-thilagavathygunavathy.pdf>
2. <https://rahulpatel121.files.wordpress.com/2018/07/s-s-sastry-introductory-methods-of-numerical-analysis-2012-phi-learning-pvt-ltd.pdf>
3. <https://www.slideshare.net/slideshow/numerical-methods-2/12784930>
4. https://www.ugierkl.ac.in/lecture_files/interpolation_1679396868.pdf
5. <https://www.slideshare.net/slideshow/matlab-tutorialppt/255185098>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : IX	25PHP09	Advanced Physics Practical-I	96	4
Contact hours per week: 3+5					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	I & II	40	60	100	

PREAMBLE: The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipment used

COURSE OUTCOME: On the successful completion of the course, students will be able to

COs	Course Statement	Knowledge Level
CO1	identify the basic concepts of experiments related to theories in Modern Physics recognize various commands and formulae in MATLAB	K1
CO2	illustrate the working principles of various experimental setups	K2
CO3	use different experimental setup to study various physical properties of solids and liquids apply the formulae to calculate the output values for various experiments implement the procedures of solving physical problems to write and process the MATLAB programs	K3
CO4	compare and contrast the various methods of determination of various physical constants and values correlate the relations between theoretical values and experimental observations	K4
CO5	observe the output values of the physical process using required experimental setups assess rectify the errors if any in the execution of MATLAB programs	K5
CO6	design the desired circuit to carry out the required experiment and justify the observed values rewrite the MATLAB program based on the requirements of the specific problem	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	3
CO2	9	9	9	9	9	9	3
CO3	9	9	3	3	9	9	1
CO4	9	9	3	3	3	3	1
CO5	9	9	3	3	3	3	1
CO6	3	3	0	3	0	3	0
Total Contribution of COs to POs	48	48	27	30	33	36	9
Weighted Percentage	5.66	6.38	4.64	6.14	7.58	9.52	3.44

of COs Contribution to POs							
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs							
COURSE CONTENT							
S.No	Course Content	Instructional Hours					
1	Young's Modulus-Elliptical Fringes (Cornu's Method)	96					
2	Young's Modulus-Hyperbolic Fringes (Cornu's Method)						
3	Viscosity of a Liquid-Mayer's Oscillating Disc						
4	Stefan's Constant						
5	Rydberg's Constant-Solar Spectrum						
6	Thickness of Wire by Air Wedge and Diffraction						
7	Determination of Audio Frequencies-Bridge Method						
8	Thermionic Work Function						
9	Thermal Conductivity-Forbe's Method						
10	Electronic Charge 'e' by Millikan's Oil Drop Method						
11	Electronic Specific Charge 'e/m' by Thomson's Method						
12	Thermistor-Temperature Coefficient and Band Gap Energy						
13	Determination Specific Heat of a Liquid-Ferguson's Method						
14	Biprism on Optical Bench-Determination of Wavelength						
15	He-Ne Laser –Measurement of Wavelength using reflectancegrating.						
16	Babinet's Compensator						
17	LG Plate-Resolving Power						
18	Thickness of the wire by diffraction						
19	Fabry-Perot Interferometer-Study of Fine Structure						
20	Geiger Muller Counter-Determination of Half Life of 'In'						

21	MATLAB Programming-Roots of a Quadratic Equation & Solution of a System of Linear Equations	
22	MATLAB Programming – Solution of Ordinary Differential Equations	
23	MATLAB Programming -Runge-Kutta Method	
24	MATLAB Programming -Newton-Raphson Method	
25	MATLAB Programming-Mean, Median & Standard Deviation	
26	MATLAB Programming-Curve Fitting & Interpolation	
27	MATLAB Programming-Matrix Summation, Subtraction and Multiplication	
28	MATLAB Programming-Matrix Inversion and Solution of Simultaneous Equations	
29	He-Ne Laser – Measurement of refractive index of liquids.	
30	He-Ne Laser – Power distribution measurement.	
31	He-Ne Laser – Thickness of Wire	

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : X	25PHP10	General Electronics Practical-I	96	4
Contact hours per week: 3+5					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	I & II	40	60	100	
PREAMBLE: The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipment used					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	demonstrate and explain basic electrical and electronic components and different types of circuits recognize various commands and formulae in MATLAB				K1
CO2	interpret the working principles of the electronic circuits express the applications of diodes, OP-AMP, BJT, SCR, FET and UJT				K2

CO3	use CRO and AFO to analyze and study various waveforms and its amplitude and frequency controls apply the circuit equations to calculate the output values for various electronic circuits relate the electronic circuit analysis to write and process the MATLAB program.	K3
CO4	compare and contrast the various circuits for the specific application correlate the relations between theoretical values and experimental observations construct various electronic circuits using diodes, OP-AMP, BJT, SCR, FET and UJT	K4
CO5	measure the output values of the constructed circuits using required tools assess rectify the errors if any in the execution of MATLAB programs	K5
CO6	design the desired circuit based on the parameters and properties of the various electronic components rewrite the MATLAB program based on the requirements of the specific problem	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	3
CO2	9	9	9	9	9	9	3
CO3	9	9	3	3	9	9	1
CO4	9	9	3	3	3	3	1
CO5	9	9	3	3	3	3	1
CO6	3	3	0	3	0	3	0
Total Contribution of COs to POs	48	48	27	30	33	36	9
Weighted Percentage of COs Contribution to POs	5.66	6.38	4.64	6.14	7.58	9.52	3.44

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

S.No	Course Content	Instructional
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		Hours
1	Design of Regulated and Dual Power Supply.	96
2	Basic Logic Gates-Digital IC's	
3	Parameters of Op-Amp	
4	Design of Wave Form Generators- using Op-Amp.	
5	Design of Phase-Shift Oscillator- Op-Amp	
6	Design of Wein's Bridge Oscillator- Op-Amp	
7	Design of Active Filters- Op-Amp	
8	Design of Differential Amplifier- Op-Amp	
9	Sign Changer, Scale Changer, Adder and Subtractor- Op-Amp	
10	Design of UJT Relaxation Oscillator	
11	CRO-Differentiating, Integrating, Clipping and Clamping Circuits, Square Wave Testing	
12	SCR-Characteristics and an Application	
13	Source Follower	
14	Amplifier-Inverting, Non-Inverting, Voltage Follower- Op-Amp	
15	Characteristics of FET	
16	Digital IC's- Counters	
17	Schmitt Trigger using discrete components and OP-AMP/ Timer 555	
18	D/A converter using Op. Amp	
19	MATLAB Programming-Charging of a Capacitor in an RC Circuit with three Time Constants	
20	MATLAB Programming- Full Wave Rectifier- Determination of (a) Peak-to-Peak Value of Ripple Voltage, (b) DC Output Voltage (c) Discharge Time of the Capacitor (d) Period of Ripple Voltage	
21	MATLAB Programming- Plot of Voltage and Current of an RLC Circuit under Steady State Conditions	
22	MATLAB Programming- NPN Transistor-Plotting Input & Output Characteristics	
23	MATLAB Programming-Frequency Response of a Low Pass Op-Amp Filter Circuit	

24	MATLAB Programming-Diode-Plot of Forward Characteristics & Load Line Plot - Estimation of Operating Point.	
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Category	Course Type	Course Code	Course Title			Contact Hours	Credit (C)
Part III	Core : XI Elective : II	25PHP11A	Physics of Nanoscience and Technology			36	3
Contact hours per week: 3							
Year	Semester		Internal Marks	External Marks	Total Marks		
I	II		25	75	100		
PREAMBLE: The aim is to explore the fundamentals of nanoscience and technology, including the properties, synthesis, fabrication, and characterization techniques of nanomaterials, as well as their applications in sensors, electronics, medicine, and energy.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	Recall the fundamental principles, historical perspective, and classification of nanomaterials, including 1D, 2D, and 0D nanostructured materials.					K1	
CO2	Explain the physical, mechanical, optical, electrical, and magnetic properties of nanomaterials and their applications.					K2	
CO3	Apply various synthesis and fabrication techniques like PVD, CVD, sol-gel, electrochemical deposition, and nanolithography to create nanomaterials.					K3	
CO4	Analyze the properties and behavior of nanomaterials through characterization techniques such as X-ray diffraction, SEM, TEM, SPM, and STM.					K4	
CO5	Evaluate the functionality and performance of different types of nanomaterials and nanotechnologies in applications like sensors, nanoelectronics, and energy storage.					K5	
CO6	Create novel applications for nanomaterials in medicine, energy, and environmental sectors, and assess the potential impact of these materials in practical implementations.					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	3	3	9	9	9

CO2	9	9	3	3	9	9	9
CO3	9	9	3	3	9	9	9
CO4	9	9	1	1	9	9	3
CO5	9	3	1	1	9	9	1
CO6	9	3	1	1	9	9	1
Total Contribution of COs to POs	54	42	12	12	54	54	32
Weighted Percentage of COs Contribution to POs	3.33	3.04	1.25	1.71	4.77	5.86	4.44

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

UNIT I - Fundamentals of Nanoscience and Technology (8 Hours)

Fundamentals of NANO – Historical Perspective on Nanomaterial and Nanotechnology – Classification of Nanomaterials – Metal and Semiconductor Nanomaterials - 2D, 1D, 0D nanostructured materials - Quantum dots – Quantum wires – Quantum wells - Surface effects of nanomaterials.

UNIT II - Properties of Nanomaterials (7 Hours)

Physical properties of Nanomaterials: Melting points, specific heat capacity, and lattice constant - Mechanical behavior: Elastic properties – strength - ductility - superplastic behavior - Optical properties: - Surface Plasmon Resonance – Quantum size effects - Electrical properties - Conductivity, Ferroelectrics and dielectrics - Magnetic properties – super para magnetism – Diluted magnetic semiconductor (DMS).

UNIT III - Synthesis and Fabrication (7 Hours)

Physical vapour deposition - Chemical vapour deposition - sol-gel – Wet deposition techniques - electrochemical deposition method – Plasma arching - Electrospinning method - ball milling technique - pulsed laser deposition - Nanolithography: photolithography – Nanomanipulator.

UNIT IV - Characterization Techniques (7 Hours)

Powder X-ray diffraction – X-ray photoelectron spectroscopy (XPS) - UV-visible spectroscopy – Photoluminescence - Scanning electron microscopy (SEM) - Transmission electron microscopy (TEM) - Scanning probe microscopy (SPM) - Scanning tunneling microscopy (STM) – Vibrating sample Magnetometer.

UNIT V - Applications of Nanomaterials (7 Hours)

Sensors: Nanosensors based on optical and physical properties - Electrochemical sensors – Nano-biosensors. Nano Electronics: Nanobots - display screens - GMR read/write heads - Carbon Nanotube Emitters – Photocatalytic application: Air purification, water purification - Medicine: Imaging of cancer cells – biological tags - drug delivery - photodynamic therapy - Energy: fuel cells - rechargeable batteries - supercapacitors - photovoltaics.

TEXT BOOKS

1. **A textbook of Nanoscience and Nanotechnology**, Pradeep T., Tata McGraw-Hill Publishing Co. (2012).(Unit-IV,V)
2. **Principles of Nanoscience and Nanotechnology**, M.A. Shah, Tokeer Ahmad, Narosa Publishing House Pvt Ltd., (2010). Unit-I,II)
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).(Unit-III)
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** – Huozhong Gao – 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 REFERENCES

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>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : XI Elective : II	25PHP11B	Solar Energy Utilization	36	3
Contact hours per week: 3					
Year	Semester	Internal Marks	External Marks	Total Marks	
I	II	25	75	100	
PREAMBLE: The aim is to equip students with the fundamental principles and practical applications of solar energy systems, including heat transfer, solar collectors, photovoltaic cells, and the use of nanomaterials in fuel cells, preparing them to critically assess and innovate in the field of renewable energy.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					

COs	Course Statement						Knowledge Level
CO1	Recall the basic principles of heat transfer (conduction, convection, and radiation), solar radiation analysis, and the operation of solar energy measuring instruments.						K1
CO2	Describe the different types of solar collectors, including flat plate and focusing collectors, and explain their thermal performance evaluation methods and optical loss considerations.						K2
CO3	Apply the principles of solar heaters, including types of solar water heaters, their components (collectors, storage tanks), and systems such as solar ponds and cooling systems, to real-world applications.						K3
CO4	Analyze the working principles of photovoltaic systems, including the types of solar cells, process flow for silicon-based solar cells, and the approaches used in their production (texturization, diffusion, antireflective coatings).						K4
CO5	Evaluate the role of nanomaterials in fuel cell technology, focusing on their use in fuel cell catalysts, electrolytes, and hydrogen production and storage.						K5
CO6	Create a comprehensive approach to integrating solar energy systems and nanomaterials in renewable energy applications, such as solar photovoltaic systems and fuel cells, to optimize their performance and energy efficiency.						K6
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	3	3	9	9	9
CO2	9	9	3	3	9	9	9
CO3	9	9	3	3	9	9	9
CO4	9	9	1	1	9	9	3
CO5	9	3	1	1	9	9	1
CO6	9	3	1	1	9	9	1
Total Contribution of COs to POs	54	42	12	12	54	54	32
Weighted Percentage of COs Contribution	3.33	3.04	1.25	1.71	4.77	5.86	4.44

XHcwZo9XwC&sitesec=buy&source=gbs_vpt_read
3. www.nptel.ac.in/courses/112105051
4. www.freevideolectures.com
5. http://www.e-booksdirectory.com

Category	Course Type	Course Code	Course Title		Contact Hours	Credit (C)	
Part III	Core : XI Elective : II	25PHP11C	Fundamentals of Data Sciences		36	3	
Contact hours per week: 3							
Year		Semester	Internal Marks	External Marks	Total Marks		
I		II	25	75	100		
PREAMBLE: This Paper offers the basic understanding and knowledge of different data structures, sorting algorithms and symbol tables							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	Recall the various data structures, algorithms and sorting methods					K1	
CO2	Describe the basic concepts of data structures, sorting and symbol table					K2	
CO3	Use appropriate data structures for varied problems					K3	
CO4	Examine different data structures and algorithms to find best solution for the real time applications					K4	
CO5	Recommend a specific data structure and sorting algorithm for an application.					K5	
CO6	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	3	3	9	9	9

COURSE CONTENT	
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Symbol Tables - Static Tree Tables - Dynamic Tree Tables - Hash Tables

3. **Data Structures and Algorithms Concepts**, G A V PAI, Techniques Applications, McGraw Hill Education, New Delhi.

Category	Course Type	Course Code	Course Title			Contact Hours	Credit (C)
PART – IV	ABILITY ENHANCEMENT	25AEP01	CYBER SECURITY			24	2
Contact hours per week: 2							
Year		Semester	Internal Marks	External Marks	Total Marks		
I		II	100	-	100		
PREAMBLE: The aim is to provide the students, the basics of cyber security and the security threats in day-to-day activities.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	Recall the basic concepts of information security and its types					K1	
CO2	Gain knowledge on cyber space issues and cyber security measures					K2	
CO3	Identify various risks and threats in cyber space					K3	
CO4	Apply security measures to prevent ourselves from threats in social media					K4	
CO5	Compare various social media, security issues and measures					K5	
CO6	Propose a secured cyber platform for people to connect each other for their social and professional concerns					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	3
CO2	9	9	9	9	9	9	3
CO3	9	9	9	9	9	9	3
CO4	9	9	9	9	3	3	3

6. <https://cyber security in banking 4 trends to watch in 2017.html>
7. <https://gmail hacking security tips-indian cyber security solutions.html>
8. <https://why social media sites are the new cyber weapons of.html>
9. EBook:A complete guide to Staying Ahead in the Cyber Security Game

SEMESTER-III

Category	Course Type	Course Code	Course Title			Contact Hours	Credit (C)
Part III	Core : XII	26PHP12	Atomic and Molecular Spectroscopy			60	4
Contact hours per week: 5							
Year		Semester		Internal Marks	External Marks	Total Marks	
II		III		25	75	100	
PREAMBLE: The aim is to develop a comprehensive understanding of atomic and molecular spectroscopy, including microwave, IR, Raman, electronic, and magnetic resonance techniques. It equips students to analyze spectral data and understand molecular structure and interactions.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	outline the Atomic Spectra and Study the microwave spectra					K1	
CO2	explain the concepts in Atomic and Molecular Spectroscopy					K2	
CO3	apply the concepts to understand the properties of molecules					K3	
CO4	analyze the properties of atoms and molecules using different types of Spectroscopy					K4	
CO5	choose appropriate spectroscopy to analyze atoms and molecules					K5	
CO6	develop spectrum of molecules of different types by applying the concepts					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	9
CO2	9	9	9	9	3	3	3

CO3	9	9	3	3	3	1	3
CO4	9	9	3	3	3	1	3
CO5	9	3	3	1	3	1	1
CO6	9	3	3	1	1	1	1
Total Contribution of COs to POs	54	42	30	26	22	16	20
Weighted Percentage of COs Contribution to Pos	6.37	5.58	5.16	5.32	5.05	4.23	7.66

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos

COURSE CONTENT

UNIT I – Atomic & Microwave Spectroscopy (12 Hours)

Atomic Spectroscopy - Spectra of Alkali Metal Vapours - Normal Zeeman Effect - Anomalous Zeeman Effect - Magnetic Moment of Atom and the G Factor - Lande's 'g' Formula - Paschen Back Effect – Hyperfine Structure of Spectral Lines

Microwave Spectroscopy - Experimental Methods - Theory of Microwave Spectra of Linear and Symmetric Top Molecules - Hyperfine Structure

UNIT II - Infrared and Raman Spectroscopy (12 Hours)

IR Spectroscopy - Practical Aspects - Theory of IR Rotation Vibration Spectra of Gaseous Diatomic Molecules – Applications - Basic Principles of FTIR Spectroscopy

Raman Spectroscopy - Classical and Quantum Theory of Raman Effect - Rotation Vibration Raman Spectra of Diatomic and Polyatomic Molecules – Applications - Laser Raman Spectroscopy

UNIT III - Electronic Spectroscopy (12 Hours)

Excitation of Diatomic Species - Vibrational Analysis of Band Systems of Diatomic Molecules - Deslandre's Table - Intensity Distribution - Franck Condon Principle - Rotational Structure of Electronic Bands – basics of Fluorescence and Phosphorescence spectroscopy

UNIT IV - NMR & NQR Spectroscopy (12 Hours)

NMR Spectroscopy - Quantum Mechanical and Classical Description - Bloch Equations - Relaxation Processes - Experimental Technique- Chemical Shift.

NQR Spectroscopy -Fundamental Requirements - General Principle - Experimental Detection of NQR Frequencies - Interpretation and Chemical Explanation of NQR Spectroscopy

UNIT V - ESR & Mossbauer Spectroscopy (12 Hours)

ESR Spectroscopy - Basic Principles- Experiments - ESR Spectrometer - ESR Spectrum - Hyperfine Structure

Mossbauer Spectroscopy - Mossbauer Effect - Recoilless Emission and Absorption - Mossbauer Spectrum- Experimental Methods - Hyperfine Interaction

TEXT BOOKS:

1. **Molecular Structure and Spectroscopy**, G.Aruldas, 2011, PHI Learning Private Limited Unit (I-V)

2. **Fundamentals of Molecular Spectroscopy**, C.N. Banwell and E.M. McCash, 2013, McGraw Hill Education Private Limited Unit (I-V)

REFERENCE BOOKS:

1. **Spectroscopy (Atomic and molecular)**, G. R. Chatwal and S. K. Anand, Himalaya Publishing House, 5/e, 2016.

WEB REFERENCES:

1. https://books.google.co.vi/books?id=z08q2SyROjoC&printsec=frontcover&source=gbbs_ge_sum_mary_r&cad=0

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core :XIII	26PHP13	Nuclear & Particle Physics	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	III	25	75	100	
PREAMBLE: The objective is to develop a comprehensive understanding of nuclear properties, models, decay processes, and particle physics. It equips students to analyze nuclear interactions, experimental techniques, and fundamental particles in modern physics.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall key concepts of nuclear structure, models, decay processes, and fundamental particles.				K1
CO2	Explain nuclear properties, decay mechanisms, models, and particle classifications.				K2
CO3	Apply nuclear theories and models to solve problems involving binding energy, decay, and reactions.				K3
CO4	Analyze nuclear models, decay spectra, and reaction data to interpret nuclear behavior.				K4
CO5	Evaluate the limitations of nuclear models and instrumentation techniques for various applications.				K5
CO6	Design experimental setups or propose models to investigate advanced nuclear and particle physics phenomena.				K6

Collective model: Qualitative description of Collective model

UNIT III- Decay and Reactions (12 Hours)

Alpha decay - Gamow's theory of Alpha decay - Beta decay - Fermi's theory of beta decay
Gamma decay - Kinematics of Gamma decay – Spectrum – Internal conversion – Selection rules.

Nuclear Reactions : Cross section of nuclear reactions - Compound nucleus model – Breit Wigner single level formula

Fission & Fusion : Characteristics of fission – Mass distribution of fragments- Bohr-Wheeler's theory of nuclear fission- Basic fusion processes -Characteristics of fusion.

UNIT IV - Instrumentation and Applications (12 Hours)

Detectors - Ionization Chamber – Geiger-Muller counter – Scintillation detectors –
Accelerators - Linear Accelerator – Cyclotron – Large Hadron Collider - Applications

UNIT V- Particle Physics (12 Hours)

Interactions– Strong – Electromagnetic – Weak – Gravitational – Leptons and Quarks –
Baryon number – Isospin – Resonance Particles – Strangeness and Strange particles –
Hypercharge – Charge conjugation – Time reversal – Parity - CPT Theorem – Eightfold Way
– Baryon Octet – Meson octet – Hypercharge vs Isospin – Baryon decuplet - Conservation laws – Ideas of Standard model and Higgs particle

Text books

1. Nuclear Physics - D.C. Tayal, 2001, Himalaya Pub. House, New Delhi. Unit (I-V)
2. Nuclear Physics by S.N. Ghoshal 2019, S Chand Publishing. Unit (I-V)
3. Introductory Nuclear Physics, K.S. Krane, Wiley India Ltd. 2008

Reference books

1. Nuclear Physics – Principles and Applications, John Lilley, Wiley India, 2006
2. Nuclear Physics, V. Devanathan, Narosa, 2012

WEB REFERENCES:

1. <https://ocw.mit.edu/courses/8-701-introduction-to-nuclear-and-particle-physics-fall-2020/pages/lecture-slides/>
2. https://onlinecourses.nptel.ac.in/noc21_ph26/preview

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : XIV	26PHP14	Electromagnetic Field Theory	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	III	25	75	100	

PREAMBLE: The course aims to develop a strong foundation in electrostatics, magnetostatics, classical electrodynamics, and electromagnetic wave propagation. It equips students to analyze electromagnetic phenomena using Maxwell's equations and relativistic formulations.

COURSE OUTCOME: On the successful completion of the course, students will be able to

COs	Course Statement	Knowledge Level
CO1	learn about Coulomb's law and apply Gauss's law to determine electric fields for various symmetrical charge distributions.	K1
CO2	explain the Laplace's and Poisson's equations for electrostatic potentials under different boundary conditions.	K2
CO3	apply Biot-Savart law and Ampere's law to compute magnetic fields from steady currents.	K3
CO4	analyze magnetic fields in matter and interpret boundary conditions and magnetization effects.	K4
CO4	evaluate the electrostatic energy and potential for localized charge distributions and conductors.	K5
CO5	compare and contrast electrostatics and magnetostatics, and explain magnetic vector potentials.	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	9
CO2	9	9	9	9	3	3	3
CO3	9	9	3	3	3	1	3
CO4	9	9	3	3	3	1	3
CO5	9	3	3	1	3	1	1
CO6	9	3	3	1	1	1	1
Total Contribution of COs to POs	54	42	30	26	22	16	20
Weighted Percentage of COs Contribution to Pos	6.37	5.58	5.16	5.32	5.05	4.23	7.66

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos

COURSE CONTENT					
UNIT I - Electrostatics (12 Hours) Coulomb's law-Gauss law-differential and integral representation-Electric field-Electric potential-Method of images-Multipole expansions. UNIT II - Magnetostatics (12 Hours) Lorentz force law- Biot-Savart law – condition for steady electric current - Ampere's law – Application of Ampere's law – comparison of Magnetostatics and Electrostatics – Magnetic vector potential – Magneto static boundary conditions UNIT III - Classical Electrodynamics (12 Hours) Electromotive force – ohms law – Faradays law – Induced electric field – Energy in magnetic fields – Maxwell's equation in free space – Magnetic charge - Maxwell's equation in matter – Boundary conditions on the fields at interface - Conservation laws – Conservation of energy – Poynting's theorem - conservation of momentum UNIT IV - Electromagnetic waves & interaction with matter (12 Hours) Electromagnetic waves in vacuum – Energy and momentum of EMW – EMW in matter – Propagation in linear media – Reflection and transmission at Normal incidence – Reflection and Transmission at Oblique incidence – Implications: Laws of incidence and reflectance, Snell's law, Brewster law – Fresnel's equations – wave guides- rectangular waveguide. UNIT V - Relativistic Electrodynamics (12 Hours) Four Vectors-Transformation Relation for Charge and Current Densities for Electromagnetic Potentials-Covariance of Field Equations in terms of Four Vectors-Covariant Form of Electric and Magnetic Field Equations-Covariance of Electromagnetic Field Tensor- Covariant Form of Lorentz Force Law. TEXT BOOKS: 1. Introduction to Electrodynamics, David J. Griffiths, Prentice Hall of India Pvt. Ltd, 3rd Edition, 2000. Unit (I-V) 2. Electromagnetic Theory, Chopra & Agarwal, 6thEd., 2004 Nath & Co, Meerut. Unit (I-V) REFERENCE BOOKS: 1. Jackson, J.D. – <i>Classical Electrodynamics</i> (3rd Edition) 2. B B Laud – <i>Electromagnetics</i> WEB REFERENCES: 1. https://jemajodelevo.weebly.com/uploads/1/3/4/3/134394711/9f676172e37.pdf 2. https://indico.cern.ch/event/817381/contributions/3412315/attachments/1835901/3178259/Lectures.pdf					

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : XV	25PHP15A/ 25PHP15B/	Institutional Training/Intrustrial	-	1

		25PHP15C	training/Internship				
Contact hours per week: -							
Year	Semester	Internal Marks	External Marks	Total Marks			
II	III	100	-	100			
PREAMBLE: To provide the students a deeper knowledge in Industrial training – creating a opportunity for the students							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement				Knowledge Level		
CO1	Identify the problems & solutions related to Institutional Training, Article ship Training.				K1		
CO2	Explain the principles involved in concerned Mini projects & Summarize the processes in various Industries.				K2		
CO3	Solve the problems in concerned project works & also Produce excellent project report for both Institutional Training & Mini projects.				K3		
CO4	Examine different types of problems, principles, Experimental techniques& applications of concerned project works.				K4		
CO5	Design new machines, principles & applications for future generations& evaluate different issues related to Science & Technology.				K5		
CO6	Invent new technology and use it in various application				K6		
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	9
CO2	9	9	9	9	9	9	9
CO3	9	9	9	9	9	9	9
CO4	9	9	9	9	9	9	9
CO5	9	9	9	9	3	3	3
CO6	9	3	3	3	3	3	3
Total Contribution of COs to POs	54	48	48	48	42	42	42

Weighted Percentage of COs Contribution to Pos	4.47	4.48	5.7	6.6	6.3	7.09	9.31
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos							

Category	Course Type	Course Code	Course Title		Contact Hours	Credit (C)	
Part III	Core :XVI Open Elective	****	Offered for students of other programmes / departments		36	2	
Contact hours per week: 3							
Year		Semester		Internal Marks	External Marks	Total Marks	
II		III		25	75	100	
PREAMBLE: The aim is to provide the students to gain knowledge and understanding the Environmental Pollution and Control Techniques.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement					Knowledge Level	
CO1	recall the basic terms involved in Environmental Pollution and Pollution Control Techniques					K1	
CO2	outline the basic Principles involved in Pollution Control Techniques & Conservation of renewable &non renewable energy resources					K2	
CO3	apply Pollution Control Techniques to reduce pollution					K3	
CO4	analyze the different types of Pollution					K4	
CO5	evaluate control measures for different types of pollution					K5	
CO6	create new techniques to control Pollution					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	9

1. http://pdf.wri.org/environmentalpollution_bw.pdf
2. https://www.researchgate.net/publication/323944189_Environmental_Pollution_Causes_and_Consequences_A_Study
3. <https://www.slideshare.net/VivekJain68/waste-management-70027829>
4. <http://www.tezu.ernet.in/denvsc/IDC/Waste%20Management.ppt>
5. https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=522265&Lab=NRMRL
6. <https://www.slideshare.net/pallabipriyadarsini25/solid-waste-management-ppt>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core :XVII Elective: III	25PHP16A	Characterization of Materials	48	3
Contact hours per week: 4					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	III	25	75	100	
PREAMBLE: The aim is to equip students with the knowledge and skills to apply various material characterization techniques for analyzing and evaluating materials in research and practical applications.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall the basic principles, instrumentation, and techniques used in Thermal Analysis, Microscopic Methods, and Electron Microscopy.				K1
CO2	Describe and explain the different methods used for characterization, including optical microscopy, SEM, TEM, AFM, and X-ray diffraction.				K2
CO3	Apply various methods for material analysis, including thermal analysis, electron microscopy, and spectroscopic techniques to characterize materials.				K3
CO4	Analyze experimental data using techniques like photoluminescence, X-ray spectroscopy, and electron microscopy to determine material properties.				K4
CO5	Evaluate the performance of different methods (e.g., Hall probe measurements, X-ray diffraction) in terms of material characterization, properties, and quality.				K5
CO6	Create a systematic approach to selecting and using various analytical techniques for specific material characterization tasks, including data interpretation.				K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	3	3	9	9	9
CO2	9	9	9	1	9	9	9
CO3	9	9	3	1	9	9	9
CO4	9	9	1	1	9	9	9
CO5	3	3	1	1	3	3	3
CO6	3	3	1	1	3	3	3
Total Contribution of COs to POs	42	42	18	08	42	42	42
Weighted Percentage of COs Contribution to Pos	3.33	3.04	6.08	4.61	3.18	2.60	3.33
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos							
COURSE CONTENT							
UNIT I - Thermal Analysis (10 Hours) Introduction – thermogravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves – differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermomechanical parameters.							
UNIT II - Microscopic Methods (10 Hours) Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy – Dispersion staining microscopy - phase contrast microscopy – differential interference contrast microscopy - fluorescence microscopy - confocal microscopy - - digital holographic microscopy - oil immersion objectives - quantitative metallography - image analyzer.							
UNIT III - Electron Microscopy And Scanning Probe Microscopy (10 Hours) SEM, EDAX, EPMA, TEM: working principle and Instrumentation – sample preparation – Data collection, processing and analysis- Scanning tunneling microscopy (STEM) - Atomic force microscopy (AFM) - Scanning new field optical microscopy.							
UNIT IV - Electrical Methods and Optical Characterisation (9 Hours) Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations. Photoluminescence – light –							

matter interaction – instrumentation – electroluminescence – instrumentation – Applications.

UNIT V - X-ray and Spectroscopic Methods (9 Hours)

Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, XPS, AES and SIMS-proton induced X-ray Emission spectroscopy (PIXE) –Rutherford Back Scattering (RBS) analysis-application - Powder diffraction - Powder diffractometer -interpretation of diffraction patterns - indexing - phase identification - residual stress analysis - Particle size, texture studies - X-ray fluorescence spectroscopy - uses.

TEXT BOOKS

1. R. A. Stradling and P. C. Klipstain. Growth and Characterization of semiconductors. Adam Hilger, Bristol, 1990.(Unit-IV)
2. J. A. Belk. Electron microscopy and microanalysis of crystalline materials. Applied Science Publishers, London, 1979.(Unit-III)
3. Lawrence E. Murr. Electron and Ion microscopy and Microanalysis principles and Applications. Marcel Dekker Inc., New York, 1991(Unit-I,II)
4. D. Kealey and P. J. Haines. Analytical Chemistry. Viva Books Private Limited, New Delhi, 2002.(Unit-V)
5. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press, (2008).

REFERENCE BOOKS

1. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001).
2. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. USA, (2001).
3. Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009). Volumes 49 – 51, (2009).
4. Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986).
5. Wachtman, J.B., Kalman, Z.H., Characterization of Materials, ButterworthHeinemann, (1993)

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1. [https://cac.annauniv.edu/uddetails/udpg_2015/77.%20Mat%20Sci\(AC\).pdf](https://cac.annauniv.edu/uddetails/udpg_2015/77.%20Mat%20Sci(AC).pdf)
2. <http://www.digimat.in/nptel/courses/video/113106034/L11.html>
3. <https://nptel.ac.in/courses/104106122>
4. <https://nptel.ac.in/courses/118104008>
5. <https://www.sciencedirect.com/journal/materials-characterization>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core :XVII Elective: III	25PHP16B	Medical Physics	48	3
Contact hours per week: 4					
Year	Semester	Internal	External	Total Marks	

		Marks	Marks				
II	III	25	75	100			
PREAMBLE: The aim is to understand the principles, applications, and safety measures of X-ray production, radiation physics, medical imaging systems, and radiation protection, with a focus on practical and theoretical knowledge of transducers, medical devices, and radiation safety.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement			Knowledge Level			
CO1	Recall the principles of X-ray production, X-ray spectrum, electromagnetic spectrum, and types of transducers such as thermistors, photoelectric transducers, and piezoelectric transducers.			K1			
CO2	Describe the basic functioning of medical instruments like sphygmomanometer, ECG, ENG, MRI, and heart rate measurement, explaining their role in diagnostic procedures.			K2			
CO3	Apply the concepts of radiation physics (units, absorbed dose, radiation detectors, etc.) to understand radiation interaction with matter and its effects in medical imaging applications like X-ray, MRI, and CT scans.			K3			
CO4	Analyze various medical imaging techniques like X-ray, MRI, CT, and ultrasound, exploring their principles, functioning, and the technological components involved in these systems.			K4			
CO5	Evaluate radiation protection methods, assess radiation effects (somatic, genetic), and interpret the use of protective materials and personal monitoring devices such as TLD Film Badges and Pocket Dosimeters.			K5			
CO6	Create effective radiation protection protocols in medical settings, integrating safety measures, personal monitoring devices, and principles of radiation protection to ensure patient and staff safety.			K6			
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	9
CO2	9	9	9	9	9	9	9
CO3	9	9	9	9	9	3	3
CO4	9	9	9	3	3	1	1
CO5	9	3	3	3	3	1	1

CO6	9	3	3	3	3	1	1
Total Contribution of COs to POs	54	42	42	36	36	24	24
Weighted Percentage of COs Contribution to Pos	3.33	3.04	6.08	4.61	3.18	2.60	3.33

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos

COURSE CONTENT

UNIT I: X-Rays and Transducers (10 Hours)

Electromagnetic Spectrum – Production of X-Rays – X-Ray Spectrum – Bremsstrahlung – Characteristic X-Ray – X-Ray Tubes – Coolidge Tube – X-Ray Tube Design – Thermistors – photo electric transducers – Photo voltaic cells – photo emissive cells – Photoconductive cells – piezoelectric transducer

UNIT II: Blood Pressure Measurements (10 Hours)

Introduction – sphygmomanometer – Measurement of heart rate – basic principles of electrocardiogram (ECG) – Basic principles of electro-neurography (ENG) – Basic principles of magnetic resonance imaging (MRI).

UNIT III: Radiation Physics (10 Hours)

Radiation Units – Exposure – Absorbed Dose – Rad to Gray – Kera Relative Biological Effectiveness – Effective Dose – Sievert (Sv) – Inverse Square Law – Interaction of radiation with Matter – Linear Attenuation Coefficient – Radiation Detectors – Thimble Chamber – Condenser Chambers – Geiger Counter – Scintillation Counter

UNIT IV: Medical Imaging Physics (9 Hours)

Radiological Imaging – Radiography – Filters – Grids – Cassette – X-Ray Film – Film processing – Fluoroscopy – Computed Tomography Scanner – Principal Function – Display – Mammography – Ultrasound Imaging – Magnetic Resonance Imaging – Thyroid Uptake System – Gamma Camera (Only Principle, Function and display)

UNIT V: RADIATION PROTECTION (9 Hours)

Principles of Radiation Protection – Protective Materials – Radiation Effects – Somatic – Genetic Stochastic and Deterministic Effect – Personal Monitoring Devices – TLD Film Badge – Pocket Dosimeter

TEXT BOOKS

1. Dr. K. Thayalan, *Basic Radiological Physics*, Jayapee Brothers Medical Publishing Pvt. Ltd. New Delhi, 2003. Unit-I-III
2. Curry, Dowdey and Murry, *Christensen's Physics of Diagnostic Radiology: - Lippincot Williams and Wilkins*, 1990.-Unit-IV-V
3. FM Khan, *Physics of Radiation Therapy*, William and Wilkins, 3rd ed, 2003.
4. D. J. Dewhurst, *An Introduction to Biomedical Instrumentation*, 1st ed, Elsevier

Science, 2014.

5. R.S. Khandpur, *Hand Book of Biomedical Instrumentations*, 1st ed, TMG, New Delhi, 2005.

REFERENCE BOOKS:

1. Muhammad Maqbool, *An Introduction to Medical Physics*, 1st ed, Springer International Publishing, 2017.
2. Daniel Jiráček, František Vitek, *Basics of Medical Physics*, 1st ed, Charles University, Karolinum Press, 2018
3. Anders Brahme, *Comprehensive Biomedical Physics*, Volume 1, 1st ed, Elsevier Science, 2014.
4. K. Venkata Ram, *Bio-Medical Electronics and Instrumentation*, 1st ed, Galgotia Publications, New Delhi, 2001.
5. John R. Cameron and James G. Skofronick, 2009, *Medical Physics*, John Wiley Interscience Publication, Canada, 2nd edition.

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1. https://onlinecourses.swayam2.ac.in/nou23_bt05/preview?utm_source=chatgpt.com
2. https://onlinecourses.nptel.ac.in/noc21_ee17/preview?utm_source=chatgpt.com
3. https://onlinecourses.swayam2.ac.in/ini24_ph03/preview?utm_source=chatgpt.com
4. <https://archive.nptel.ac.in/courses/108/105/108105101/>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core :XVII Elective: III	25PHP16C	Cloud computing	48	3
Contact hours per week: 4					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	III	25	75	100	
PREAMBLE: This Paper enables students to understand basics of Cloud computing, virtualization, services of cloud computing and its applications.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Understand the basics of Cloud Computing ,Working, Benefits				K1
CO2	Explain the knowledge of cloud architecture and tools and AWS				K2
CO3	Analyze the concepts of cloud computing Services and Security				K3

	and AWS	
CO4	Determine the virtualization and data storage in cloud	K4
CO5	Apply the Future Cloud in applications and AWS	K5
CO6	Discuss the applications of Cloud computing and AWS	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	9
CO2	9	9	9	9	9	9	9
CO3	9	9	9	9	9	3	3
CO4	9	9	9	3	3	1	1
CO5	9	3	3	3	3	1	1
CO6	9	3	3	3	3	1	1
Total Contribution of COs to POs	54	42	42	36	36	24	24
Weighted Percentage of COs Contribution to Pos	3.33	3.04	6.08	4.61	3.18	2.60	3.33

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos

COURSE CONTENT

UNIT I - Basics of Cloud Computing	(10 Hours)
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Definition of cloud computing – on-premises, hybrid and cloud environment, on-demand delivery and cloud deployment – benefits of AWS global infrastructure, Availability zones, regions (AWS, CLI, management console and SDK). Cloud front and Edge locations, provisioning AWS services, well architected framework – benefits of cloud computing

UNIT II - Compute in the cloud and networking (10 Hours)

Elastic compute cloud, Instance types- EC₂ Auto scaling, Elastic load balancing, Networking private and public, Virtual private gateway, virtual private network, AWS Direct Connect, DNS, CDN, hybrid deployments, VPC, SNS and SQS

UNIT III- Storage and Database (10 Hours)

Definitions, Amazon EBS, S3, EFS, file and object storage, RDS, including Amazon Aurora,

NOSQL Database, dynamo DB, Amazon DBMS, Additional database services,

UNIT IV- Security (9 Hours)

Shared responsibility model, MFA, IAM security levels, security policies, Bucket policies in S3, AWS organizations. Compliance with AWS, primary AWS security services,

UNIT V- AWS (9 Hours)

Monitoring, cloud watch, cloud Trail AWS trusted advisor, Migration to cloud, AWS clouds adoption framework, 6 key factors of cloud migration, AWS data migration services – AWS transfer family, AWS snow family, AWS data sync, AWS cloud (Migration service)

TEXT BOOKS:

1. A. Srinivasan, J.Suresh, “Cloud Computing – A Practical approach for learning and implementation”, Pearson –Unit-I,II
2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, “ Cloud Computing: A Practical Approach”, McGraw Hill. –Unit-III
3. Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009. Unit-IV,V

REFERENCE BOOKS:

1. RajkumarByya, James Broberg, AndrzejGoscinski, “ Cloud Computing Principles and Paradigms”, Wiley & sons

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1. <https://d0.awsstatic.com/whitepapers/aws-overview.pdf>
2. <https://aws.amazon.com/getting-started/fundamentals-overview/>
3. <https://aws.amazon.com/products/compute/>
4. https://docs.aws.amazon.com/?nc2=h_ql_doc_do

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part V	Proficiency Enhancement	25PEPHP01	Astrophysics (Self –Study)	-	2
Contact hours per week: -					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	III	-	100	100	
PREAMBLE: The aim is to introduce principles of astrophysics describing the science of formation and evolution of stars and interpretation of various heavenly phenomena and provide an understanding of the physical nature of celestial bodies along with the instrumentation and techniques used in astronomical research					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall basic concepts of optical and radio telescopes, structure of the solar system, types of eclipses, layers of the Sun, stellar evolution stages, and galaxy types.				K1

CO2	Describe the functioning and differences of telescope types, components of the Sun's atmosphere, solar activity, eclipse mechanisms, stellar life cycles, and galaxy classification.	K2
CO3	Apply astronomical laws (e.g., Bode's law, Chandrasekhar limit), and physical principles (e.g., f/a ratio, H-R diagram) to analyze solar and stellar phenomena.	K3
CO4	Analyze telescope performance, solar cycles, effects of eclipses, star classifications, and structure of galaxies using astronomical data and diagrams.	K4
CO5	Evaluate astrophysical discoveries like gravitational waves, sunspot cycles, black holes, and galaxy interactions to understand universe evolution.	K5
CO6	Create observational strategies or theoretical models explaining stellar evolution, telescope enhancements, solar phenomena, or galactic behavior.	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	3	3
CO2	9	9	9	9	3	3	3
CO3	9	9	9	3	3	3	3
CO4	9	3	3	3	1	3	3
CO5	3	3	3	1	1	3	3
CO6	3	3	1	1	0	1	1
Total Contribution of COs to POs	42	36	34	26	17	16	16
Weighted Percentage of COs Contribution to Pos	3.47	3.36	4.0	3.6	2.5	2.7	3.5

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos

COURSE CONTENT

UNIT I - Telescopes

Optical telescopes – magnifying power, brightness, resolving power and f/a ratio – types of reflecting and refracting telescopes – detectors and image processing – radio telescopes

– Hubble space telescope

UNIT II - Solar System

Bode's law of planetary distances – meteors, meteorites, comets, asteroids – Kuiper belt – Oort cloud – detection of gravitational waves – recent advances in astrophysics

UNIT III – Eclipses

types of eclipses – solar eclipse – total and partial solar eclipse – lunar eclipse – total and partial lunar eclipse – transits. The Sun: Physical and orbital data – solar atmosphere – photosphere – chromosphere – solar corona – prominences – sunspots – 11 year solar cycle – solar flares.

UNIT IV - Stellar Evolution

H-R diagram – birth & death of low mass, intermediate mass and massive stars – Chandrasekar limit – white dwarfs – neutron stars – pulsars – black holes – supernovae

UNIT V – Galaxies

classification of galaxies – galaxy clusters – interactions of galaxies, dark matter and super clusters – evolving universe.

TEXT BOOKS

1. Baidyanath Basu, (2001). An introduction to Astrophysics, Second printing, Prentice – Hall of India (P) Ltd, New Delhi (I, IV)
2. K.S. Krishnaswamy, (2002), Astrophysics – a modern perspective, New Age International (P) Ltd, New Delhi (II, III, V)

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1. Shylaja, B.S. & Madhusudan, H.R., (1999), Eclipse: A Celestial Shadow Play, Orient Black Swan.

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1. <https://web.iucaa.in/~dipankar/gradschool2013/Home.html>

SEMESTER-IV

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core :XVIII	25PHP17	Condensed Matter Physics	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	IV	25	75	100	
PREAMBLE: The aim is to impart knowledge of crystal structures, lattice dynamics, electronic properties, superconductivity, and magnetism in solids with theoretical and analytical approaches					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level

CO1	Recall the basic crystal structures (NaCl, CsCl, HCP, Diamond, ZnS) and types of magnetism and superconductivity phenomena.						K1
CO2	Describe the reciprocal lattice, Brillouin zones, color centers, phonons, Bloch theorem, magnetic and superconducting theories.						K2
CO3	Apply Bragg’s law, Fick’s law, Kronig–Penney model, BCS theory, and Curie-Weiss law in solving solid state physics problems.						K3
CO4	Analyze the properties of lattices, imperfections, phonon dispersion, band structure, superconductors, and magnetic materials.						K4
CO5	Evaluate physical models (e.g., free electron theory, energy bands, Josephson effects) and compare material behavior under various conditions.						K5
CO6	Create and propose new designs or improvements in materials based on crystal defects, energy band engineering, and magnetic/superconducting theories.						K6
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	3	3	3
CO2	9	9	9	9	3	3	3
CO3	9	9	9	9	3	3	3
CO4	9	9	9	3	3	3	3
CO5	9	9	3	3	1	1	1
CO6	9	3	3	3	9	9	3
Total Contribution of COs to POs	54	48	42	36	22	22	16
Weighted Percentage of COs Contribution to Pos	6.37	6.38	7.22	7.37	5.05	5.82	6.13
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos							
COURSE CONTENT							

Unit-I Crystal Structure and Reciprocal lattice (12 Hours)

Three dimensional Bravais lattices- Crystal structure: NaCl - Cesium Chloride – Hexagonal Close – Packed Structure - Diamond— Cubic Zinc Sulfide - Reciprocal lattice -Graphical construction-Vector development of reciprocal lattice-Properties of reciprocal lattice - Reciprocal lattice to BCC, FCC lattices - Bragg condition in terms of reciprocal lattices - Laue equations – Brillouin Zones-Atomic Scattering factor and Geometrical Structure factor for BCC, FCC

Unit-II Imperfections in Crystals and Lattice vibrations (12 Hours)

Classification of defects - Point defects- Lattice Vacancies - Schottky defect- Frenkel defect - Fick's law - Colour centers- F-center- other colour centers – Line Defects – Dislocation - Plastic deformation -Edge dislocation- Screw dislocation- Burgers vector - Stress field around dislocation - Vibrations of One Dimensional Diatomic Linear Lattice -Acoustic and Optical Branches – Phonons- lattice specific heat

Unit-III Free electron theory of metals and Energy bands (12 Hours)

Free electron gas in three dimensions - Electrical conductivity and Ohm's law- Thermal conductivity of metals - Early free electron model –Wave equation in periodic potential – Bloch theorem – The Kronig – Penney model - zone schemes

Unit-IV Superconductivity (12 Hours)

Occurrence of superconductivity – Effect of Magnetic field- Meissner effect – Type I and Type II Superconductors - Isotope effect -Thermodynamic effects – Energy gap – Thermodynamics of superconducting Transition - Electrodynamics of Superconductors – London Equations - Penetration depth – BCS theory – Josephson Superconductor Tunneling – Theory of DC and AC Josephson effect

Unit- V Magnetism (12 Hours)

Classical and Quantum theories of Diamagnetism and Paramagnetism – Adiabatic Demagnetization - Ferromagnetism- Classical theory of Ferromagnetism - Domain theory – Antiferromagnetism – Ferrimagnetism – Structure of Ferrite.

TEXT BOOKS:

1. **Introduction to Solid State Physics**, Kittel. C. 2005, 8th Edition, Wiley India (P) Ltd., New Delhi.(Units III, IV & V)
2. **Fundamentals of Solid State Physics**, Saxena. B.S., R. C. Gupta and P. N. Saxena, 2012, 16th edition, PragatiPrakashan, Meerut.(Units I & IV)
3. **Solid State Physics**, S. L. Gupta, V. Kumar, Ninth Edition, K. Nath& Co, Meerut.[ISBN:978-81-924088-7-3]

REFERENCE BOOKS:

1. **Solid State Physics**, A.J. Dekkar, revised edition, 2000, Macmillan India Ltd., New Delhi.
2. **Principles of Solid State**, Keer. H.V. 1st edition, 2002, New age international, New Delhi.
3. **Solid State Physics**, Pillai S.O., 2005, 4th Edition, New Age International Publishers Ltd.

WEB REFERENCE:

1. <https://www.wiley.com/en-us/Introduction+to+Solid+State+Physics%2C+8th+Edition-p-9780471415268>
2. https://www.researchgate.net/publication/307976662_Fundamentals_of_Solid_State_Physics

3. http://vnit.ac.in/chem/wp-content/uploads/2018/10/PG-Course_Book-2016.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core: XIX	25PHP18	Thermodynamics and Statistical Mechanics	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	IV	25	75	100	
PREAMBLE: The aim is to provide a comprehensive understanding of the laws of thermodynamics and statistical physics, enabling students to analyze the behavior of macroscopic systems based on microscopic principles and statistical distributions.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					
COs	Course Statement				Knowledge Level
CO1	Recall the key principles of thermodynamics, statistical physics, Maxwell-Boltzmann statistics, quantum statistics, and applications of quantum statistics.				K1
CO2	Illustrate the first and second laws of thermodynamics, different ensembles in statistical physics, and the fundamental principles of quantum statistics with examples.				K2
CO3	Apply the Maxwell-Boltzmann distribution, partition functions, Bose-Einstein and Fermi-Dirac statistics to explain thermodynamic quantities and behavior of gases.				K3
CO4	Analyze the effects of phase transitions, the Clausius-Clapron equation, and the Ising model, including the application of quantum statistics to different physical systems.				K4
CO5	Evaluate the implications of indistinguishability in quantum statistics and apply Bose-Einstein condensation, free electron models, and phase transition concepts.				K5
CO6	Formulate advanced applications of statistical and quantum physics concepts to study energy, pressure, and phase transitions, and apply statistical methods to real-world problems.				K6
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate					

CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	0	0	0
CO2	9	9	9	9	3	0	0
CO3	9	9	9	9	3	3	9
CO4	9	1	9	1	1	3	9
CO5	9	9	3	3	1	1	1
CO6	9	3	3	3	9	9	3
Total Contribution of COs to POs	54	48	42	36	22	22	16
Weighted Percentage of COs Contribution to Pos	6.37	6.38	7.22	7.37	5.05	5.82	6.13
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos							
COURSE CONTENT							
UNIT I - Thermodynamics (12 Hours) First and Second law of thermodynamics - Entropy - Consequences of second law of thermodynamics - Thermodynamic Potential and Reciprocity relation- Thermodynamic Equilibria - Chemical Potential – The third law of thermodynamics							
UNIT II - Basic Concepts of Statistical Physics (12 Hours) Probability- Phase space - Ensemble - Micro canonical ensemble - Canonical ensemble- Grand Canonical ensemble- Density of states - Postulate of equal apriori probability- Statistical equilibrium- Thermal equilibrium- Mechanical equilibrium-Particle equilibrium- Connection between Statistical and thermodynamic quantities - Liouville's theorem - Microstates and Macro states							
UNIT III - Maxwell-Boltzmann Statistics (12 Hours) Thermodynamical Probability - Classical Maxwell-Boltzmann distribution law- Evaluation of constants, α and β - Maxwell's law of Distribution of velocities- Principle of equipartition of energy- Gibbs paradox- Partition function and its correlation with thermodynamics quantities.							
UNIT IV - Quantum Statistics (12 Hours) Indistinguishability and quantum statistics- Statistical weight and apriori probability- Identical particles and symmetry requirements- Bose Einstein's Statistics- Fermi Dirac Statistics- Results of three statistics- Thermodynamic interpretation of parameters α and β - Blackbody radiation and Planck radiation law- Specific heat of solids: Dulong and Petit's law- Einstein's Theory- Debye theory.							

UNIT V - Application of Quantum Statistics (12 Hours)

Energy and pressure of ideal Bose Einstein gas- Bose Einstein condensation- Liquid helium- Energy and pressure of ideal Fermi Dirac gas- Free electron model and electronic emission- Phase transitions – First and second order Phase Transitions – Clausius-Clapron equation - Ising model-Bragg William Approximation- One dimensional Ising model .

TEXT BOOKS:

1. **Statistical mechanics**, Gupta & Kumar, 2003, Pragatiprakashan, Meerut. (Unit I - V)
2. **Statistical Mechanics, Kerson Haung, 2nd edition**, Wiley, 2008(Unit I - V)

REFERENCE BOOKS:

1. **Elements of Statistical Mechanics**, Miss Kamal Singh, S.P.Singh, 1999, S.Chand& Company Ltd
2. **Thermal Physics**, S.C.Garg, R.M. Banshal, C.K.Ghosh, 2nd Edition, 2020, McGraw Hill Education India Pvt Ltd
3. **Fundamentals of Statistical Mechanics and Thermodynamics**, Reif, 2008, Waveland Pr Inc

WEB REFERENCES:

1. <https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/>
2. <https://web.stanford.edu/~peastman/statmech/>
3. <https://www.grc.nasa.gov/www/k-12/airplane/thermo.html>
4. <https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/lecture-notes/>

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core :XX	25PHP19	Electronic Communication Systems	60	4
Contact hours per week: 5					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	IV	25	75	100	
PREAMBLE: The aim of this course is to provide students with a comprehensive understanding of the fundamental principles and practical technologies in communication electronics covering antennas and wave propagation, microwave devices, radar and television systems, optical fiber communications, and satellite links.					
COURSE OUTCOME: On the successful completion of the course, students will be able to					

[illegible]

9- High correlation between COs and Pos

COURSE CONTENT

- UNIT I- Antennas And Wave Propagation (12 Hours)**
Radiation field and radiation resistance of short dipole antenna-grounded antenna ungrounded antenna-antenna arrays-broadside and end fire arrays-antenna gain directional high frequency antennas-sky wave-ionosphere- Eccles and Larmor theory Magneto ionic theory-ground wave propagation
- UNIT II- Microwaves (12 Hours)**
Microwave generation-multi cavity Klystron-reflex klystron-magnetron travelling wave tubes (TWT) and other microwave tubes-MASER-Gunn diode-wave guides rectangular wave guides-standing wave indicator and standing wave ratio(SWR)
- UNIT III - Radar and Television (12 Hours)**
Elements of a radar system-radar equation-radar performance Factors radar transmitting systems-radar antennas-duplexers-radar receivers and indicators-pulsed systems-other radar systems-(colour TV transmission and reception-colour mixing principle-colour picture tubes-Delta gun picture tube-PIL colour picture tube-cable TV, CCTV and theatre TV
- UNIT IV - Optical Fiber (12 Hours)**
Propagation of light in an optical fibre-acceptance angle-numerical aperture-step and graded index fibres-optical fibres as a cylindrical wave guide-wave guide equations wave guide equations in step index fibres - fibre losses and dispersion-applications
- UNIT V - Satellite Communication (12 Hours)**
Orbital satellites-geostationary satellites-orbital patterns-satellite system link models satellite system parameters-satellite system link equation link budget-INSAT communication satellites

TEXT BOOKS:

1. **Hanbook of Electronics** by Gupta and Kumar, 2008 edition.(Unit I - III)
2. **Electronic Communication System**, George Kennedy & Davis, 1999, Tata McGraw Hill 4th edition.[ISBN:978-0-07-107782-8] (Units I - III)
3. **Communication Electronics**, N D Deshpande, D A Deshpande, 1999, Tata McGraw Hill 11th edition. (Unit – III)
4. **Mono Chrome and colour television**, R. R. Ghulathi(Unit – III)
5. **Optical fiber and fiber optic communication systems**, S. K. Sarkar, 2007, S. Chand Publication. (Unit – IV)
6. **Advanced Electronics Communication System**, Wayne Tomasi, Prentice Hall of India 4th edition, 1998. (Unit – V)
7. **Electronics Communication**, Sanjeeva Gupta, Khanna Publishers, Second edition, 2001. (Unit – V)

REFERENCE BOOKS :

1. **Principles of Electronic Communication Systems** by Louis E. Frenzel, David L. Heiserman , 2004, McGraw-Hill Higher Education.
2. **Modern Electronic Communication** by Jeffrey S. Beasley, Gary M. Miller, 2005, Prentice Hall Publication.
3. **Introduction to Satellite Communication** by Bruce R. Elbert, 2008, Artech House.
4. **Modern radar system analysis** by David Knox Barton, 1988, Artech House.

WEB REFRENECES:

1. https://vemu.org/uploads/ppt/10_02_2021_931781742.pdf
2. <https://www.slideshare.net/slideshow/microwave-generators/80518625>
3. <https://ftp.idu.ac.id/wp-content/uploads/ebook/tdg/ADVANCED%20MILITARY%20PLATFORM%20DESIGN/Radar%20Handbook.pdf>
4. <https://www.slideshare.net/slideshow/optical-fiber-communication-ppt/50618950>
5. <https://impune.gov.in/training/icitc/satellite%20communication%20systems.pdf>

Category	Course Type	Course Code	Course Title			Contact Hours	Credit (C)
Part III	Core : XXI	25PHP20	Advanced Physics Practical-II			108	4
Contact hours per week: 4+5							
Year	Semester		Internal Marks	External Marks	Total Marks		
II	III & IV		40	60	100		
PREAMBLE: The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipments used.							
COURSE OUTCOME: After completion of the course, the learners will be able to							
COs	Course Statement					Knowledge Level	
CO1	remember the formulae and properties for different experiments					K1	
CO2	be aware of principles and characteristics of various experiments					K2	
CO3	seek different applying conditions and procedure in each experiment					K3	
CO4	explore the causes for each experiments and relationship between different formulae					K4	
CO5	assess and compare the effectiveness of each experiment					K5	
CO6	develop new innovation on the basis of existing experiment					K6	
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	3

CO2	9	9	9	9	9	9	3
CO3	9	9	3	3	9	9	1
CO4	9	9	3	3	3	3	1
CO5	9	9	3	3	3	3	1
CO6	3	3	0	3	0	3	0
Total Contribution of COs to POs	48	48	27	30	33	36	9
Weighted Percentage of COs Contribution to POs	5.66	6.38	4.64	6.14	7.58	9.52	3.44

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

S.No	Course Content	Instructional Hours
1	e/m-Magnetron Method	108
2	Compressibility of a Liquid-Ultrasonic Method	
3	Arc Spectra-Constant Deviation Spectrograph-Copper, Iron & Brass	
4	Michelson Interferometer- λ , $d\lambda$ and Thickness of Mica Sheet	
5	Susceptibility-Guoy and Quincke's Method	
6	Hall Effect and its application	
7	e/m-Zeeman Effect	
8	B-H Curve-Solenoid	
9	B-H Curve-Anchor ring	
10	Double Slit-Wavelength Determination	
11	G.M Counter-Characteristics	
12	Kelvin's Double Bridge-Determination of Very Low Resistance & Temperature Coefficient of Resistance	

13	Planck's Constant	
14	Determination of particle size using He-Ne laser (Lycopodium sheet)	
15	Matlab Programming-Radioactive Decay	
16	Matlab Programming-Numerical Integration	
17	Matlab Programming-Double Integration	
18	Matlab Programming-Solution of Ordinary Differential Equations	
19	Matlab Programming-Computer Simulation of Equations of Motion for a System of Particles	
20	Matlab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations	
21	Matlab Programming-Computer Simulation of Kronig-Penney Model	
22	Matlab Programming-Numerical simulation of Wave-Functions of Simple Harmonic Oscillator	
23	Matlab Programming-Simulation of Wave Functions for a Particle in Critical Box	
24	Matlab Programming-Solution of Diffusion Equation	

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : XXII	25PHP21	General Electronics Practical-II	108	4
Contact hours per week: 4+5					
Year	Semester	Internal Marks	External Marks	Total Marks	
II	III & IV	40	60	100	
PREAMBLE: The aim is to provide the students better practical knowledge of general Physics experiments, learn about handling of experiments and to know about different equipments used.					
COURSE OUTCOME: After completion of the course, the learners will be able to					
COs	Course Statement				Knowledge Level
CO1	recall the working principle of Operational Amplifier, IC 555 and microprocessor				K1
CO2	elucidate the functioning of circuits constructed using operational amplifier and IC 555				K2

CO3	perform analog to digital conversion and digital to analog conversion using operational amplifier perform interfacing for waveform generator, stepper motor, 7 segment LED display Hex keyboard musical tone generator using microprocessor	K3
CO4	analyze the mathematical operations performed by circuits constructed using operational amplifier	K4
CO5	determine the frequency of as table multi vibrator and output voltage in simultaneous adder and subtractor execute programs using microprocessor	K5
CO6	construct the circuits to perform mathematical operations, measurement of temperature and light intensity using operational amplifier	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	3
CO2	9	9	9	9	9	9	3
CO3	9	9	3	3	9	9	1
CO4	9	9	3	3	3	3	1
CO5	9	9	3	3	3	3	1
CO6	3	3	0	3	0	3	0
Total Contribution of COs to POs	48	48	27	30	33	36	9
Weighted Percentage of COs Contribution to POs	5.66	6.38	4.64	6.14	7.58	9.52	3.44

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs

COURSE CONTENT

S.No	Course Content	Instructional Hours
1	Op-Amp: Simultaneous Addition & Subtraction	108

2	Op-Amp: V to I & I to V Converter	
3	Op-Amp: Circuits Using Diodes-Half Wave, Full Wave, Peak Value, Clipper, Clamper	
4	Op-Amp: Log and Antilog Amplifier	
5	Op-Amp Comparator-Zero Crossing Detector, Window Detector, Time Marker	
6	Op-Amp: Instrumentation Amplifier-Temperature Measurement	
7	Op-Amp: Instrumentation Amplifier-Light Intensity-Inverse Square Law	
8	IC 555 Timer Application-Monostable, Linear &Astable	
9	A/D Converters-Any One Method	
10	D/A Converters-Binary Weighted Method	
11	Microprocessor: LED Interfacing	
12	Microprocessor: Stepper Motor Interfacing	
13	Microprocessor: Traffic Control Simulation	
14	Microprocessor: ADC Interface-Wave Form Generation	
15	Microprocessor: Hex Keyboard Interfacing	
16	Microprocessor: Musical Tone Generator Interface	
17	MATLAB Programming-Mean, Median & Standard Deviation	
18	MATLAB Programming-Curve Fitting & Interpolation	
19	MATLAB Programming-Matrix Summation, Subtraction and Multiplication	
20	MATLAB Programming-Matrix Inversion and Solution of Simultaneous Equations	

Category	Course Type	Course Code	Course Title	Contact Hours	Credit (C)
Part III	Core : XXIII	25PHP22	Project Work & Viva Voce		3

Contact hours per week: 5							
Year	Semester	Internal Marks	External Marks	Total Marks			
II	IV	20	80	100			
PREAMBLE: The aim is to provide the student to acquire knowledge on synthesis, fabrication and evaluation on basis of day to day life scenario and to understand the Importance of undergone project.							
COURSE OUTCOME: On the successful completion of the course, students will be able to							
COs	Course Statement						Knowledge Level
CO1	remember the facts about concerned project and its availability in environment						K1
CO2	be aware of principles that are interconnected to their individual project like material science, thin films, solar cells						K2
CO3	seek different applying technique and create innovative ideas on basis of project studies						K3
CO4	explore the causes and reason behind applied techniques of the project						K4
CO5	evaluate the results made from the project and analyse the usage of project in daily life						K5
CO6	develop further more innovations in the existing project based on innovative ideas						K6
K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate							
CO-PO MAPPING (COURSE ARTICULATION MATRIX)							
POs Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	3	9
CO2	9	9	9	9	3	3	3
CO3	9	9	9	9	3	3	3
CO4	9	9	3	9	3	3	1
CO5	9	3	1	3	1	3	1
CO6	3	3	1	3	1	1	1
Total Contribution of COs to POs	48	42	32	42	20	16	18
Weighted Percentage of COs	3.97	3.92	3.8	5.8	3.0	2.70	3.99

Contribution to Pos							
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and Pos							