P.K.R. ARTS COLLEGE FOR WOMEN (AUTONOMOUS),

(Accredited with 'A' grade by NAAC - Affiliated to Bharathiar University, Coimbatore)

GOBICHETTIPALAYAM – 638 476

DEPARTMENT OF PHYSICS

MASTER OF SCIENCE

SYLLABUS

For the candidates admitted from the Academic Year

2021-2022 and onwards

Under CBCS PATTERN

M.Sc., Physics Programme Structure
CBCS – 2021-2022 & Onwards

Category	Components	No. of Courses	Credit(s)/ Courses	Total Credits	Proposed Semester
Part - III	Core: Theory	13	4/3	83	I - IV
	Core: Practical	4	4		
	Core: Elective	3	3		
	Core: Open Elective	1	2		
	Core: Industrial / Institution Training	1	1		
	Core: Major Project and Viva Voce	1	3		
Part - IV	Ability Enhancement	1	2	2	II
Part - V	Proficiency Enhancement: Self Study Course	1	2	6	I - IV
	Competency Enhancement: Online Course/ Learning Object Repository (LOR)	2	4		
	Certificate Course				
	Total	**27**		**90**	

P.K.R ARTS COLLEGE FOR WOMEN (Autonomous)

MASTER OF SCIENCE - PHYSICS
Programme Scheme and Scheme of Examinations
(For students admitted from 2021-22 & onwards)

Scholastic Courses:

Category /Part	Components	Course Code	Title of the Course	Hrs/ week	Exam Duration hrs.	Max.Marks CIA	Max.Marks ESE	Max.Marks Total	Credits
			SEMESTER – I						
III	Core: I	21PHP01	Classical Mechanics	5	3	50	50	100	4
III	Core :II	21PHP02	Mathematical Physics	5	3	50	50	100	4
III	Core : III	21PHP03	Quantum Mechanics - I	5	3	50	50	100	4
III	Core : IV	21PHP04	Numerical Methods & MATLAB Programming	5	3	50	50	100	4
III	****	****	Advanced Physics Practical-I	3	-	-	-	-	-
III	****	****	General Electronics Practical-I	3	-	-	-	-	-
III	Core : V Elective: I	21PHP05A/ 21PHP05B	Essentials of Nanoscience/ Radiation Physics	4	3	50	50	100	3
			TOTAL	**30**				**500**	**19**
			SEMESTER – II						
III	Core : VI	21PHP06	Quantum Mechanics - II	5	3	50	50	100	4
III	Core : VII	21PHP07	Advanced Electronics	5	3	50	50	100	4
III	Core : VIII	21PHP08	Solar Physics	5	3	50	50	100	3
III	Core : IX	21PHP09	Advanced Physics Practical-I	5	3	50	50	100	4
III	Core : X	21PHP10	General Electronics Practical-I	5	3	50	50	100	4

III	Core : XI Elective: II	21PHP11A/ 21PHP11B	Astronomy &Astrophysics/ Experimental Techniques	4	3	50	50	100	3
IV	Ability Enhancement	21AEP01	Cyber Security	2	3	--	100	100	2
			TOTAL	**32**				700	24
SEMESTER – III									
III	Core : XII	21PHP12	Atomic and Molecular Spectroscopy	5	3	50	50	100	4
III	Core :XIII	21PHP13	Nuclear & Particle Physics	5	3	50	50	100	4
III	Core :XIV	21PHP14	Electromagnetic Field Theory	5	3	50	50	100	4
III	Core : XV	21PHP15	Institutional Training	-	-	100	-	100	1
III	****	****	Advanced Physics Practical-II	4	-	-	-	-	-
III	****	****	General Electronics Practical-II	4	-	-	-	-	-
III	Core : XVI (Open Elective)	****	Offered for students of other PG programmes/ Departments	3	3	50	50	100	2
III	Core : XVII Elective : III	21PHP16A/ 21PHP16B	Biomedical Instrumentation/ Thin Film Physics and Crystal Growth	4	3	50	50	100	3
V	Proficiency Enhancement	21PEP01	Laser and its applications (Self –Study)	-	3	-	100	100	2
			TOTAL	**31**				**700**	**20**
SEMESTER – IV									
III	Core :XVIII	21PHP17	Condensed Matter Physics	6	3	50	50	100	4
III	Core : XIX	21PHP18	Thermodynamics and Statistical Mechanics	6	3	50	50	100	4

III	Core : XX	21PHP19	Electronic Communication Systems	6	3	50	50	100	4
III	Core : XXI	21PHP20	Advanced Physics Practical-II	5	6	50	50	100	4
III	Core : XXII	21PHP21	General Electronics Practical-II	5	6	50	50	100	4
III	Core :XXIII	21PHP22	Project Work & Viva Voce	2	3	50	50	100	3
			TOTAL	**30**				**600**	**23**
	Competency Enhancement	Online Course / Learning Object Repository (LOR)		SEMESTER I – IV					2
		Certificate Course		SEMESTER I – IV					2
				Total Marks & Credits -2500					**90**

(Signature with Seal)

Head,
Department of Physics,
P.K.R. Arts College for Women,
Gobichettipalayam - 638 476.

SYLLABUS

(For students admitted from 2021-22 & onwards)
Semester – I

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: I	21PHP01	**CLASSICAL MECHANICS**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	I	50	50	100

Preamble: The aim is to provide the students, the knowledge and understanding of the fundamental concepts in the dynamics of system of particles, motion of rigid body, Lagrangian and Hamiltonian formulation of mechanics

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recall important terms such as Constraints, Degree of Freedom, Phase Space, angular Momentum and Poissons bracket	K1
CO2	illustrate D'Alembert's principle, Hamilton's Canonical Equation of Motion, Poisson Brackets, Principle of Least Action, Equivalent One body problem, Euler's theorem, Euler's angles, Kepler's Problem - Shapes of orbits	K2
CO3	apply Lagrange's and Hamilton's equation of motion in Linear Harmonic Oscillator, Simple Pendulum, Isotropic Oscillator, HJ method in Harmonic Oscillator	K3
CO4	analyze Inertial/Non inertial frames, Stable and Unstable Equilibrium, The motion of a Symmetric Top under the action of Gravity, Equation of motion in Poisson Bracket form	K4

CO5	evaluate the Hamilton's Variational principle, Canonical Transformations, Generating Function and different forms, Principle Axis of Transformation, Moments and Products of Inertia	K5
CO6	Formulate Effects of Coriolis force on moving bodies.	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

PO / Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
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

SYLLABUS

UNIT- I : LAGRANGIAN FORMULATION (12 Hours)

Constraints and Degrees of Freedom-Generalized Coordinates: Generalized Displacement, Velocity, Acceleration, Momentum, force & Potential-Variational technique and Euler Lagrange Differential

equation-Hamilton's Variational principle-Lagrange's equation of motion from Hamilton's principle-D'Alembert's principle-Application of Lagrange's equation of motion: Linear Harmonic Oscillator-Simple Pendulum-Isotropic Oscillator.

UNIT - II : HAMILTONIAN FORMULATION (12 Hours)

Phase space – Hamiltonian - Hamilton's Canonical Equation of Motion - Physical Significance of H - Deduction of Canonical Equation from Variation principle - Application of Hamilton's equation of motion: Simple Pendulum, Linear Harmonic Oscillator, and Isotropic Oscillator - Principle of Least Action and Proof - Canonical Transformations - Generating Function and different forms.

UNIT- III : HAMILTON –JACOBI METHOD (12 Hours)

Hamilton Jacobi Method- Solution of Harmonic Oscillator Problem by HJ method-Particle falling freely-Damped Harmonic Oscillator-Poisson Brackets-Definition-Equation of motion in Poisson Bracket form-Jacobi -Poisson Theorem-Angular Momentum and Poisson's Bracket.

UNIT- IV : TWO BODY PROBLEMS (12 Hours)

Equivalent One body problem-General Features of central force motion-Stability of orbits and Conditions for closure- Kepler's Problem - Shapes of orbits-Inertial/Non inertial frames-Rotating Co-ordinate system-Effects of Coriolis force on moving bodies.

UNIT- V : RIGID BODY DYNAMICS (12 Hours)

Euler's theorem-Euler's angles-Angular velocity of a rigid body-Angular momentum of Rigid Body-Moments and Products of Inertia-Principle Axis of Transformation-Torque Free Motion of a Rigid Body-Poinsot Solutions-The motion of a Symmetric Top under the action of Gravity-Stable and Unstable Equilibrium.

Text Books:

1. **Classical Mechanics**, S.L.Gupta, V. Kumar & H. V. Sharma, 2015, Pragati Prakashan, Meerut. (All units)

References Books:

1. **Classical Mechanics**, H. Goldstein, Charles P. Poole, John Safko, 2011**,** Pearson, India.

Web Reference:

1. https://sites.astro.caltech.edu/~golwala/ph106ab/ph106ab_notes.pdf
2. https://www.physics.rutgers.edu/~shapiro/507/book.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: II	21PHP02	**MATHEMATICAL PHYSICS**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	I	50	50	100

Preamble: The aim is to provide the students firm foundation in various mathematical methods developed and used for understanding different Physics phenomena.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	identify the basic definitions of differential Equations, Polynomials, Functions, Complex Variable and Groups	K1
CO2	summarize the Legendre's Polynomials and Functions, Orthogonality, Functions of a Complex Variable, Vector Space, Basis, Inner Product, Fourier Series, Laplace Transform, Multiplication table, Subgroups, cosets and classes, Schur's lemma, rotation groups	K2
CO3	perform the Special function and complex variables in various theorems and relations	K3
CO4	classify the functions and variables, vector space and groups	K4
CO5	relate the Legendre Polynomial and their derivatives	K5
CO6	Make Fourier Series and Laplace Transform for different problems and create character table of C2v and C3v by using groups	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO- PO MAPPING (COURSE ARTICULATION MATRIX)

PO Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO1	9	9	9	3	3	3	1
CO2	9	9	9	3	3	3	1
CO3	9	9	9	3	3	3	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 PO s	54	42	36	16	14	10	6
Weighted Percentage of COs Contribution to PO s	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

SYLLABUS

UNIT-I : SPECIAL FUNCTIONS (12 Hours)

Legendre's Polynomials and Functions- Differential Equations and Solutions-Generating Functions- Orthogonality-Relation between Legendre Polynomial and their Derivatives Recurrence Relations- Bessel's Function-Differential Equation and Solution-Generating Functions-Recurrence Relations- Hermite function.

UNIT-II: COMPLEX VARIABLE THEORY (12 Hours)

Functions of a Complex Variable-Single and Multi valued Functions-Cauchy-Reimann Differential Equation-Analytical Line Integrals of Complex Function-Cauchy's Integral Theorem and Integral Formula-Derivatives of an Analytic Function-Taylor's Variables Residue and Cauchy's Residue Theorem.

UNIT-III: LINEAR SPACE (12 Hours)

Definition of Vector Space-Linear Dependence-Linear Independence-Basis-Dimension of a Vector

Space-Representation of Vectors and Linear Operators with respect to Basis-Schmidt Orthogonalization Process-Inner Product.

UNIT- IV:FOURIER SERIES & LAPLACE TRANSFORMS (12 Hours)

Fourier Series-Dirichlet's Theorem-Change of Interval-Complex Form-Fourier Series in the Interval $(0, \infty)$ - Uses of Fourier Series.-Laplace Transform-Definition-Properties-Translation Property-Inverse Laplace Transform-Properties, example problems.

UNIT- V: GROUP THEORY (12 Hours)

Definition of Groups– Multiplication table – Subgroups, cosets and classes – Point and space groups – Homomorphism and isomorphism – Reducible and irreducible representations – Schur's lemma -- The great orthogonality theorem (qualitative treatment without proof) – Formation of character table of C2v and C3v -- Elementary ideas of rotation groups.

Text Books:

1. **Mathematical Physics,** SathyaPrakash, 2002, Sultan Chand & Sons. [ISBN: 81-7014-925-8] (All Units)
2. **Mathematical methods for Physicists,** Arfken, weber & Harris, 2005, 7th edition, Elsevier Academic Press.
3. **Elements of group theory for Physicists** - A.W. Joshi, -Wiley Eastern, 2002 (Unit – V)

Reference books:

1. **Mathematical Physics**, B.D. Gupta, 3rd Edition, 2006, Vikas Publishing House.
2. **Mathematical Physics**, B.S. Rajput, 17th Edition 2004, Pragati Prakashan, Meerut
3. **Mathematical Physics**, P.K. Chattopadhayay, New Age International, New Delhi.
4. **Mathematical Physics**, P.P. Gupta, Yadav& Malik, KedarnathRamnath, Meerut.

Web Reference:

1. https://pdfcoffee.com/download/mathematical-physics-by-satya-prakash-pdf-50pdf-pdf-free.html
2. https://isidore.co/calibre/get/pdf/4469

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: III	21PHP03	**QUANTUM MECHANICS-I**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	I	50	50	100

Preamble: The aim is to make the students to understand the concepts of Matrix formalism, learn the approximation methods and to know the Orbital and Spin angular momentum.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recall the limitations of Classical Physics, wave packets, wave functions, Schrödinger equation, operators and eigen values in quantum mechanical systems	K1
CO2	explain matrix formalisms in quantum mechanics, Schrödinger equation of motion, approximation methods and commutation relations.	K2
CO3	apply Schrödinger equation and approximation methods to solve quantum mechanical systems and to find eigen values of the systems	K3
CO4	Correlate the various approximation methods, equation of motions in Schrodinger, Heisenberg and Interaction pictures	K4
CO5	Validate the matrix representation of angular momentum operators, addition of angular momentum and Clebsch-Gordon co-efficients	K5
CO6	formulate wave functions and operators in matrix form.	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO- PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

PO Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
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 PO s	54	42	36	24	24	20	10
Weighted Percentage of COs Contribution to PO s	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 PO

SYLLABUS

UNIT- I : INTRODUCTION AND MATRIX FORMALISM (12 Hours)

Inadequacy of classical Physics - Wave packets –Uncertainty relations-Schrodinger wave equation and probabilistic interpretation. Hilbert space – Dirac's bra and ket notation – Operators as matrices – Matrix form of wave functions – Unitary transformation: Change of basis – Properties of unitary transformations – Schrodinger picture – Heisenberg picture – Interaction picture

UNIT- II : SPHERICALLY SYMMETRIC SYSTEMS (12 Hours)

Schrödinger's equation for spherically symmetric potentials – Three dimensional harmonic oscillator – Rigid rotator with free axis – Solution of wave equation and eigen function for the rotator – Rigid rotator in a fixed plane – The Hydrogen atom – φ, θ and r equations and their solutions – Energy eigen

values for the hydrogen atom – Degeneracy – The normal state of hydrogen atom

UNIT- III : INDEPENDENT APPROXIMATION METHODS (12 Hours)

Time Independent Perturbation Theory in Non-Degenerate Case-Ground State of Helium Atom-Degenerate Case-Stark Effect in Hydrogen-Variation Method & its Application to Hydrogen Molecule- WKB Approximation.

UNIT-IV:TIME DEPENDENT PERTURBATION THEORY (12 Hours)

Time Dependent Perturbation Theory-First and Second Order Transitions-Transition to Continuum of States-Fermi Golden Rule-Constant and Harmonic Perturbation-Transition Probabilities-Selection Rules for Dipole Radiation-Collision-Adiabatic Approximation

UNIT- V: ANGULAR MOMENTUM (12 Hours)

Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators-Commutation Relations of Total Angular Momentum with Components-Ladder Operators-Commutation Relation of Jz with J_+ and J_- Eigen Values of J^2, Jz -Matrix Representation of J^2, Jz, J_+ and J_--Addition of Angular Momenta- Clebsch Gordon Coefficients-Calculation of Clebsch Gordon Coefficients for $j_1=1/2$, $j_2=1/2$.

Text Books:

1. **Quantum Mechanics**, Aruldas, 2nd edition, 2013, PHI Learning Pvt. Ltd. [ISBN: 978-81-203-3635-3] (All Units)
2. **Introduction to Quantum Mechanics** –David J Griffiths– Pearson- 2nd edition- 2016. [ISBN: 978-93-325-4289-1]

Reference books:

1. **Quantum Mechanics,** Gupta, Kumar & Sharma, 34th Edition, 2017, Jai Prakash Nath Publications. (All units)
2. **Advanced Quantum Mechanics,** Satya Prakash, 2001, Kedar Nath Ram Nath Co., Meerut.
3. **Quantum Mechanics**, Leonard.I. Schiff, 1968, McGraw Hill 3rd Edition. [ISBN: 0-07-085643-5] (Unit II)
4. **Quantum Mechanics**, V. Devanathan, 2005, Narosa Publishing House, New Delhi.
5. **A textbook of Quantum Mechanics**, P.M. Mathews and Venkatesan, 27th reprint 2002, Tata McGraw Hill publishing company Ltd., New Delhi.

Web Reference:

1. https://ocw.mit.edu› coursesPDF Web result Chapter 5 The Dirac Formalism and Hilbert Spaces (unit 1)
2. https://www.bbau.ac.in › deptPDF
   Web results Matrix representations of wave functions and operators ... (Unit 1)
3. https://www.rpi.edu› lct4PDF
   Web results 4.1 Schrödinger Equation in Spherical Coordinates (unit 2)

4. https://www.google.com/url?sa=t&source=web&rct=j&url=https://ocw.mit.edu/courses/physics/8-06-quantum-physics-iii-spring-2018/lecturE-notes/MIT8_06S18ch4.pdf&ved=2ahUKEwiEg53JzqPzAhU0yzgGHZ1DAyIQFnoECDEQAQ&usg=AOvVaw0uqBxeeJUf3_kKF1uj3SU0 (unit 4 and 5)
5. https://www.google.com/url?sa=t&source=web&rct=j&url=https://0space.org/file/13199/download%3Ftoken%3D3MFpY12s&ved=2ahUKEwi80tXD0KPzAhXOV30KHWSQAgEQFnoECDQQAQ&usg=AOvVaw1R_dXurAqOpeCnFtuREw30 (unit 5)

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: IV	21PHP04	**NUMERICAL METHODS & MATLAB PROGRAMMING**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	I	50	50	100

Preamble: The aim is to provide the students to develop appropriate numerical abilities, prove results for various numerical root finding methods and to code various numerical methods in a modern computer language

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	remember the Differential equation by using various Numerical methods and MATLAB basics,	K1
CO2	explain Newton Raphson Method, Guass elimination Method, Rungekutta method, SimPOn's rule , Trapezoidal rule, Gauss Quadrature , MATLAB fundamentals, in programming and Graphics	K2
CO3	apply various numerical methods and MATLAB Help and Demos , Control flow statements, MATLAB fundamentals,	K3

	programs and Graphics with 2D and 3D plots.	
CO4	correlate Different Techniques in Numerical methods like Giraffe's root square methods and MATLAB programs for various loops MATLAB Built-In Functions	K4
CO5	validate the different methods in Numerical Methods and fundamentals in Basic MATLAB programming and interpretation of 2D and 3D Graphics in MATLAB	K5
CO6	Adapt numerical Methods in many mathematical fields and MATLAB programming in many computerize world,	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO- PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

PO Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
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

SYLLABUS

UNIT -I : 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 first order Ordinary Differential Equations.

UNIT- II : NUMERICAL INTEGRATION (12 Hours)

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

UNIT- III : 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-Matrices and Matrix Operations-Complex Numbers- MATLAB Built-In Functions- Saving and loading data – Plotting simple graphs-Illustrative Examples

UNIT- IV : MATLAB PROGRAMMING (12 Hours)

Control Flow Statements: **if, else, else if, switch** Statements-**for, while** Loop Structures-**break** Statement-Input/output Commands-Script "m" Files -Function "m" Files-Controlling Output - Language specific features – Advanced Data objects . Applications – (Programs about Linear Algebra – Curve fitting and Interpolation – Data analysis and Statistics – Numerical Integration – Ordinary differential equations – Nonlinear Algebraic Equations).

UNIT -V : MATLAB Graphics (12 Hours)

2D Plots-Planar Plots, Log Plots, Scatter Plots, Contour Plots- Using subplot to Layout multiple graphs -Multiple Figures, Graph of a Function-Titles, Labels, Text in a Graph- Line Types, Marker types, Colors-3D Graphics-Curve Plots-Mesh and Surface Plots- Handle Graphics – Saving and printing Graphs – 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 & II)
2. **Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers,**RudraPratap, 2003, Oxford University Press. (Units III – V)
3. **MATLAB An Introduction with Applications -** Amos Gilat, 2007, John Wiley & Sons, Inc., U.K. [ISBN: 978-81-26511394-9] (Units III – 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 Reference:

1. http://demo.prahu-hub.com/A2C1ED269A17F/numerical-methods-by-kandasamy-thilagavathy-gunavathy.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.researchgate.net/profile/Hazim_Tahir/post/How-can-I-fit-a-curve-to-data-from-a-thermodynamic-model-like-NRTL/attachment/59d63d25c49f478072ea8502/AS%3A273757480914957%401442280277251/download/MATLAB_+An+Introduction+with+Ap+-+Amos+Gilat.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core:V Elective I	21PHP05A	**ESSENTIALS OF NANOSCIENCE**	48	3

Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	I	50	50	100

Preamble: The aim is to provide the basic knowledge about basics of nano science and technology and to acquire the knowledge about synthesis methods and characterization techniques and its

applications

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recall the basic concepts of Nano science, Nanotechnology and Nanoscale, Introduction to polymers	K1
CO2	explain the Nano material and its structure, properties, importance and applications.	K2
CO3	apply the fabrication methods to synthesis the new nano particles	K3
CO4	infer the chemical interactions, quantum confinement and emission characteristics of semi- conductor nano crystals	K4
CO5	verify the nanoparticles dimension and justify quantum dot , core shell nano particles and carbon nano tubes	K5
CO6	create the nano particles and nano materials in the field of agriculture and medical, other field to solve the recent problems	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

PO Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
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

SYLLABUS

UNIT -I : EVOLUTION OF NANOSCIENCE AND NANOTECHNOLOGY (9 Hours)

History of Nanoscience and Nanotechnology – Ancient, Medieval and Modern period – Terms and Definitions – Scale of materials – macro, micro and nanoscale – pioneers and contributors in Nanoscience and nanotechnology – Fabrication methods – Top-down and bottom-up approaches (Principles and types) – Nanoscience and nanotechnology practiced by nature –Inspirations from nature – Natural nanomaterials – Inorganic, organic and biological origin.

UNIT -II : NANOMATERIALS (9 Hours)

Structure , properties and importance of the following Nanomaterials - Metallic nanoparticles – Semiconductor quantum dots, core-shell nanoparticles - carbon based nanomaterials – fullerenes, carbon nanotubes (single walled and multi walled) and graphenes – Supramolecules – Dendrimers, micelles and reverse micelles – Nanoporous Materials. (Synthesis of the nanomaterials not included)

UNIT- III : POLYMERIC NANOMATERIALS (10 Hours)

Introduction to polymers – classification of polymers – types of polymerization processes – Block copolymers - Glass transition temperature of Polymers – Structure, properties and importance of selected synthetic and Biopolymers – Polystyrene, Polyvinyl alcohol, Polystyrene sulphonate, Polyethylene glycol, Polyhydroxy alkanoate, Polylactic acid and Chitosan – Conducting polymers – Introduction, principle of conduction and different types of conducting polymers.

UNIT- IV : PROPERTIES AT THE NANOSCALE – I (10 Hours)

Comparison of properties at bulk and nano – Surface and Volume – Surface energy – Surface stabilization – Surface energy minimization mechanisms – Application of classical thermodynamics 133 to nanomaterials (Small system thermodynamics) – Chemical interactions at Nanoscale.- Primary interactions (Ionic, Covalent and Metallic bonds) – Secondary interactions – Electrostatic interaction, Hydrogen bonding, Van-der waals attraction, hydrophobic effect.

UNIT- V: PROPERTIES AT THE NANOSCALE – II (10 Hours)

Optical properties in metals, semiconductors and insulators- Photoluminescence - Cathode luminescence- Electro luminescence- Fluorescence- Phosphorescence- Surface Plasmon resonance and optical properties in metallic nanoparticles – Quantum confinement and emission characteristics of semiconductor nanocrystals – optical properties of core-shell nanoparticles – Mechanical, thermal and electrical properties of carbon based nanomaterials (CNT & graphenes) – Guest-Host relationship and Molecular recognition in supramolecules.

Text Books

1. **Nanoscience and Nanotechnology -** M. S. RamachandraRaoShubrasingh [ISBN: 978 – 81 – 265 – 4201 – 7]. (Units I, II and III)
2. **Principles of Nanoscience and Nanotechnology -** M. A. ShahTokeerAhmad, Narosa publishing home pvt. Ltd., [ISBN: 978 – 81 – 8487 – 072 – 5]. (Units IV and V)

Reference Books

1. **Nanotechnology,** Er. RakeshRathi, 2009-15, S. Chand and Co. Pvt. Ltd.
2. **Nanotechnology Science Innovations and Oppurtunity,** Lynn E.Foster.

Web Reference:

1. http://www.lkouniv.ac.in
2. http://www.trl.lab.uic.edu
3. http://www.nanosensesri.com
4. http://www.nanoyou.eu
5. http://www.web.pdx.edu

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: v Elective: I	21PHP05B	**RADIATION PHYSICS**	48	3

Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	I	50	50	100

Preamble: The aim is to provide deeper knowledge and understanding of Radiation Physics and to learn information about their principles and methods.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recall an introduction of Radiation physics, basics of radiotherapy, environmental radioactivity introductions	K1
CO2	elucidate the various types of interactions between the elementary particles, linear accelerators and measuring equipments	K2
CO3	identify the particle detectors of gas electron multiplier, surface photoemission detector and semiconductor detector	K3
CO4	compare attenuation with absorption factors of medicine in the measuring equipment	K4
CO5	evaluate toxic agent and mitigating internal radiation hazards, airborne radioactivity	K5
CO6	bring out the interaction of the particles using particle detectors, prepare to protect human beings from organizational plan, laboratory procedure for protection of radiation	K6

K1 – Remember;K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

POs / COs	PO 1	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

SYLLABUS

Unit –I: BASIC RADIATION PHYSICS (9 Hours)

Introduction to radiation Physics- Atomic and Nuclear structure- Electron interaction- Photon interaction- Classification of forces in nature, fundamental particles, radiation- Atomic and nuclear structure- Bohr's model of the hydrogen atom- Radioactivity- Modes of radioactive decay- Electron Interaction- Photon Interaction.

Unit –II: RADIATION AND PARTICLE DETECTOR (9 Hours)

Interaction of particles and radiation with matter- Photoelectric and Compton effect- Gas Electron Multiplier (GEM)- Detection of neutrons- Surface photoemission detectors- Photo cathodes and Photo tubes- Semiconductor detectors.

Unit- III : RADIOACTIVITY IN THE ENVIRONMENTAL MEDIA (10 Hours)

Introduction to environmental radioactivity- Airborne radioactivity- Production and Propagation of Airborne radioactivity by tall & short stacks- Water Activation- Geological Media Activation- The Propagation of Radio nuclides Through Geological Media.

Unit -IV : RADIOACTIVITY IN MEDICINE (10 Hours)

Basics of radiotherapy- Linear accelerators- Measuring equipments- Treatment planning & process- Dependence of photon energy and atomic number- attenuation and absorption.

Unit -V : RADIATION PROTECTION (10 Hours)

Human Factors- Environmental Factors- Toxic Agents, such as radioactive Material- Organizational Plan for Radiation Protection- Radiation Lab Protection Procedures- Accident Anticipation-

Mitigating Internal Radiation Hazards.

Web References:

1. http://www-naweb.iaea.org/nahu/DMRP/documents/Chapter1.pdf
2. https://www.asc.ohio-state.edu/honscheid.1/s12-780/references/turku_lecturenotes.pdf
3. https://www-esh.fnal.gov/TM1934_PDF_Files/TM_1934_Revision_9B.pdf
4. http://www.imre.ucl.ac.be/rpr/sv2012/RDTH3120-partie1.pdf
5. http://www.ehs.washington.edu/rsotrain/radprotectionprinciples/table_of_contents.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: VI	21PHP06	**QUANTUM MECHANICS - II**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	II	50	50	100

Preamble: The aim is to make the students understand the Scattering theory, the applications to atomic structures, about the identical particles and their spin and quantum field theory.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recite the definitions of scattering amplitude and identical particles	K1
CO2	interpret the scattering process in quantum mechanical system and the application of approximation methods to atomic structure	K2
CO3	apply symmetric and anti symmetric wave functions in central field approximation and apply approximation methods to find scattering amplitude and scattering cross section	K3

CO4	justify probability and current densities and negative energy states from relativistic wave equations	K4
CO5	quantize classical and quantum mechanical equations of motions.	K5
CO6	construct symmetric and anti symmetric wave functions	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	3	9	3	3
CO2	9	9	9	3	9	3	3
CO3	9	3	3	3	3	3	1
CO4	3	3	3	1	3	1	1
CO5	1	1	1	1	1	1	1
CO6	1	1	1	1	1	1	1
Total Contribution of COs to POs	32	26	26	12	26	12	10
Weighted Percentage of COs Contribution to POs	3.77	3.45	4.47	2.45	5.97	3.17	3.83

Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High

correlation between COs and POs

SYLLABUS

Unit –I : SCATTERING THEORY (12 Hours)

Scattering Amplitude - Expression in terms of Green's Function - Born Approximation and its Validity - Partial Wave Analysis - Phase Shifts – Scattering by Coulomb and Yukawa Potential

Unit –II : APPLICATION TO ATOMIC STRUCTURE (12 Hours)

Central Field Approximation - Thomas Fermi Model –Hartree's Self Consistent Model – Hartree Fock Equation - Alkali Atoms - Doublet Separation –Intensities - Complex Atoms - Coupling Schemes

Unit –III: RELATIVISTIC WAVE EQUATION (12 Hours)

Klein Gordon Equation - Plane Wave Equation - Charge and Current Density - Application to the study of Hydrogen Like Atoms - Dirac Relativistic Equation for a Free Particle - Dirac Matrices - Dirac Equation in Electromagnetic Field - Negative Energy States.

Unit –IV: IDENTICAL PARTICLES AND SPIN (12 Hours)

Identical particles – Symmetric and anti-symmetric wave functions – Construction of symmetric and antisymmetric wave functions – Pauli's exclusion principle – Physical significance – Pauli's spin operator – Commutation relations

Unit –V: QUANTUM FIELD THEORY (12 Hours)

Quantization of Real Scalar wave Field – Quantization of Complex Scalar wave Field - Quantization procedure for particles - Classical Lagrangian Equation -Classical Hamiltonian Equation - Field Quantization of the Non - Relativistic Schrodinger Equation - Creation, Destruction and Number Operators.

Text Book :

1. **QuantumMechanics** -Aruldas, 2nd edition, 2013, PHI Learning Pvt. Ltd. [ISBN: 978-81-203-3635-3] (All Units)
2. **Quantum Mechanics** -Leonard.I. Schiff, 1968, McGraw Hill 3rd Edition. [ISBN: 0-07-085643-5] (Unit II)
3. **Introduction to Quantum Mechanics** – David J Griffiths, Pearson- 2nd edition- 2016. [ISBN: 978-93-325-4289-1]

Reference Books

1. **A Text Book of Quantum Mechanics**-P.M. Mathews & K. Venkatesan-Tata McGraw Hill 29th Reprint 2002
2. **Quantum Mechanics**-Devanathan-Narosa Publishing-New Delhi, 2005
3. **Quantum Mechanics**-A.K. Ghatak and S. Loganathan- McMilan India 4th Edition, 1999
4. **Introduction to Quantum Mechanics** – David J Griffiths- Addison Wesley – 2nd edition

Web Reference:

1. http://juser.fz-juelich.de/record/20885/files/A2_Bluegel.pdf&ved=2ahUKEwienuaa4aPzAhUcIbcAHUdQANMQFnoECAMQAQ&usg=AOvVaw0CEdb862rnJdihdmzyWiAf(unit 1)
2. http://scipp.ucsc.edu/~dine/ph216/atomic_physics.pdf&ved=2ahUKEwjEgJC-4aPzAhWvILcAHRglDcEQFnoECAMQAQ&usg=AOvVaw1PQGGLKpoQ6xni51I0riXN (unit 2)
3. https://www.cmi.ac.in/~govind/teaching/rel-qm-rc13/rel-qm-notes-gk.pdf&ved=2ahUKEwiZ1erj4aPzAhUc4zgGHX6KAGsQFnoECAMQAQ&usg=AOvVaw0-SNbiYJFpgVJHTdXhyqsW(unit 3)
4. https://www.feynmanlectures.caltech.edu/III_04.html(unit 4)
5. https://www.britannica.com/science/quantum-field-theory(unit 5)

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: VII	21PHP07	**ADVANCED ELECTRONICS**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	II	50	50	100

Preamble: The aim is to make the students to understand the concept of semiconductor devices, to gain knowledge about fabrication and characteristics of Integrated Circuits and to learn the concepts of advanced level of digital electronics.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recall the logic gates, basic types of transistors, counters ,shift registers and flip-flops	K1
CO2	elucidate to make integrated circuits, JFET,MOSFET,SCR,	K2

	optoelectronic devices by chronologically order	
CO3	examine basic laws of Boolean algebra, De- Margan's theorem and types of flip- flops, A/D converter, D/A converter	K3
CO4	analyze the results of integrated circuits and non-linear analog system	K4
CO5	verify the opto electronic devices such as photo register, photo diode, photo transistor and field effect transistors.	K5
CO6	create a new design of synchronous counters by using of flip-flop, karnaugh map	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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 POs	54	54	48	48	36	22	20
Weighted Percentage	6.37	7.18	8.26	9.83	8.27	5.82	7.66

of COs Contribution to POs							

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

SYLLABUS

Unit -I: SEMICONDUCTOR DEVICES (12 hours)

Field effect transistors – JFET bias line and load line – MOSFET construction and Symbols – FET as a Voltage Variable Resistor-Common Source Amplifier at High Frequencies-Common Drain Amplifier at High Frequencies-Silicon Controlled Rectifier (SCR) Characteristics-SCR Power Control- Tunnel Diode -Optoelectronics: Photo Resistor-Photo Diode-Photo Transistor-LED-Photo Voltaic Effect-Solar Cells.

Unit–II: INTEGRATED CIRCUITS-FABRICATION AND CHARACTERISTICS (12 hours)

Integrated circuit technology – Basic monolithic circuits – Epitaxial growth – Masking and etching – Diffusion of impurities – Transistor for monolithic circuits – Monolithic diodes – Integrated resistors-Integrated capacitors – Monolithic circuit layout – Additional isolation methods – LSI and MSI – Metal semiconductor contact.

Unit –III: INTEGRATED CIRCUITS AS ANALOG SYSTEM BUILDING BLOCKS (12 hours)

Linear analog systems: Basic Op.Amp. applications – Sign changer – Scale changer – Phase shifter – Summing amplifier – Voltage to current converter – Current to voltage converter – DC voltage follower – Differential DC amplifier – Stable AC coupled amplifier – Analog integration and differentiation – Electronic analog computation

NONLINEAR ANALOG SYSTEMS: Comparator – Sample and hold circuits – D/A converter: Binary weighted resister and ladder type – A/D converter: Successive type and Dual-slop converters

Unit –IV: (12 hours)

FLIP-FLOPS: S-R, Clocked S-R, D, J-K, T, Master-Slave J-K flip-flops – Their state diagrams and characteristic equations – Edge triggering in flip-flops

LOGIC GATES: OR, AND, NOT, NOR and NAND gates, Exclusive OR gate – NAND and NOR as Universal gates.

BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES: Basic laws of Boolean algebra – De Morgan's theorems – Adder, Subtractor, Comparator, Decoder / Demultiplexer - Sum of products and Product –of-sums - Karnaugh map (up to four variables only) –Don't care

Unit- V: SYNCHRONOUS COUNTERS **(12 hours)**

Design of Synchronous Counters: Design of MOD-3, MOD-6 ,and MOD-10 counters using JK Master-slave flip-flops only – Register – 4 bit shift Register – Serial-in serial-out, Serial-in Parallel-out, Parallel-in Serial-out and Parallel-in Parallel-out – Design of four bit self-correcting ring counter using D-flip-flop

Text Book :

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

Reference Books

1. **Handbook of Electronics**, Gupta and Kumar.
2. **Digital Fundamentals**, Floyd-UBS 1600.
3. **Digital Principles and Applications**, Malvino& Leach, McGraw Hill.
4. **Applied Electronics**, R S Sedha.

Web Reference:

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
Part – III	Core: VIII	21PHP08	**SOLAR PHYSICS**	60	3

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	II	50	50	100

Preamble: The aim is to provide the students an overview of the energy problem faced by the current generation, underline the importance of renewable energy sources and to get a thorough knowledge

about renewable solar energy technology.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recall the facts about Energy Sources and its availability and basics of solar energy	K1
CO2	narrate the principles of solar cells, solar radiation measurements	K2
CO3	Seek different applying technique behind solar cell and creates innovative ideas.	K3
CO4	explore the causes and relationship between different types of solar cells. Helps in evaluating performance of solar cell	K4
CO5	create new innovation on the basis of Solar energy such as solar cell and solar greenhouse	K5
CO6	Develop new proposal on the basis of solar energy principle	K6

K1 – Remember;K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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	3
CO5	9	3	3	3	1	3	3

CO6	9	3	3	3	3	3	9
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

SYLLABUS

Unit –I: INTRODUCTION TO ENERGY SOURCES (12 Hours)

Energy sources - World and Indian energy future - Types of energy sources - World energy futures - Energy sources and their availability.

Unit –II: RENEWABLE ENERGY (12 Hours)

Prospects of renewable energy sources - solar energy - Its uses and barriers in the implementation of renewable energy systems. Indian research and perspectives.

Unit- III: (12 Hours)

SOLAR ENERGY: Solar radiation at the Earth's Surface - Solar constant.

SOLAR RADIATION MEASUREMENTS: Solar energy measuring equipments – pyrheliometers – pyranometers.

Unit- IV: SOLAR CELLS (12 Hours)

Solar cells for direct conversion of solar energy to electric energy - Solar cell parameter - Solar cell electrical characteristics - Efficiency - Single crystal silicon solar cells - Polycrystalline silicon solar cells - Cadmium sulphide solar cells.

Unit –V: APPLICATIONS OF SOLAR ENERGY (12 Hours)

Solar water heating - space heating and space cooling - solar photo voltaics - agricultural and industrial process heat - solar distillation - solar pumping- solar furnace - solar water heater - solar cooking - solar green house.

Text Book :

1. **Solar Energy Utilisation** - G.D.Rai, 1987, Khanna Publishers, New Delhi, 3rd Edition. (All Units)
2. **Non-Conventional Energy Sources**- B.H.Khan, 2006, Tata McGraw Hill. [ISBN 0-07-060654-4]
3. **Non-Conventional Energy Sources and Utilisation** - Er. R. K. Rajput, (2014) S.Chand& Company Pvt. Ltd, [ISBN 81-219-3971-2].
   Non-Conventional sources of Energy- G.D.Rai, 5th Edition, Khanna Publishers, New Delhi.
   [ISBN: 81-7409-073-8]

Reference Books

1. **Renewable Energy**, Godfrey Boyle, Oxford University Press in association with the Open University, 2004, [ISBN: 9780199261789]
2. **Principles of Solar Engineering** F. Kreith and J.F. Kreider, 1978, Tata McGraw Hill.
3. **Solar Energy**, M.P.Agarwal, 1983 S. Chand and Co., New Delhi.
4. **Solar Energy,** S.P.Sukhatme, 1996, Tata McGraw Hill. [ISBN: 0-07-462453-9]

Web Reference:

1. http://oro.open.ac.uk › ...
2. Renewable energy. 2nd edition - Open Research Online
3. https://www.ebooknetworking.net/ebooks/principles-of-solar-engineering.html
4. http://mguniversity.ac.in/syllabus/ug_sec/VI%20Semester%20Skill%20Enhancement%20Courses.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part-III	Core : IX	21PHP09	**ADVANCED PHYSICS PRACTICAL-I**	120	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	I & II	50	50	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

CO Statement: On the successful completion of the course, students will be able to

COs	CO 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; K6 – Create

CO- PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

PO COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
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

SYLLABUS

S.No	Course Content	Instructional Hours
1	Young's Modulus-Elliptical Fringes (Cornu's Method)	120
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
Part – III	Core: X	21PHP10	**GENERAL ELECTRONICS PRACTICAL - I**	120	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	I & II	50	50	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

CO Statement: On the successful completion of the course, students will be able to

COs	CO 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	K2

	express the applications of diodes, OP-AMP, BJT, SCR, FET and UJT	
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; K6 – Create;

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

PO COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
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

SYLLABUS

ANY FIFTEEN(15) EXPERIMENTS ONLY

EXAMINATION AT THE END OF SECOND SEMESTER

S.No	Course Content	Instructional Hours
1	Design of Regulated and Dual Power Supply.	120
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.	

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: XI Elective:	21PHP11A	**ASTRONOMY &**	48	3

	II		**ASTROPHYSICS**		

Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	II	50	50	100

Preamble: The aim is to provide the students deeper knowledge and understanding of astronomy, learn information about stars and galaxies and to know about the destruction of stars.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	outline the history of astronomy, stars, galaxies, components of the Sun and stellar evolution	K1
CO2	explain the concepts in highlights of Einstein's special and general theory of relativity, fusion reaction mechanism, classification of galaxies and stages of stars	K2
CO3	classify concepts of astronomy, calculating the distance between stars, components of the Sun, galactic astronomy and stages of stars	K3
CO4	categorize the classification of galaxies and stars	K4
CO5	evaluate the science behind observation of universe	K5
CO6	elaborate the hypothesis behind the geo and helio centric theories, calculating the distance between the stars and its composition, types of galaxies and to formulate the lives and death of stars	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate;K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT- I: HISTORY OF ASTRONOMY (9 Hours)

Introductory History of Astronomy-Ptolemy's Geocentric Universe-Copernicus' Heliocentric Universe- Tycho Brahe and Galileo's Observations- Kepler's Laws of Planetary Motion-Newtonian Concept Of Gravity-Highlights of Einstein's Special and General Theory Of Relativity-Curved Space Time-Evidence of Curved Space Time-Bending Of Light-Time Dilation

UNIT- II: STARS & GALAXIES (9 Hours)

Stars and Galaxies-Distances-Trigonometric Parallax-Inverse Square Law-Magnitude of Stars-Apparent Magnitude-Absolute Magnitude and Luminosity-Color and Temperature- Composition of Stars-Velocity, Mass and Sizes of Stars-Types of Stars- Temperature Dependence-Spectral Types-Hertzsprung - Russell (HR) Diagram-Spectroscopic Parallax

UNIT –III: SUN AND ITS COMPOSITION (10 Hours)

The Sun-Its Size and Composition- Sun's Interior Zones-Sun's Surface-Photosphere-Chromosphere-Corona-Sun's Power Source-Fusion Reaction Mechanism.

UNIT IV : GALACTIC ASTRONOMY (10 Hours)

Milky Way Hubble classification of galaxies-Spiral galaxies, Elliptical galaxies, Irregular galaxies, Dwarf galaxies; Masses of galaxies-Rotation curves of galaxies; Dark matter

UNIT –V: LIVES AND DEATH OF STARS (9 Hours)

Stellar Evolution-Mass Dependence-Giant Molecular Cloud-Protostar-Main Sequence Star-Subgiant, Red Giant, Supergiant-Core Fusion-Red Giant (Or) Supergiant- Planetary Nebula (Or) Supernova-White Dwarfs-Novae And Supernovae- Neutron Stars-Pulsars-Black Holes-Detecting Black Holes

Text Book :

1. **Lectures on Astronomy, Astrophysics, and Cosmology** - Luis A. Anchordoqu, Department of Physics, University of Wisconsin-Milwaukee, U.S.A (Dated: Spring 2007).
2. **Lecture Notes of Department of Physics** - University of Wisconsin-Milwaukee
3. **Astrophysics of the Solar System**- K.D. Abhayankar, University press (India) Pvt Ltd, January 24, 2017. [ISBN: 9788173719694].
4. **An Introduction to Planetary Physics - The terrastial Planets**, William M. Kaula, 1968, Wiley, NewYork, Space Science text series.
5. **Astrophysics of the Sun**- HaroldZirin, Cambridge University Press, 23 June 1988.

Web Reference:

1. www.astronomynotes.com(All Units)

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – III	Core: XI Elective: II	21PHP11B	**EXPERIMENTAL TECHNIQUES**	48	3

Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	II	50	50	100

Preamble: The aim is to provide the students knowledge about the techniques behind various measuring instruments and to handle the various electronic measuring instruments.

CO Statement: On the successful completion of the course, students will be able to

COs	CO Statement	Knowledge Level
CO1	recall the errors in measurements, transducers, Amplifiers, Electronic Measuring Instruments and Wave Analyzers	K1
CO2	explain the types of transducer, the working of Amplifiers, Electronic Measuring Instruments and Wave Analyzers	K2
CO3	apply the different types of transducers, amplifiers, electronic Measuring Instruments	K3
CO4	analyze the applications of various electronic measuring instruments	K4
CO5	evaluate appropriate methods for analyzing electronic waves and Conditioning of signals	K5
CO6	design amplifiers, filters, Electronic Measuring Instruments and Wave Analyzers	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT- I: MEASUREMENT OF ERRORS (9 Hours)

Accuracy, precision, resolution, sensitivity -absolute and relative errors-Types of errors -gross error, systematic error and random error.

STANDARDS OF MEASUREMENTS: Classification of standards, time and frequency standards, electrical standards.

UNIT- II: ELECTRICAL TRANSDUCER CLASSIFICATION (9 Hours)

Active and Passive transducers- selecting a good transducer – requirements of an electrical transducer – transducer types- resistive, inductive, capacitive and Piezoelectric transducer-Digital displacement

transducers – thermistors.

UNIT –III: AMPLIFIERS AND SIGNAL CONDITIONING (10 Hours)

Instrumentation amplifiers-Isolation amplifiers-Chopper amplifiers-Voltage to frequency converters-Frequency multipliers-logarithmic amplifiers, S/H Circuits Active filters-Low pass, High pass, Band pass and Band stop filters.

UNIT - IV: ELECTRONIC MEASURING INSTRUMENT (10 Hours)

Q-meter-Vector impedance meter Digital frequency meter -Digital voltmeter -Phase meter-RF power and voltage measurement -Power factor meter -Vector voltmeter. Display and Recording: X-Y Recorders-Magnetic Tape recorders-Storage Oscilloscope- cathode ray oscilloscope.

UNIT - V: ANALYSIS (10 Hours)

Wave Analyzers-Audio frequency Wave analyzer-Harmonic distortion analyzers-Resonant harmonic distortion analyzer-Heterodyne harmonic distortion analyzer-Fundamental suppression harmonic distortion analyzer-Spectrum analyzer.

Text Book :

1. **Electrical & Electronics Measurement &Instrumentation**, A.K. Sawhney, DhanpatRai and sons. (All Units)
2. **Modern Electronic Instrumentation**, H. S. Kalsi, 2010, 3rd Edition - Tata McGraw Hill.

Reference Books

1. **Modern Electronic Instrumentation and Measurement Techniques**, A.O. Hefnick and W.D. Cooper., Prentice Hall India Publications.
2. **Introduction to Instrumentation and Control**, A.K. Ghosh-Prentice Hall India Publications

Web Reference:

1. https://www.academia.edu/8140873/A_K_Sawhney_A_course_in_Electrical_and_Electronic_Measurements_and_Instrumentation
2. https://pdfcoffee.com/h-s-kalsi-electronic-instrumentation-3e-pdf-free.html
3. http://fmcet.in/ECE/EC2351_uw.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
Part – IV	Ability Enhance	21AEP01	**CYBER SECURITY**	24	2

	ment				

Contact hours per week: 2

Year	Semester	Internal Marks	External Marks	Total Marks
First	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.

CO Statement: On the successful completion of the course, students will be able to

COs	CO 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; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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	3	9	9
CO5	9	9	3	3	3	9	3
CO6	9	9	3	3	3	3	3
Total Contribution of COs to POs	54	54	42	42	36	48	42
Weighted Percentage of COs Contribution to POs	4.47	5.04	5.0	5.8	5.4	8.1	9.3

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

SYLLABUS

UNIT - I: INFORMATION SECURITY (5 Hours)

History of Information Security - Need for Security-**Types of Security:** Physical Security –Network Security –Personal Security –Operation Security –Communication Security - Information Security Threats.

UNIT -II: INTRODUCTION TO CYBER SECURITY (5 Hours)

Cyber Security: Objectives- Roles- Differences between Information Security and Cyber Security. **Cyber Security Principles:** Confidentiality- Integrity – Availability

UNIT -III: RISKS & VULNERABILITIES (5 Hours)

Risk Meaning: Risk Management –Problems of Measuring Risk -Risk Levels-Risk Analyzes-Risk Assessment –Response to Risk Terminology- **Threats:** Components of Threats-Types of Threats-**Vulnerabilities:** Computing System Vulnerabilities –Hardware Vulnerabilities-Software Vulnerabilities-Data Vulnerabilities-Human Vulnerabilities.

UNIT - IV: SOCIAL MEDIA (5 Hours)

Introduction to social media: What, Why –Pros and cons- Security issues in social media: Mail-Facebook-Whatsapp-Twitter-Preventive and control measures.

UNIT –V: CASE STUDY **(4 Hours)**

Impact of social media: Education -Business- Banking-Mobile –Human Life- Present generation- Indian scenario.

Web References:

1. https://m.youtube.com/watch?v=o6pgd8gLFHg
2. https://m.youtube.com/watch?v=3rl4ZjZpcHU
3. https://blog.barkly.com/10-fundamental-cybersecurity-lessons-for-beginners
4. https://5social media security risk and how to avoid them.html
5. https://10 cyber security twitter profiles to watch.html
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

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XII	21PHP12	**ATOMIC AND MOLECULAR SPECTROSCOPY**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
Second	III	50	50	100

Preamble: The aim is to provide the students, the skills and capability for formulating and analyzing chemical compounds using Atomic and Molecular Spectroscopy

CO Statement: After completion of the course, the learners will be able to

Cos	CO 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 ; K6- Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT –I: ATOMIC SPECTROSCOPY (12 Hours)

Atoms in External Magnetic Fields -Normal Zeeman Effect-Anomalous Zeeman Effect-Magnetic Moment of Atom -Lande's g Formula- Paschen Back Effect- Stark Effect-Hyperfine Structure of Spectral Lines - Spectra of Hydrogen and Alkali Atoms

MICROWAVE SPECTROSCOPY-Experimental Methods-Theory of Microwave Spectra of Linear, Symmetric Top Molecules -Hyperfine Structure

UNIT - II: IR SPECTROSCOPY (12 Hours)

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: FLUORESCENCE & PHOSPHORESCENCE SPECTROSCOPY (12 Hours)

Electronic Excitation of Diatomic Species-Vibrational Analysis of Band Systems of Diatomic Molecules-Deslander's Table-Intensity Distribution-Franck Condon Principle- Rotational Structure of

Electronic Bands-Resonance and Normal Fluorescence - Intensities of Transitions-Phosphorescence-Population of Triplet State -Experimental Methods-Applications of Fluorescence and Phosphorescence

UNIT –IV: NMR SPECTROSCOPY (12 Hours)

Quantum Mechanical and Classical Description - Bloch Equations - Relaxation Processes-Experimental Technique-Principle and Working of High Resolution NMR Spectrometer- Chemical Shift

UNIT - V: ESR SPECTROSCOPY (12 Hours)

Basic Principles-Experiments-ESR Spectrometer-Reflection Cavity and Microwave Bridge-ESR Spectrum-Hyperfine Structure

Text books:

1. **Molecular Structure and Spectroscopy**- G.Aruldhas, 2011, PHI Learning Private Limited.

Reference Books:

1. **Fundamentals of Molecular Spectroscopy** - C. N. Banwell, 1994, Tata McGraw Hill Publishing Company Limited.

Web Reference:

1. https://books.google.co.vi/books?id=z08q2SyROjoC&printsec=frontcover&source=gbs_ge_summary_r&cad=0
2. http://www3.tellabs.com/cgi-bin/content/view.php?data=fundamentals_of_molecular_spectroscopy_banwell_solutions_book_mediafile_free_file_sharing&filetype=pdf&id=9e219833ce89228ea665a996607beea8
3. https://www.prsu.ac.in/backend/web/theme/tender/5860.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XIII	21PHP13	**NUCLEAR & PARTICLE PHYSICS**	60	4
Contact hours per week: 5					

Year	Semester	Internal Marks	External Marks	Total Marks
Second	III	50	50	100

Preamble: The aim is to provide the students, the concepts of Nucleus and elementary particles and to develop skills to find the binding energy, spin and parity values for various elements.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	recall the properties of nucleus, radioactive decay, fusion, fission reaction mechanism and elementary particles	K1
CO2	explain the concepts of nuclear theories, decay process of particles, nuclear models, fusion reactors and nuclear models	K2
CO3	classify the concepts of nuclear composition, forms of interactions inside the nucleus and models of a nucleus	K3
CO4	Analyse the classification of nuclear composition, nuclear force, properties of radioactive decays, selection rules, magic numbers, thermal reactors and for particle physics	K4
CO5	evaluate the nuclear properties, decay process, nuclear reaction mechanisms and basic conservation laws	K5
CO6	elaborate the hypothesis behind particle physics, forms of interactions and radioactive decay, nuclear energy levels and nuclear models	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze;
K5 – Evaluate ; K6- Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT I: NUCLEAR PROPERTIES: (12 Hours)

Nuclear Structure- Distribution of Nuclear Charge-Nuclear Mass-Mass Spectroscopy-Mass

Spectrometer-Theories of Nuclear Composition (proton-electron, proton-neutron)- Tensor Force-Static Force-Exchange Force- Nuclear energy levels - Nuclear angular momentum, parity, isospin – Nuclear magnetic dipole moment – Nuclear electric quadropole moment - Ground state of deuteron

UNIT II: RADIOACTIVE DECAYS - ALPHA DECAY (12 Hours)

Properties of α Particles-Gamow‟s Theory of α Decay-Geiger Nuttal Law- α Ray Energies-Fine Structure of α Rays- α Disintegration Energy-Long Range α Particles.

BETA DECAY: Properties of β Particles-General Features of β Ray Spectrum-Pauli‟sHypothesis-Neutrino Hypothesis-Fermi‟s Theory of β Decay-Forms of Interactions and Selection Rules.

GAMMA DECAY: Absorption of γ Rays by Matter-Interaction of γ Rays with MatterMeasurement of γ Ray Energies-Internal Conversion.

UNIT III: NUCLEAR REACTIONS AND NUCLEAR MODEL (12 Hours)

Reciprocity theorem– Breit-Wigner formula – Resonance theory – Liquid drop model – Shell model -- Evidences for shell model -- Magic numbers -- Harmonic oscillator – Square-well potential -- Spin-orbit interaction – Collective model of a nucleus.

UNIT IV: FISSION AND FUSION REACTOR (12 Hours)

Characteristics of fission – Mass distribution of fragments – Radioactive decay processes – Fission cross-section – Energy in fission – Bohr-Wheeler's theory of nuclear fission – Fission reactors – Thermal reactors – Homogeneous reactors – Heterogeneous reactors – Basic fusion processes -- Characteristics of fusion – Solar fusion – Controlled fusion reactors.

UNIT V: PARTICLE PHYSICS (12Hours)

Nucleons, leptons, mesons, baryons, hyperons, hadrons, strange particles - Classification of fundamental forces and elementary particles – Basic conservation laws – Additional conservation laws: Baryonic, leptonic, strangeness and isospin charges/quantum numbers – Gell-mann--Nishijima 23 formula - Invariance under charge conjugation (C), parity (P) and time reversal (T) – CPT theorem -- Parity nonconservation in weak interactions – Eight-fold way and supermultiplets – SU(3) symmetry and quark model.

Text Books:

1. **Nuclear Physics - An Introduction**, S. B. Patel, 2009, New Age, New Delhi.(Unit II,III)
2. **Nuclear Physics** - D.C. Tayal, 2001, Himalaya Pub. House, New Delhi. (Unit I-V)

Web Reference:

1. https://www.rac.ac.in/assets/download/Syllabus.php?filename=Njc=

2. http://idhayacollegekum.org/syllabus/physics/PG/sem4/NUCLEAR%20AND%20PARTICLE%20PHYSICS.pdf
3. http://www3.tellabs.com/cgi-bin/content/view.php?data=nuclear_physics_tayal&filetype=pdf&id=986f50b41754af3cf0045be6ac81807a

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XIV	21PHP14	**ELECTROMAGNETIC FIELD THEORY**	60	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	50	50	100

Preamble: The aim is to provide the students, the theory for the fields produced by stationary and moving charges and charged systems and hence the propagation of electromagnetic fields.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	recap the basics of electrostatics, magnetostatics and Maxwell's equation	K1
CO2	recognize the principles behind electrostatics in macroscopic media and Electromagnetic potentials	K2

CO3	apply different formulae in the field of electrostatics, magneto statics and relativistic electrodynamics	K3
CO4	infer innovative ideas in the field of electromagnetic theory	K4
CO5	examine the effectiveness of different laws in electromagnetic problems with the help of electrodynamic potentials	K5
CO6	Originate new theories and innovations based on electromagnetic field theory	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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	6.37	5.58	5.16	5.32	5.05	4.23	7.66

Percentage of COs Contribution to POs							

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

SYLLABUS

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: ELECTROSTATICS IN MACROSCOPIC MEDIA (12 Hours)

Potential and Field due to an Electric Dipole-Dielectric Polarization-External Field of a Dielectric Medium-Gauss' Theorem in a Dielectric-Electric Displacement Vector D-Linear Dielectrics-Relations connecting Electric Susceptibility χ_e, Polarization P, Displacement D and Dielectric Constant-Boundary Conditions of Field Vectors-Molecular Field-Clausius Mosotti Relation for Non-Polar Molecules-Electrostatic Energy and Energy Density.

UNIT III : MAGNETOSTATICS (12 Hours)

Biot-Savart Law - Statement-Lorentz Force Law - Definition of B-Divergence and Curl of B Magnetic Scalar Potential (derivation of expression only)-Equivalence of Small Current Loop and Magnetic Dipole-Magnetic Vector Potential (derivation of expression only).

UNIT IV: ELECTROMAGNETICS (12 Hours)

Equation of Continuity-Displacement Current-Derivation of Maxwel's Equations - Physical Significance - Poynting Vector - Momentum in EM Field - Electro Magnetic Potentials-Maxwell's Equations in terms of EM Potentials - Lorentz Gauge-Coulomb Gauge - Boundary Conditions at Interfaces.

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. **Electromagnetic Theory, Chopra & Agarwal-** , 2016, K. Nath&Co,Educational Publishers,6th Edition. [ISBN: 978-81-924088-9-7] (Unit I-V)
2. **Electromagnetic Theory & Electrodynamics** - SathyaPrakash, 2004, KedarNath Ram Nath & co, Publishers New Edition.(Unit II, III, V)

Web Reference:

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
3. https://rcub.ac.in/econtent/ug/bsc/4sem/BSc%20Sem%20IV%20Physics%20Electromagnetic%20Theory.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XV	21PHP15	**INSTITUTIONAL TRAINING**	-	**1**

Contact hours per week: -

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	100	-	100

Preamble: To provide the students a deeper knowledge in

Institutional training – creating a opportunity for the students

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
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 variour application	K6

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

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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 PO

Category	**Course Type**	**Course Code**	**Course Title**	**Contact Hours**	**Credit**
III	Core : XVI	Open Elective	**ENVIRONMENTAL PHYSICS**	**45**	**2**

Contact hours per week: 3

Year	**Semester**	**Internal Marks**	**External Marks**	**Total Marks**
First	III	50	50	100

Preamble: The aim is to provide the students to gain knowledge and understanding the Environmental Pollution and Control Techniques.

CO Statement: After completion of the course, the learners will be able to

Cos	**CO Statement**	**Knowledge Level (RBT)**
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	K2

	energy resources	
CO3	apply Pollution Control Techniques to reduce pollution	K3
CO4	Analyse 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; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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 Contributio	6.3	5.5	5.1	5.3	5.0	4.2	7.6

n to POs							

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

SYLLABUS

UNIT I **(9 hours)**

Introduction - Environmental pollution – Sources of pollution – types of pollutants – Carbon Monoxide, Nitrogen Oxides, Sulphurdioxide – Particulates – Toxic Chemicals in the Environment - Effects of pollution – Preventive Measures of pollution.

UNIT II **(9 hours)**

Types of pollution – Air Pollution ,Causes and its effects – Water pollution ,Causes and its Effects -Soil Pollution , Causes and its Effects , Thermal pollution ,Causes and its effects ,Noise pollution - Causes and its Effects.

UNIT III **(9 hours)**

Pollution Control Techniques - Solid Waste Management - Solid Waste Disposal – Solid Waste Ocean Dumping – Solid Waste Management by Bio Technology – Organic Waste Management by composting process.

UNIT IV **(9 hours)**

Waste Water Treatment – Water quality Parameters – Sludge Treatment – Reverse Osmosis – Water Reuse and Recycling – Domestic Water Treatment- Disinfection methods- UV Treatment and Ozonolysis.

UNIT V **(9 hours)**

Natural Energy Sources – Renewable Energy Sources – Solar Energy , Natural gases ,Wind Energy and Tidal Energy – Non Renewable Energy Sources – Coal , Minerals and Petroleum products.

Text Books :

1. **Environmental Chemistry** (7thEdition by A.K. DE) New Age International Publishers.
2. **Environmental Studies** Published by Bharathiar University.

Web Reference:

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
III	Core : XVII Elective III	21PHP16A	**BIOMEDICAL INSTRUMENTATION**	60	3

Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	50	50	100

Preamble: The aim is to provide the students, the working principles of medical instruments and Physics behind the instruments.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	recall ultrasonic resonance, Magnetic intensity, brain ,the central nervous system,Transducer, and Doppler Ultrasound.	K1
CO2	discuss electroencephalogram, ENT and ophthalmic instruments, Magnetic Resonance and Imaging	K2
CO3	apply the components of a typical laser system in ophthalmology.	K3
CO4	analyze the Recording of ECG waves, opthamology , ultrasound technology, magnetic resonance phenomena ,	K4

	magnetic relaxation and MRI parameters.	
CO5	evaluate the techniques behind ultrasonography, ultrasound scanning, retinoscopy and Keratometer.	K5
CO6	modifythe characteristics of the normal ECG and transducer design.	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT I: ELECTROPHYSIOLOGICAL MEASUREMENTS (12 Hours)

Cell potential genesis – Nernst relation – cell in resting state – action potential from a cell – the resultant externally recorded action potential.

Electrocardiography(ECG): Electrocardiographic planes – Einthoven triangle – bi polar and uni-polar limb lead frontal plane ECG measurements – ECG leads – precordial leads – relationship between various leads – recording of ECG waves and measurements (block diagram)

UNIT II: ELECTROENCEPHALOGRAM (12 Hours)

The brain and the central nervous system – the brain and its parts – cell potential and action – the characteristics of the normal ECG – the input electrodes – electrode construction and connections – EEG recording instruments (explanation with block diagram) – EEG wave analysis – a typical EEG machine specifications and requirements.

UNIT III: ENT AND OPHTHALMIC INSTRUMENTS (12 Hours)

Audiometry – Bekesy audiometer system – instruments used in opthamology - opthalmoscope – retinoscopy – Keratometer – intra ocular pressure – ultra sound in ophthalmology – components of a typical laser system in ophthalmology.

UNIT IV (12 Hours)

Ultrasonography – advantages – B scan – ultrasound scanning – ultrasonic system – probes for ultrasound – Doppler ultrasound (basic aspects) – transducer design – demodulation methods.

UNIT V: MAGNETIC RESONANCE AND IMAGING (MRI) (12 Hours)

Magnetic intensity – magnetic resonance phenomena – the magnets – magnetic relaxation and MRI parameters – pulse sequences.

Text Books:

1. **A Text book of Medical Instruments**, S.Anandhi, 2005, New Age International (P) Ltd., Publishers, 1st Edition.(Units I-V)

Reference books:

1. **Encyclopedia of medical devices and instrumentation**, John G. Webster et.al, Wiley-Interscience, Second Edition.
2. **Medical Physics and Bio medical Engineering,** B. H. Brown et, al. Institute of Physics Publishing Bristol and Philadelphia.
3. **Design and Development of Medical Electronic Instrumentation**, David Prutchi, Michael Norris, Wiley - Interscience.
4. **Bio medical instrumentation**, M. Arumugam, 2002, Anuradha Publications. [ISBN**:** 818772112X]

Web Reference:

1. https://pdfroom.com/books/a-textbook-of-medical-instruments-s-ananthi-new-age-2005-ww/7jgkRPbmdMV
2. https://iopscience.iop.org/article/10.1088/0967-3334/21/4/701
3. https://biblioseb.files.wordpress.com/2018/03/wiley-encyclopedia-of-medical-devices-and-instrumentationvol-3.pdf
4. https://www.researchgate.net/publication/3246222_Design_and_Development_of_Medical_Electronic_Instrumentation_-_Book_review

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XVII Elective III	21PHP16B	**THIN FILM PHYSICS AND CRYSTAL GROWTH**	60	3

Contact hours per week: 4

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	50	50	100

Preamble: The aim is to provide the students to gain knowledge and understanding the Environmental

Pollution and Control Techniques.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	recall the nature of thin films, deposition and Growth Process of crystals	K1
CO2	explain the concepts of different Deposition techniques, stages of film growth and various characterization Techniques of crystals	K2
CO3	apply the required deposition technique of thin films and growth technique of crystals	K3
CO4	analyze the thickness of the film and the growth and structure of a crystal,	K4
CO5	evaluate the defects and impurities in films and crystals, deposition parameters and grain size of thin films, Growth Techniques of crystal	K5
CO6	Prepare a thin film, grow a crystal	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT I: PREPARATION OF THIN FILM: (12 Hours)

Nature of Thin Film-Deposition Technology-Distribution of Deposit-Resistance Heating- Thermal Evaporation-Flash Evaporation

UNIT II: DEPOSITION TECHNIQUES (12 Hours)

Electron Beam Method-Cathodic Sputtering-Glow Discharge Sputtering-Low Pressure Sputtering-Reactive Sputtering-RF Sputtering-Chemical Vapour Deposition-Chemical Deposition

UNIT III: THIN FILM GROWTH PROCESS (12 Hours)

Epitaxy-Thin Film Structure-Substrate Effect-Epitaxial Deposit - Film growth-five stages- Nucleation theories-Incorporation of defects and impurities in films Deposition parameters and grain size-structure of thin films.

FILM THICKNESS: Mass Methods-Optical Method-Photometry-ElliPOmetry-Interferometry-Other Methods- Substrate Cleaning.

UNIT IV: CRYSTALLIZATION PRINCIPLES AND GROWTH TECHNIQUES (12 Hours)

Solution growth-Low and high temperatures solution growth-Slow cooling and solvent evaporation

methods-Constant temperature bath as a crystallizer. Principle of gel technique-Various types of gel - Structure and importance of gel-Methods of gel growth and advantages-Melt technique- Czochralski growth- Vapor-phase growth-Physical vapor deposition-Chemical vapor deposition.

UNIT V: CHARACTERIZATION TECHNIQUE (12 Hours)

X-ray Diffraction (XRD)-power and single crystal-Fourier transform infrared analysis-FT-Raman analysis-Elemental dispersive x-ray analysis (EDA–X)-scanning electron microscopy (SEM)-UV-VIS Spectrometer-Photo luminance (PL)

Text Books:

1. **Thin Film Fundamentals**, A. Goswami, 2008, New Age, New Delhi. (Units I – III)
2. **Elementary Crystal Growth**, K. Sangawal, 1994, Shan Publisher, UK. (Unit – IV)
3. **Crystal Growth and Processes**, P. Santhana Ragavan, P.Ramasamy, 2000, KRU Publications, Kumbakonam. (Unit IV, V)
4. **Crystal Growth Process**, J. C. Brice, 1996, John Wiley Publications, New York.

Reference books:

1. **Hand book of Thin Films Technology**, L.I. Maissel and R. Clang, 1970, McGraw Hill.
2. **Thin Films Process**, J. L. Vossen and W. Kern, 1978, Academic Press.
3. **The Materials Science of Thin Films**, M. Ohring, 1992, Academic Press.
4. **Instrumental Methods of Analysis**, M. William and D. Steve, 1986, CBS publishers, New Delhi.
5. **Instrumental Methods of Analysis**, H.H. Williard, L.L. Merritt, M.J. Dean, and F.A. Settle, Sixth Edition, 1986, CBS Publishers and distributors, New Delhi.

Web Reference:

1. https://books.google.co.in/books/about/Thin_Film_Fundamentals.html?id=K0e-8Nh9zSYC
2. http://www.issp.ac.ru/ebooks/books/open/Advanced_Topics_on_Crystal_Growth.pdf
3. https://www.acadpubl.eu/hub/2018-119-12/articles/2/489.pdf
4. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/SCY2.pdf
5. https://arshadnotes.files.wordpress.com/2018/02/the_materials_science_of_thin_films.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
V	Proficiency Enhancement	21PEP01	**LASER AND ITS APPLICATIONS (SELF –STUDY)**	-	**2**

Contact hours per week: -

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	-	100	100

Preamble: The Aim is to provide the students knowledge about Lasers, types of lasers available and its applications, in medical and industrial lines and train them to fabricate new models of lasers.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	recall the basic terms involved in the lasers	K1
CO2	Explain the fundamental properties and conditions of different lasers	K2
CO3	apply the laser applications in material processing	K3
CO4	Analyze the different types of surface treatments, laser deposition of thin film, integrated circuit fabrication	K4
CO5	Evaluate the needed method for the preparation of thin film.	K5
CO6	Create a new technique for sample fabrications	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT I: FUNDAMENTALS OF LASERS

Electromagnetic radiation – energy levels – Interaction of radiation and matter – fluorescence, absorption, stimulated emission.

LASER MATERIALS: population inversion – optical pumping- excitation by electron collisions – resonant transfer of energy – resonant cavity.

UNIT II: PROPERTIES OF LASER LIGHT

Line width – collimation – spatial profiles of laser beams – temporal behavior of Laser output – Q switched operation – mode locked operation – cavity dumping – coherence – radiance – focusing properties of Laser radiation – power.

UNIT III: GAS LASER

He-Ne Laser – ionized gas laser – Molecular Laser (CO2) — Solid state lasers: Neodymium YAG

Lasers- glass Lasers- Ruby Lasers.

UNIT IV: SEMI CONDUCTOR LASER

semiconductor laser properties – Diode structures – diode doped solid state laser – Organic dye lasers – chemical lasers – X ray lasers – Tunable lasers

UNIT V: APPLICATIONS

Interferometric distance measurement – velocity measurements – measurement of wire diameter – measurement of surface finish – particle diameter measurement – laser applications in material processing – laser welding – surface treatment – drilling, cutting and marking – laser deposition of thin film – integrated circuit fabrication.

Text Books:

1. **Laser Systems and Application**, V.K.Jain, 2013, Narosa Publisher. (All Units)
2. **Laser and Non-Linear Optics**, B.B.Laud, 2011, New age Int. publisher, 3rd Edition.

Reference books:

1. **Semiconductor LasersI-Fundamentals**, Edited by Eli Kapon, 1999, Academic press.
2. **Solid state Lasers: A graduate text**, Walter Koechner Michael Bass, 1937, Springer.
3. **Laser & Optical Fibre Communications**, P.sarah, 2008, I.K.Int publisher.
4. **Laser Physics**, S. Mohan, V. Arjunan, M. Selvarani, M. Kanjanamala, 2012, MJP Publishers.

Web Reference:

1. https://spie.org/Documents/Courses/OP-TEC/Course_2_Laser_Systems_and_Applications_2nd_Edition_2016.pdf
2. https://www.academia.edu/42707790/Lasers_and_Non_Linear_Optics
3. http://www.ime.cas.cn/icac/learning/learning_3/201907/P020190717575056933547.pdf
4. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/FIBER%20OPTICAL%20COMMUNICATIONS.pdf
5. https://ehs.msu.edu/_assets/docs/laser/laser-fundamentals-pt1-springer-2005.pdf

SEMESTER IV

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XVIII	21PHP17	**CONDENSED**	**90**	**4**

			MATTER PHYSICS		

Contact hours per week: 6

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	50	50	100

Preamble: The aim is to provide students knowledge and understanding the Crystal structure and crystal defects and to advance skills for analyzing Heat capacity of the electron ga**s** and Magnetism

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	remember the Crystal, lattice, Reciprocal lattice, Defects, Hall effect, Semiconductors, Superconductor and magnetic materials.	K1
CO2	Describe the concept of Reciprocal, various defects and different types of materials.	K2
CO3	calculate the reciprocal value of BCC and FCC thermal conductivity of metals by suitable methods.	K3
CO4	analyze various various theories in Semiconductor, Dielectric, Superconductor and magnetic materials	K4
CO5	classify the defects and dislocations in crystals and identify the defects by various methods.	K5
CO6	create new types of semiconductor, Superconductor and magnetic materials	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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

SYLLABUS

UNIT I: RECIPROCAL LATTICES (18 Hours)

Vector development of reciprocal lattice – Properties of the reciprocal lattice – Reciprocal lattice to bcc lattice and fcc lattice.

UNIT II: CRYSTAL DEFECTS (18 Hours)

Classification of defects - Points defect - The Schottky defect - The Frenkel defect -colour centers - F center - other colour centers - Production of colour centers by X rays and practice irradiation – Defect and energy state.Dislocations - Slip and plastic deformation - Shear strength of single crystals - Edge

dislocation - Screw dislocation - Stress field around an edge dislocation

UNIT III :LATTICE VIBRATIONS, SEMICONDUCTORS & FREE ELECTRON THEORY (18 Hours)

Vibrations of One Dimensional Diatomic Linear Lattice -Acoustic and Optical Branches Phonon State- Energy levels and density of orbitals – Motion in magnetic fields – Hall effect – Thermal conductivity of metals – Nearly free electron model –Electron in a periodic potential – Semiconductors – Band gap – Effective mass – Intrinsic carrier concentration

UNIT IV: DIELECTRICS, FERROELECTRICS AND SUPERCONDUCTIVITY (18 Hours)

Macroscopic electric field – Local electrical field at an atom –Polarizability – Clausius- Mossotti equation – Ferroelectric crystals – Polarization Catastrophe – Ferroelectric domains.Occurrence of Superconductivity – Meissner effect – Thermodynamics of Superconducting transition – London equation – Coherence length – BCS theory – Flux Quantization – Type-I and Type-II Superconductors –Josephson tunneling effect- DC and AC Josephson effect – SQUID.

UNIT V: MAGNETISM (18 Hours)

Quantum theory of Paramagnetism – Paramagnetic susceptibility of conduction electrons – Hund's rules- Kondo effect. Ferroelectric order – Curie point and the exchange integral – Temperature dependence of saturation magnetization – Magnons – Thermal excitation – Ferromagnetic order – Antiferromagnetic order – Antiferromagnetic Magnons – Ferromagnetic domains – Origin of domains – Coercive force and hysteresis.

Text Books:

1. **Introduction to Solid State Physics,** Kittel. C. 2005, 8th Edition, Willey 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, Pragati Prakashan, Meerut.(Units I & IV)
3. **Solid State Physics,** S. L. Guptha, 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
III	Core : XIX	21PHP18	**THERMODYNAMICS AND STATISTICAL MECHANICS**	**90**	**4**

Contact hours per week: 6

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	50	50	100

Preamble: The aim is to provide students a deeper knowledge and understanding of Thermodynamics, particle distribution and statistics

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	recall the laws and principles in Thermodynamics and Statistical Mechanics	K1
CO2	explain the link between statistics and thermodynamics, classical and quantum statistics and its applications	K2
CO3	apply principles to explain Black body radiation, Gibbs paradox and Phase transition	K3
CO4	categorize different type of statistics based on application	K4

CO5	select appropriate statistics for the distribution of particles	K5
CO6	predict the proper statistics to explain various phenomena in Thermodynamics	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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	1	1	9	1	0	3	3
CO6	1	1	9	1	0	3	0
Total Contribution of COs to POs	38	30	45	30	7	12	21
Weighted Percentage of COs Contribution to Pos	4.48	3.98	7.74	6.14	1.60	3.17	8.04

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

SYLLABUS

UNIT I: Thermodynamics and Radiation (18 Hours)

Second law of thermodynamics- Entropy and Second law of thermodynamics- Entropy and Disorder- Thermodynamic Potential and Reciprocity relation- Thermodynamic Equilibria- Chemical Potential- Blackbody radiation- Planck's Radiation law.

UNIT II: BASIC CONCEPTS OF STATISTICAL PHYSICS (18 Hours)

Phase space- Concept of ensemble- Micro canonical ensemble-Canonical ensemble- Grand Canonical ensemble- Density distribution in phase space- Liouvilles theorem- Postulate of equal apriori probability- Statistical equilibrium- Thermal equilibrium- Mechanical equilibrium-Particle equilibrium-Connection between Statistical and thermodynamic quantities.

UNIT III:CLASSICAL DISTRIBUTION LAW (18 Hours)

Microstates and Macro states-Classical Maxwell-Boltzmann distribution law- Evaluation of constants, α and β- Maxwell's law of Distribution of velocities- Principle of equi-partition of energy- Gibbs paradox- Partition function and its correlation with thermodynamics quantities.

UNIT IV: QUANTUM STATISTICS (18 Hours)

Indistinguishability and quantum statistics- Statistical weight and apriori probability- Identical particle's and symmetry requirements- Bose Einstein's Statistics- Fermi Dirac Statistics- Results of three statistics- Thermodynamic interpretation of parameter's α and β- Blackbody radiation and Planck radiation- Specific heat of solids: Dulong and Petit's law- Einstein's Theory- Debye theory.

Unit V: APPLICATION OF QUANTUM STATISTICS (18 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- Onsager relations- Fluctuation in Energy, Pressure, Volume & Enthalpy- The Ising model-Bragg William Approximation- One dimensional Ising model .

Text Books:

1. **Statistical mechanics,** Gupta & Kumar, 2003, Pragati prakashan, Meerut. (All Units)

Reference books:

1. **Elements of Statistical Mechanics**, Miss Kamal Singh, S.P.Singh, 1999, S.Chand & Company Ltd

Web Reference:

1. https://ocw.mit.edu/courses/physics/8-333-statistical-mechanics-i-statistical-mechanics-of-particles-fall-2013/

2. https://core.ac.uk/download/pdf/44144078.pdf
3. https://cds.cern.ch/record/988948/files/0521841984_TOC.pdf
4. http://www0.unsl.edu.ar/~cornette/ME/An-Introduction-to-Statistical-Mechanics-and-Thermodynamics.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XX	21PHP19	**ELECTRONIC COMMUNICATION SYSTEMS**	**90**	**4**

Contact hours per week: 6

Year	Semester	Internal Marks	External Marks	Total Marks
First	III	50	50	100

Preamble: The aim is to provide the students good understanding of radar systems and types of modulation used in electronic communication systems and the operation of different types of microwave devices.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
CO1	recall the propagation and properties of light, Antennas, Signals and Optical fibre	K1
CO2	discuss the types of Antenna, the microwave generators, Radar Systems, Types of Modulation	K2
CO3	apply Light propagation in Sky ,Ground Wave Propagation and Ionosphere, Radar in Radar Systems, Signals in Modulation, Interpret the application of optical fibres	K3
CO4	analyze the Working of Directional High frequency Antennas, Klystron, Magnetron, Travelling Wave Tubes, MASER, and Optical Fibre Propagation	K4

CO5	evaluate the Grounded Antenna, Ungrounded λ/2 Antenna, and Mathematical representation of FM, Step and Graded Index Fibres, Fibre Losses and Dispersion	K5
CO6	predict the rule for reducing Noise and Signal Loss in Antenna transmission	K6

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

POs / Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	9	9	9	9	9	9	9
CO2	9	9	9	9	9	9	3
CO3	9	9	9	9	9	3	3
CO4	9	9	9	3	3	3	3
CO5	9	9	3	1	1	1	3
CO6	9	9	3	1	1	1	1
Total Contribution of COs to Pos	54	54	42	32	32	26	22
Weighted Percentage of COs Contribution to POs	6.37	7.18	7.22	6.55	7.35	6.87	8.42

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

SYLLABUS

UNIT I: ANTENNAS & WAVE PROPAGATION (18 Hours)

Terms and Definition -Effect of Ground on Antenna-Grounded λ/4 Antenna Ungrounded λ/2 Antenna Antenna Arrays-Broadside and End Side Arrays-Antenna Gain-Directional High Frequency Antennas-Sky Wave Propagation-Ionosphere-Ground Wave Propagation.

UNIT II: MICROWAVES (18 Hours)

Microwave Generation-Multicavity Klystron -Reflex Klystron-Magnetron-Travelling Wave Tubes (TWT) -MASER.

UNIT III: RADAR SYSTEM (18 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

UNIT IV: COMMUNICATION ELECTRONICS (18 Hours)

Analog and Digital Signals –Modulation –Types of Modulation-Amplitude modulation theory – Frequency spectrum of the AM wave –Representation of AM –Power relations in the AM wave – Generation of AM –Basic requirements-Description of frequency and phase modulation – Mathematical representation of FM –Frequency spectrum of the FM wave -Effects of noise on carrier.

UNIT V: OPTICAL FIBRES (18 Hours)

Propagation of Light in an Optical Fibre-Acceptance Angle-Numerical Aperture-Step and Graded Index Fibres-Optical Fibre as a Cylindrical Wave Guide-Wave Guide Equations-Wave Equations in Step Index Fibres-Fibre Losses and Dispersion-Applications.

Text Books:

1. **Electronic Communication System**, George Kennedy & Davis, 1989, Tata McGraw Hill 4th edition.[ISBN:978-0-07-107782-8] (Units I - IV)
1. **Optical fiber and fiber optic communication systems**, S. K. Sarkar, 2007, S. Chand Publication. (Unit – V)

References books:

2. **Electronic Communications,** Sanjeeva Gupta, 2002, Khanna Publishers.

Web References:

1. https://soaneemrana.org/onewebmedia/ELECTRONICS%20COMMUNICATION%20SYSTEM%20BY%20GEORGE%20KENNEDY.pdf
2. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/FIBER%20OPTICAL%20COMMUNICATIONS.pdf

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XXI	21PHP20	**ADVANCED PHYSICS PRACTICAL-II**	**135**	4

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	III & IV	50	50	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.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
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; K6 – Create

CO- PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

PO COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
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

SYLLABUS

S.No	Course Content	Instructional Hours
1	e/m-Magnetron Method	135
2	Compressibility of a Liquid-Ultrasonic Method	
3	Arc Spectra-Constant Deviation Spectrograph-Copper, Iron & Brass	
4	Michelson Interferometer- λ, dλ 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	
13	LowResistance& Temperature Coefficient of Resistance He-Ne Laser determination	
14	Matlab Programming-Radioactive Decay	
15	Matlab Programming-Numerical Integration	
16	Matlab Programming-Double Integration	
17	Matlab Programming-Solution of Ordinary Differential Equations	
18	Matlab Programming-Computer Simulation of Equations of Motion for a System of Particles	
19	Matlab Programming-Computer Simulation of 1-D and 2-D Lattice Vibrations	

20	Matlab Programming-Computer Simulation of Kronig-Penney Model	
21	Matlab Programming-Numerical simulation of Wave-Functions of Simple Harmonic Oscillator	
22	Matlab Programming-Simulation of Wave Functions for a Particle in Critical Box	
23	Matlab Programming-Solution of Diffusion Equation	

Category	Course Type	Course Code	Course Title	Contact Hours	Credit
III	Core : XXII	21PHP21	**GENERAL ELECTRONICS PRACTICAL-II**	**135**	**4**

Contact hours per week: 5

Year	Semester	Internal Marks	External Marks	Total Marks
First	III & IV	50	50	100

Preamble: The aim of this course is to provide knowledge on the applications of Operational amplifier and to gain the practical hands on experience of programming the microprocessor and also gain knowledge on interfacing of different peripherals to microprocessor

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
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	K3

	conversion using operational amplifier perform interfacing for waveform generator, stepper motor, 7 segment LED display Hex keyboard musical tone generator using microprocessor	
CO4	analyze the mathematical operations performed by circuits constructed using operational amplifier	K4
CO5	determine the frequency of astablemultivibrator 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; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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	48	48	27	30	33	36	9

POs							
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

SYLLABUS

ANY TEN(10) EXPERIMENTS ONLY

EXAMINATION AT THE END OF SECOND SEMESTER

S.No	Course Content	Instructional Hours
1	Op-Amp: Simultaneous Addition & Subtraction	135
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	
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**
III	Core : XXIII	21PHP22	PROJECT WORK & VIVA VOCE	**50**	**3**
Contact hours per week: 2					

Year	**Semester**	**Internal Marks**	**External Marks**	**Total Marks**
2022	III	50	50	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.

CO Statement: After completion of the course, the learners will be able to

Cos	CO Statement	Knowledge Level (RBT)
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; K6 – Create

CO-PO MAPPING (COURSE ARTICULATION MATRIX)

CO – PO Mapping

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 Contribution to POs	3.97	3.92	3.8	5.8	3.0	2.70	3.99
Level of correlation: 0 – No correlation; 1 – Low correlation; 3 – Medium correlation; 9- High correlation between COs and POs							

(i) Value-added Courses:

Course Code	Course Name	Category	L	T	P	Credit
	MATERIAL SCIENCE	Value added				

Preamble

The aim of the objectives is to provide basic knowledge and skill of Material Science.

SYLLABUS

UNIT I

Material Science– Properties of Engineering Material– Selection of Materials for Engineering Applications.

UNIT II: MAGNETIC MATERIALS

Different types of Magnetic Materials –Diamagnetism and Paramagnetism – Ferromagnetism – Domain theory of ferromagnetism - Hard and Soft magnetic materials

UNIT III : MODERN ENGINEERING MATERIALS

Polymer – Ceramics – Super Strong Materials – Cermets– High temperature materials– Thermoelectric Materials– Electrets– Nuclear Engineering materials

UNIT IV : NEW MATERIALS

Metallic glasses – Fiber reinforced plastics – Metal matrix composites – Optical Materials– Materials for optical sources and detectors– Fiber Optic materials and their applications

UNIT V

Display Materials – Acoustic Materials and their applications– SAW materials– Biomaterials

Text Books

1. Materials science- M Arumugam, Anuradha agencies

References Books

1.Materials Science and Engineering - V. Raghavan, Prentice Hall of India,

Course Code	Course Name	Category	L	T	P	Credit
	PROBLEM SOLVING FOR NET/SLET	Value added				

Preamble

The aim of the objectives is to provide basic skills to solve Problems on Physics.

SYLLABUS

UNIT I

VECTOR CALCULUS

Product of vectors – Gradient – Divergence & Curl – Integration of vectors: Linear integration of vectors, Surface integration of vectors, Volume integration of vectors, Linear dependency of vectors, Orthogonal curvilinear co-ordinates.

UNIT II

MATRICES

Eigen values & Eigen vectors – Cayley-Hamilton theorem – Rank of a matrix – Diagonalisation of a matrix – Linear transformation – Applications.

UNIT III

COMPLEX ANALYSIS

Function of complex variables – Complex analytic function – Power series: Expansion of Complex function – Singularity of Complex function – Residue of a Complex function.

UNIT IV

DIFFERENTIAL EQUATIONS

Differential equation of first order and first degree – Linear second order differential equation – Legendre differential equation – Bessel differential equation – Hermite differential equation – Lagauerre differential equation.

UNIT V

TENSOR ANALYSIS

Basic review of tensors – Algebra of tensors – Fundamental tensors – Chrystoffel symbols – Co-variant, contra-variant and mixed tensors.

Text Books

1) Mathematical Physics (revised), H K Dass, S. Chand (2008), ISBN 8121914698, 9788121914697.

2) Mathematical Physics(revised), SatyaPrakash, Sultan Chand & Sons (2014), ISBN 8180549283, 978-8180549281

References Books

1) Mathematical Physics, Kalkani S.L - 3rd Edition 2009, ISBN **9789386478238**.
2) Mathematical Physics, B.D Gupta- Vikas publishing house–4th Edition 2009, ISBN 8125930965, 9788125930969.
3) Mathematical Physics, Rajput B.S. –Pragatiprakashan -23rd Edition-2011

E-Reference:

1. https://nptel.ac.in>courses

c)Extra Credit Course(s):

Courses offered by the department for ADVANCED LEARNERS

Course Code	Course Name	Category	L	T	P	Credit
	ADVANCED INSTRUMENTATION	**Core**				

Course Objective: By undergoing the Statistical Mechanics, one should be able to acquire deeper knowledge on Statistical Mechanics

SYLLABUS

UNIT I **(10 Hours)**

ERRORS AND MEASUREMENTS

Measurement, Instruments-static characteristics of instruments, estimation of static errors and reliability, dynamic characteristics of instruments.

UNIT II **(10 Hours)**

TRANSDUCERS

Classifications of transducers-displacement measurement, strain measurement-stress strain relations,

resistance strain gauges, Fibre – Optic strain gauges.

UNIT III **(10 Hours)**

PRESSURE MEASUREMENTS

Definition- Pressure units and their conversions, comparison with known dead weights, Force-Summing devices, secondary transducers, vacuum measurement.

UNIT IV **(10 Hours)**

TEMPERATURE MEASUREMENTS

Temperature scale, change in dimensions, electrical properties, thermoelectricity, fibre-optic sensors, Quartz thermometer, change in velocity of sound propagation, radiation pyrometers, thermowells

UNIT V **(10 Hours)**

OTHER FORMS OF MEASUREMENTS

Acceleration and force measurement, Tachometers, Torque measurement, flow measurement, level measurement, signal conditioning, display devices and recording systems

Text Books

1. Introduction to Measurements and Instrumentation – Arun K Gosh, 4th Edition, 2012, PHI Learning Private Limited (Unit 1, 2, 3, 4 & 5)

Course Code	Course Name	Category	L	T	P	Credit
	ADVANCED QUANTUM MECHANICS	**Core**				

Course Objective: The aim is to make the students to understand the concepts of wave mechanics, Schrödinger equation, 1D and 3D energy eigen value problems, symmetry and conservation laws and approximation methods and theories for the study of chemical bondings.

SYLLABUS

UNIT I **(10 Hours)**

Wave Mechanical concepts: Wave nature of particles – the uncertainty principle – the principle of superposition – wave packet – time-dependent schrodinger equation - interpretation of wave function – ehrenfest's theorem – time-independent schrodinger equation - stationary states – admissibility conditions of the wave function

Unit II **(10 Hours)**

One Dimensional Energy Eigen Value Problems: Square well potential with rigid walls - Square well potential with finite walls – square potential barrier – Alpha emission – Bloch waves in periodic potential – Kronig-Penney square-well periodic potential – linear harmonic oscillator: Schrodinger method and operator method.

Unit III **(10 Hours)**

Three Dimensional Energy Eigen Value Problems: Particle moving in a spherically symmetric potential – system of two interacting particles – rigid rotator – hydrogen atom – hydrogenic orbits – the free particle – three-dimensional square-well potential – the deuteron.

Unit IV **(10 Hours)**

Symmetry and Conservation laws: Symmetry transformations- Translation in space: conservation of linear momentum - Translation in time: conservation of energy - Rotation in space: conservation of angular momentum – space inversion: parity conservation – time reversal.

Unit V **(10 Hours)**

Chemical bonding: Born-Oppenheimer approximation – Molecular orbital method – MO treatment of hydrogen molecule ion – Electronic configuration of diatomic molecules – Valence bond method the valence bond treatment of H_2.

Text Books

1. **Quantum Mechanics,** G. Aruldhas, 2nd Edition,2009, PHI Learning. (All units)
2. **Advanced Quantum Mechanics,** SatyaPrakash, 2001, KedarNath Ram Nath Co., Meerut.

Reference Books

1. **Quantum Mechanics**, Leonard I. Schiff, 1968, McGraw-Hill Book Company.
2. **Quantum Mechanics**, V. Devanathan, 2005, Narosa Publishing House, New Delhi.

A textbook of Quantum Mechanics, P.M. Mathews and Venkatesan, 27th reprint 2002, Tata McGraw Hill publishing company Ltd., New Delhi.

Course Code	Course Name	Category	L	T	P	Credit
	STATISTICAL MECHANICS	**Core**				

Course Objective: By undergoing the Statistical Mechanics, one should be able to acquire deeper knowledge on Statistical Mechanics

SYLLABUS

UNIT I **(10 Hours)**

THE FUNDAMENTALS OF STATISTICAL PHYSICS

Objective of statistical mechanics: macrostates, microstates, phase space and ensembles- Density of states- Density distribution in phase space- Ergodic hypothesis- Postulate of equal a priori probability and equality of ensemble average and time average- Boltzmann's postulate of entropy- Classical ideal gas- Entropy of ideal gas: Gibbs' paradox- Liouville's theorem.

UNIT II **(10 Hours)**

THEORY OF ENSEMBLES

Classification of ensembles- Micro canonical, Canonical and Grand canonical ensembles - Partition function of canonical ensemble- Thermo dynamical quantities by partition function - expression of entropy- Helmholtz free energy- fluctuation of internal energy- chemical potential of ideal gas

UNIT III **(10 Hours)**

QUANTUM STATISTICS

Introduction- Postulates of quantum statistical mechanics- Density matrix- Ensembles in Quantum statistical mechanics- Quantum Liouville theorem- Maxwell law of distribution of velocities- Ideal quantum gases- Bosons- Fermions- BE, FD, MB distributions using GCE partition functions.

UNIT IV **(10 Hours)**

APPROXIMATE METHODS

Classical Cluster expansion- Quantum Cluster expansion- Virial equations of states, Ising model in one, two, three dimensions- exact solutions

UNIT V **(10 Hours)**

PHASE TRANSITIONS

Photon gas- Equation of state- Bose-Einstein condensation- Equation of state of ideal gas - Specific heat from lattice vibration- phase transitions- first and second order phase transitions critical points- Landau’s theory- Phonon gas- Theory of Super fluidity- Liquid helium.

Text Books

1. B.B. Laud, Fundamentals of Statistical Mechanics, New Age International Publishers.

2. Kerson Huang, Statistical Mechanics, John Wiley & Sons.

3. C. Kittel, Elementary Statistical Physics, John Wiley & Sons.

4. R.P. Feynman, Statistical Mechanics, Addison Wesley.

5. R.K. Pathria, Statistical Physics, Pergamon, Oxford.

6. F. Reif, Statistical and Thermal Physics, McGraw Hill.

Course Code	Course Name	Category	L	T	P	Credit
	PLASMA PHYSICS					

Course Objective: The aim is to provide the students, understand the model plasma phenomena in the universe and explore the physical processes which occur in the space environment .

SYLLABUS

UNIT I **(10 Hours)**

FUNDAMENTAL CONCEPTS ABOUT PLASMA

Kinetic pressure in a partially ionized - mean free path and collision cross section- mobility of charged particles - Effect of magnetic field on the mobility of ions and electrons - Thermal conductivity - Effect of magnetic field - Quasi neutrality of plasma - Debye shielding distance.

UNIT II **(10 Hours)**

MOTION OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELD

Particle description of plasma – Motion of charged particle in electrostatic field- Motion of charged particle in uniform magnetic field - Motion of charged particle in electric and magnetic fields - Motion of charged particle in inhomogeneous magnetic field- Motion of charged particle in magnetic mirror confinement - motion of an electron in a time varying electric field

UNIT III **(10 Hours)**

PLASMA OSCILLATIONS AND WAVES

Introduction, theory of simple oscillations - electron oscillation in a plasma - Derivations of plasma oscillations by using Maxwell's equation - Ion oscillation and waves in a magnetic field - thermal effects on plasma oscillations - Landau damping - Hydro magnetic waves - Oscillations in an electron beam

UNIT IV **(10 Hours)**

PLASMA DIAGNOSTICS TECHNIQUES

Single probe method - Double probe method - Use of probe technique for measurement of plasma parameters in magnetic field - microwave method - spectroscopic method - laser as a tool for plasma diagnostics – X ray diagnostics of plasma - acoustic method – conclusion

UNIT V **(10 Hours)**

APPLICATIONS OF PLASMA PHYSICS

Magneto hydrodynamic Generator - Basic theory - Principle of Working - Fuel in MHD Generator - Generation of Microwaves Utilizing High Density Plasma

Text Books

1. **Plasma Physics - Plasma State of Matter** - S.N. Sen, PragatiPrakashan, Meerut
2. **Principles of Plasma Diagnostics** - I. H. Hutchinson
3. **Introduction to Plasma Physics** - F.F.Chen, Plenum Press, London
4. **Plasma Diagnostic Techniques** - R.H. Huddlestone & S.L. Leonard