PSGR
Krishnammal College for Women

DEPARTMENT OF PHYSICS

MASTER OF PHYSICS

2024-2026 Batch

MPS2301	MATHEMATICAL PHYSICS - I	Category	L	T	P	Credit
		Theory	88	2	-	4

Preamble

The aim of this course is to provide the mathematical foundation in vectors, matrices, Complex numbers and special functions required for the description of the physical phenomena.

Prerequisite

CO1. Basic idea on vectors, matrices , complex numbers, Partial Differential Equations , Special Functions

Course Learning Outcomes

CLO Number	CLO Statement	Knowledge Level
CLO 1	Understand the basic principles of mathematical physics and its applications	K2
CLO 2	Analyse the nature of the problems in physics	K3
CLO 3	To improve their logical, mathematical and analytical skills in problem solving	K4
CLO 4	Formulate, interpret and draw inferences from mathematical solutions	K5
CLO 5	Develop expertise in mathematical techniques required in physics	K6

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

Mapping with Programme Learning Outcomes

COs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO 1	S	S	S	S	M	S	M
CLO 2	S	S	S	S	S	M	S
CLO 3	S	S	S	S	S	M	M
CLO 4	S	S	S	M	S	M	M
CLO 5	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

Unit I – Vectors **17 Hrs**

Gauss divergence theorem[1]& its physical interpretation - Gauss's Theorem – Stokes's theorem- Poisson's equations – curvilinear coordinates – orthogonal curvilinear coordinates – condition for orthogonality – **cylindrical coordinates**[2] – spherical polar coordinates. linear vector space, linear independence of vectors and dimensions, basis and expansion theorem, inner product and unitary spaces, Orthonormal sets, Schmidt's orthogonalisation method.

Unit II – Matrices **17 Hrs**

Review of algebraic operations of matrices, sub matrices[3], partitioning of matrices, **special types of matrices and their properties**, **vectors as matrices**[4] and vector spaces, linear transformations, orthogonal and unitary transformation, eigen values, eigen vectors, Cayley Hamilton theorem, **Stochastic matrices, diagonalisation of matrices**, **power of a matrix**, **exponential of a matrix**[5]. Matrices in physics: rotation matrix, Pauli's spins matrices, Dirac matrices.

Unit III – Complex Variables **18 Hrs**

Introduction, **regular functions, elementary functions and mapping,** contour integration, Cauchy's theorem, Cauchy's integral formula, Results based on contour formula, **Taylor's expansion**[7], Laurent's expansion, Residue and contour integration, Cauchy's residue theorem, integration round the unit circle, evaluation of definite integrals - $\sin\theta$ and $\cos\theta$.

Unit IV – Partial Differential Equations **18 Hrs**

Laplace equation, Poisson's equation, Heat flow equation, Wave equation, Helmholtz equation, Solution of Laplace equation in Cartesian co-ordinates, in two dimensional cylindrical co-ordinates, in two dimensional spherical polar co-ordinates, Solution of Poisson equation, **Diffusion equation or equation of heat flow. Solution of heat flow equation in one dimension**[8,9]**.**

Unit V – Special Functions **18 Hrs**

Series solution, **solution of Linear differential equation of first order**[10], solution of second order linear differential equation with constant coefficients, power series solution- Frobenius' method, Legendre's equation, Legendre's function of I and II kind, Generating function of Legendre polynomial, Recurrence formula for $P_n(x)$, Bessel's function of I kind, recurrence function for $J_n(x)$, generating function for $J_n(x)$, Hermite differential equation, **Hermite polynomial, recurrence for Hermite polynomial**[11]**.**

Text Book

S. No	Authors	Title of the Book	Publishers	Year of Publication	Edition
1	Sathya Prakash	Mathematical Physics with Classical mechanics	Sultan Chand & Sons	2014	6thEdition

Reference Books

S. No	Authors	Title of the Book	Publishers	Year of Publication	Edition

1	ChattopadhayP.K	Mathematical physics	New Age International-New Delhi	2004	1st Edition.
2	Dass.H.K,	Mathematical Physics	S. Chand and Company Pvt. Ltd,	2014	7th Edition.
3	Erwin Kreyzig	Advanced Engineering Mathematics	Wiley India Private Limited,	2011	10th Edition.
4	Joshi A.W	Matrices and Tensors in Physics	Wiley Eastern Ltd,	2005	4th edition
5	Pipes & Harvill	Applied Mathematics for Engineers and Physicists	McGraw Hill international Book company	2014	3rd Edition.
6	Hans. J Weber and George. B.Arfken	Mathematical methods for Physicists	Academic Press	2011	7th Edition.

Pedagogy

Chalk and Talk lectures, Group Discussion, Seminar, Interaction, power point presentation, E-content link

Course Designers:

1.Mrs.S.Subanya
2. Mrs.D.Niveditha

E-Content link

CO1. https://www.youtube.com/watch?v=vZGvgru4TwE

CO2. https://www.youtube.com/watch?v=CrafR-XZubw

CO3. https://www.youtube.com/watch?v=MqmYlQ9zxvw

CO4. https://study.com/academy/lesson/types-of-matrices-definition-differences.html

CO5. https://www.youtube.com/watch?v=LTb9V84hG9w

CO6. https://www.youtube.com/watch?v=NtM7qFcML

CO7. https://www.youtube.com/watch?v=3d6DsjIBzJ4

CO8. https://www.youtube.com/watch?v=1X2MJH_MUgU

CO9. https://www.youtube.com/watch?v=ky4J7btqfXI

CO10. https://www.youtube.com/watch?v=2G0nihWWG8Y

CO11. https://www.youtube.com/watch?v=5UEWlnZbbLQ

MPS2302	CLASSICAL MECHANICS	Category	L	T	P	Credit
		Theory	88	2	-	4

Preamble

The aim of this course is to provide an in-depth knowledge of the principles of classical mechanics and the study of specific problems, viz. the two body central force problem and small oscillations.

Prerequisite

CO2. Basic knowledge on differential calculus and Newtonian Mechanics
CO3. Knowledge on rotational dynamics

Course Learning Outcomes

CLO Number	CLO Statement	Knowledge Level
CLO1	Study the applications of Newtonian mechanics in daily life	K2
CLO2	Understand the motion of bodies, including the special case in which bodies remain at rest in accordance with the Newtonian principles	K3
CLO3	Analyze the movement of macroscopic objects, like projectiles, and astronomical objects, such as spacecraft, planets, stars, and galaxies.	K4
CLO4	Develop knowledge of the behaviour of bodies under the influence of forces	K5
CLO5	Develop familiarity with the physical concepts and facilitate with the mathematical methods of classical mechanics	K6

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

Mapping with Programme Learning Outcomes

CLOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO1	S	S	M	M	M	L	L
CLO2	S	M	S	M	M	L	L
CLO3	S	M	M	L	M	L	L
CLO4	S	M	M	M	M	S	L
CLO5	S	M	M	S	M	M	L

S- Strong; M-Medium; L-Low

Syllabus

Unit I: Fundamental principles of Lagrangian Formulation 17hrs

Mechanics of a particle- Mechanics of a system of particles- constraints- D'Alembert's principle and Lagrange's equations- Velocity – dependent potentials and the dissipation function- **simple application of the Lagrangian formulation[1]**-Single particle in space-**Atwood's machine[2,3]-bead sliding on a rotating wire[3,4]**, linear harmonic oscillator- **simple pendulum[5]**.

Unit II: Variational principles andLagrange's equations: **17 hrs**

Hamilton's principle- some techniques of the calculus of variations- derivation of Lagrange's equations from Hamilton's Principle- Extension of Hamilton's principle to non holonomic systems- **Advantages of a variational principle formulation[6]** - conservation theorems and symmetry properties-Energy function and the conservation of energy.

Unit III: Two body central force problem 18 hrs

Reduction to the equivalent one-body problem- the equations of motion and first integrals-the equivalent one- dimensional problem and classification of orbits- law potentials- conditions for closed orbits (Bertrand's theorem) - **the Kepler problem: inverse square law of force[7]- the motion in time in the Kepler problem[7]**- The Laplace-Runge-Lenz vector-Scattering in a central force field- **transformation of the scattering problem to laboratory coordinates[8].**

Unit IV: Small oscillations 17 hrs

Formulation of the problem - Eigen value equation and the principle axis transformation- frequencies of free vibrations- normal coordinates- **Free vibrations of a linear tri atomic molecule[9]** - **Forced vibration and the effect of dissipative forces[10].**

Unit V: Hamilton's Formulation 18 hrs

Legendre transformations and the Hamilton canonical equations of motion –**Cyclic coordinates[11,12]** - Routh's procedure- Hamiltonian formulation of relativistic mechanics-**Derivation of Hamilton's equations from a variational principle[13]**- The principle of least action.

Poisson Brackets-definition-**invariance of Poisson- brackets with respect to canonical transformation[14]** –Equations of motion in Poisson bracket form-**Jacobi's identity[14]**-infinitesimal contact transformations-interpretation in terms of Poisson brackets-The angular momentum and Poisson brackets.

Text Book

S. No	Authors	Title of the Book	Publishers	Yearof Publication	Edition
1.	Herbert Goldstein	Classical Mechanics	Narosa Publishing House	2001	2nd Edition
2.	Gupta, Kumar & Sharma	Classical Mechanics	PragatiPrakashan	2012	26th reprint

3.	. R G Takwale& P S Puranik	Classical Mechanics	Tata McGraw Hill Education Pvt. Ltd,	2010	2nd Edition

Reference Books

S.No	**Authors**	**Title of the Book**	**Publishers**	**Yearof Publication**	**Edition**
1.	Rana&Joag	Classical Mechanics	TMH	2010	6th edition
2.	Douglas Gregory	Classical Mechanics	Cambridge Unversity press	2008	1stedition

Predagogy

Chalk and Talk lectures, Group Discussion, Seminar, Interaction, power point presentation

Course Designers:

1.Dr.B.Punithaveni

References For E-Content:

1. https://youtu.be/3iyDyoKZnrc
2. https://youtu.be/VwOrZ-jDqHY
3. https://youtu.be/OLJrY0v0yPI
4. https://youtu.be/PNnT9e7aTqc
5. https://youtu.be/vJ2pyd_Ag3k
6. https://youtu.be/tN_dNwQmLqU
7. https://slideplayer.com/slide/6379146/
8. https://youtu.be/0C1cbjA0HmU
9. https://youtu.be/CLKhkxaMURQ
10. https://youtu.be/nuZo8KYiWoo
11. https://youtu.be/m7XD44oG1b4
12. https://youtu.be/mQSWuwuwPxI

MPS2303	THERMODYNAMICS AND STATISTICAL MECHANICS	Category	L	T	P	Credit
		Theory	88	2	-	4

Preamble

To acquire a sound understanding of the basic principles of statistical mechanics and its application to realistic problems

Prerequisite

An idea on thermodynamical variables, quantum and classical statistics

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowldge Level
CLO1	Learn relationship between equilibrium distributions and kinetic processes leading to equilibrium	K2
CLO2	Apply classical and quantum distributions in circumstances varying from standard examples to real statistical problems	K3
CLO3	Become aware of the richness and complexity of statistical behaviour exhibited by interacting systems and various approaches (phenomenological and microscopic) developed to comprehend such systems	K4
CLO4	Examine appropriate limiting behaviours in various statistical systems and to develop statistical description of system	K5
CLO5	Construct a partition function for a system in thermal equilibrium and use it to obtain thermodynamic quantities of interest.	K6

Mapping with Programme Learning Outcomes

CLOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CLO1	S	S	S	S	S	M	S
CLO2	S	S	S	M	S	S	S
CLO3	S	S	S	L	S	S	L
CLO4	S	S	M	S	S	S	L
CLO5	S	S	S	S	S	L	S

S- Strong; M-Medium; L-Low

Syllabus

Unit – I: Thermodynamics **18 hrs**

Thermodynamic variables[1]- extensive and intensive variables- **Zeroth law of thermodynamics**[2] - equivalence of heat and work - **first law of thermodynamics**[3,4] - Significance of the first law of thermodynamics - thermodynamic processes - reversible process – irreversible process - state variables and

process variables - **definition of entropy[5] - second law of thermodynamics[6,7]** - entropy changes in irreversible processes - Maxwell's Thermodynamical relations - thermodynamic potentials – **Enthalpy[8],** Helmholtz and the Gibbs functions- Phase transitions – Clausius - Clapeyron equation – van der waals equation of state.

Unit- II: Classical Statistics - I **18 hrs**

Macroscopic and microscopic states[9] - phase space - Volume in phase space - postulate of equal a priori probability - density distribution in phase space - Liouville's theorem, Maxwell-Boltzmann distribution law - **micro-canonical ensemble[10, 11] - canonical ensemble[10, 11]-** calculation of mean values and fluctuations in a canonical ensemble - fluctuation dissipation relation - energy fluctuations and heat capacity - Grand-canonical ensemble - fluctuations in number of particles.

Unit – III: Classical Statistics - II **17 hrs**

Classical partition functions and their properties - Calculations of thermodynamic quantities - Chemical potential - Ideal mono atomic gas - entropy of mixing - Gibbs paradox – Equipartition theorem and its simple applications.i) Mean kinetic energy of a molecule in a gas ii) **Brownian motion[12]** iii) **Harmonic Oscillator[13]** iv) Specific heat of solid. Maxwell velocity distribution, Doppler Broadening of Spectral lines**.**

Unit – IV: Quantum Statistical Mechanics – I **17 hrs**

Ideal Bose systems

Symmetric and antisymmetric wavefunctions – The density matrix - **Quantum harmonic oscillator[14]** - Einstein's theory of heat capacity - Debye's theory of heat capacity - Bose – Einstein statistics - **black body radiation[15]-** photon gas - Planck's law - Bose-Einstein Condensation - lambda transition – Liquid helium – **Super fluidity[16,17]**

Unit-V: Quantum Statistical Mechanics - II **18 hrs**

Fermi-Dirac statistics[18] - Fermi distribution[18] - Fermi energy[18] - Mean energy of Fermions at absolute zero - Fermi energy as a function of temperature - electrons in metals - Electronic specific heat - **White Dwarfs[19]-** Compressibility of Fermi gas - Pauli's para magnetism - A relativistic degenerate electron gas.

Text Books

S. No	Authors	Title of the Book	Publishers	Year of Publication	Edition
1	Gupta Kumar	Elementary Statistical Mechanics	Pragati Prakashan	2011	24th edition
2	Kerson Huang	Introduction to Statistical Physics	Taylor & Francis	2001	Indian Edition
3	B.B. Laud	Fundamentals of Statistical Mechanics	New age International Publishers	2011	1st edition

Reference Books

S. No	Authors	Title of the Book	Publishers	Year of Publication	Edition

1	K. Huang	Statistical Mechanics	John Wiley & Sons	2009	2nd edition
2	L. D. Landau and E. M. Lifshitz	Statistical Physics	Pergamon Press	2011	3rd edition
3	R.K.Pathria& Paul D. Beale	Statistical Mechanics	Elsevier-Butterworth Heinemann	2011	3rd edition
4	F.Reif	Statistical Physics	Tata McGraw	2008	Special Indian Edition
5	Satya Prakash	Statistical Mechanics	Kedar Nath Ram Nath Publications	2011	Special Edition

Pedagogy

Chalk and Talk, ppt, group discussion, seminar, Interaction, problem solving

Course Designers:

1. Dr.N.Priyadharsini

References For E-Content:

- https://youtu.be/fTQslkc7f4g
- https://youtu.be/-42JmVBdlM4
- https://youtu.be/1OFlW8OXN64
- https://youtu.be/dHdlH3l8FkM
- https://youtu.be/870y6GUKbwc
- https://youtu.be/y6pGjfi8FZw
- https://youtu.be/mGDJO2M7RBg
- https://youtu.be/x_pbr5RFhVc
- https://youtu.be/F_NmS-Wy2lE
- https://youtu.be/VIVGP_IskQg
- https://youtu.be/8ttrMYZWNXc
- https://youtu.be/V7VtOa8pHno
- https://youtu.be/py3EWLKQaMs
- https://youtu.be/yG_Ot9rsNaw
- https://youtu.be/Na-mFjyP8eU
- https://youtu.be/2Z6UJbwxBZI
- https://youtu.be/dLcwmMGCfU8
- https://youtu.be/Ww9wcs3yNWI
- https://youtu.be/ITD8s-bLXSk

MPS2304	ELECTRONICS	Category	L	T	P	Credit
		Theory	88	2	-	4

Preamble

This course deals with semiconductor device characteristics, Op-Amp characteristics and their applications& digital principles

Prerequisite

CO4. Basic idea on semiconductor devices
CO5. Concepts of amplifiers and oscillators

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the concepts of semiconductor devices.	K2
CLO2	Design counters and to explain power devices and their application in various fields	K3
CLO3	apply the concepts of operational amplifier to solve differential and simultaneous equations.	K4
CLO4	Solve problem related to semiconductor devices and oscillator circuit Familiarize the conversion of data from Analog to Digital and Digital to Analog	K5
CLO5	Take projects in electronics relevant to industrial and R &D needs	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	S	S	L	L	M	L
CLO2	S	S	M	S	M	M	M
CLO3	S	S	S	M	L	M	M
CLO4	S	S	S	M	L	M	M
CLO5	S	S	S	M	S	S	M

S- Strong; M-Medium; L-Low

Syllabus

Unit I : Electronic Circuits and Devices I: 18 hrs

Tunnel Diode- Structure-Characteristics- **applications[1]** - IMPATT- PNPN diodes characteristics &**applications[2]** – Gunn diode- device operation-negative differential resistance, SCR-characteristics &**applications[3]**, Silicon Controlled Switch(SCS) – UJT structure & characteristics - UJT Oscillator - **Applications of UJT[4]**.

Optoelectronics: Photo Resistor-Photo Diode - Photo Transistor, LEDs- Device structure and **Working principle[5].**

Unit II: Electronic Circuits and Devices II: 18 hrs

The junction field effect transistor- **the pinch off voltage[6]** (Vp)-the JFET volt-ampere characteristics- Biasing the FET- FET as a Voltage Variable Resistor - the FET small signal model- the common source Amplifier at low & High Frequencies - common Drain amplifier at low & High Frequencies - MOS structure and principle of operation – **current voltage characteristics[7]**. Logic gates using MOSFETs – Complementary MOSFETs.

Unit III : Operational Amplifier: 17 hrs

The operational amplifier - parameters of op amps, Frequency Response of an amplifier**, the comparator[8]**, Basic Operational Amplifier applications-Differential DC amplifier- integrator and differentiator-Electronic analog Computation solving Simultaneous and Differential equations- **log and Exponential amplifiers[9].**

Unit IV : Oscillators and Data Converters 17hrs

Wave Form Generators and Wave Shaping Circuits using Op amps – Phase Shift-Oscillator-Wien Bridge Oscillator-Crystal Oscillator- Multivibrators- Schmitt Trigger- Triangular Wave Generators – Pulse Generators - the weighted resistor D/A convertor- The R-2R ladder D/A converter – **Switches for D/A converters[10]- Inverted ladder D/A converter[11]-** A/D converters- A counter type- successive Approximation converters. IC 555 Timer and its **Applications[12].**

Unit V : Registers and Counters 18 hrs

The shift register, Serial in –Serial out, Serial in – Parallel out, **Parallel in – Serial out[13]**, Parallel in – Parallel out – Counters, methods to improve counter speed,- Mod-3 counters, Mod 5, Mod 7, Mod 9 and **decade counters[14]**, Ripple counter, the up-down ripple counter, the up-down synchronous counter, ring counters, **sequence generator[15]**.

Text Books

S.No.	Author	Title of the book	Publisher	Year of Publication	Edition
1	Jacob Millman & Arvin Grabel	Microelectronics	Tata McGraw Hill Publishing Company Ltd-New Delhi	1999	2nd edition
2	Jacob Millman & Christos C Halkias	Integrated Electronics	Tata McGraw Hill Publishing Company Ltd-New Delhi	2005	41st Reprint
3	Malvino Leach	Digital Principles and Applications	Tata McGraw Hill Publishing Company Ltd-New Delhi	1995	5th Edition
4	Ramakant A.Gayakwad	Opamps and Linear Integrated Circuits	PHI Learning Pvt.Ltd,New Delhi	2000	4th Edition.
5	Sze .S.M,	Semiconductor devices Physics	Wiley Student Edition	2012	2nd Edition

		and Technology			
6	V Vijayendran	Introduction to Integrated Electronics (Digital and Analog)	Viswanathan (Printers and Publishers) Pvt.Ltd,	2011Reprint	

Reference books

S.No.	Author	Title of the book	Publisher	Year of Publication	Edition
1	MehtaV.K & Rohit Mehta	Principles of Electronics,	Tata McGraw Hill Publishing Company Limited New Delhi	2014	11th edition
2	Gupta & Kumar,	Hand Book of Electronics,	Pragati Prakashan	2010	32nd
3	Chatterji B.N	Digital Computer technology	Khanna Publishers Delhi	1986	2nd Edition

Pedagogy

Chalk and Talk, Group Discussion, Demonstration, Problem solving, Seminar, Designing circuits, PPT and Assignment

Course Designers:

1. Dr.G.Vanitha
2. Mrs.T.Poongodi

References For E-Content:

1. https://youtu.be/PuG8CCUbg58
2. https://youtu.be/Miu22EkyXyQ
3. https://youtu.be/8OgHY4-gcQw
4. https://youtu.be/ZOOUofPeSYY
5. https://youtu.be/NUR9tebFDRc
6. https://youtu.be/paK2Tjxuog0
7. https://youtu.be/-o39YVNMYVs
8. https://youtu.be/66Jl4YmpAMY
9. https://youtu.be/-qs3qJz6dTU
10. https://youtu.be/gsF6GVz9wV0
11. https://youtu.be/gcRBw--n9yw
12. https://youtu.be/7LmBcGiiYwk
13. https://youtu.be/TqHme0lvvCU
14. https://youtu.be/fKVZpupyP_o
15. https://youtu.be/XNAK-L7NlOM

MPS23P1	PRACTICAL I - GENERAL PRACTICALS	Category	L	T	P	Credit
		Practical	-	-	4	4

Preamble

The aim of this course is to make the students gain a practical knowledge in the basics of Physics.

Prerequisite

CO6. Basic experience in handling devices/instruments (UG level)

Course Learning Outcomes

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

CLO Number	CO Statement	Knowledge Level
CLO1	Understand the basics of experimental physics	K2
CLO2	Explore the concepts involved in the thermodynamics, heat and modern optics	K3
CLO3	Acquire strong laboratory skills	K4
CLO4	Enhance the skill to meet the present day requirements in industries, research fields	K5
CLO5	Create the knowledge of theories involved in physics using practical experiments	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	M	M	S	M	M	M
CLO2	S	M	S	M	M	S	S
CLO3	S	S	M	M	S	M	M
CLO4	S	M	M	M	M	M	M
CLO5	S	M	M	M	M	S	S

S- Strong; M-Medium; L-Low

Syllabus

PRACTICAL I - GENERAL PHYSICS

(Examination at the end of Second Semester)
Any Twelve Experiments

1. Young's Modulus-Elliptical Fringes
2. Young's Modulus-Hyperbolic Fringes
3. Viscosity of a Liquid-Mayer's Oscillating Disc
4. Determination of
   (i) Refractive Index of transparent solids and liquids using Laser source
   (ii) Particle size (iii) Diffraction at a circular aperture (pin hole)
5. Study of characteristics of Laser
   (i) Determination of Gaussian nature of laser source and evaluation of beam spot size.
   (ii) Measurement of Laser beam divergence (iii) Absorption of light on various filters
6. Electronic Specific Charge - 'e/m' by Thomson's Method
7. Thermistor -Temperature Coefficient and Band Gap Energy
8. Magnetic Hysteresis loop tracing
9. Study of characteristics of optical fibre –

(i) Numerical aperture (ii) bending losses (iii) splice losses (iv) attenuation by fibre cut –Back method

10. Determination of Curie Temperature of Ferro electric solid
11. Characteristic study of Photo Transistor, photodiode and photovoltaic cell (solar cell)
12. Determination of critical potential by Frank Hertz experimental method.
13. Thickness of Wire by Air Wedge Diffraction
14. Determination of dipole moment of a liquid
15. Identification of prominent lines – Copper arc
16. Characteristic study of LED, LDR and Opto coupler.

Course Designers:

1.Dr.G.Praveena

MPS23P2	PRACTICAL II-ELECTRONICS PRACTICALS	Category	L	T	P	Credit
		Practical	-	-	4	4

Preammble

The aim of this course is to make the students to practically learn the characteristics of different electronic circuits.

Prerequisites

CO7. Basic experience in constructing and handling electronic circuits (UG level)

Course Learning Outcomes

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

CLO Number	CO Statement	Knowledge Level
CLO1	Understand the basic concepts in IC's, digital devices and C programming.	K2
CLO2	Apply circuit systems to construct electronic devices	K3
CLO3	Evaluate the functioning of circuits	K4
CLO4	Enhance the skill to meet the present day requirements in industries, research fields.,	K5
CLO5	Become proficient to be directly employed or start his/her own work as Electronic circuit Designer	K6

Mapping with Programme Learning Outcomes

CLO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CLO1	S	M	M	S	M	M	M
CLO2	S	M	S	M	S	M	S
CLO3	S	S	M	M	M	M	S
CLO4	S	M	M	M	M	M	M
CLO5	S	M	M	M	M	M	S

S- Strong; M-Medium; L-Low

Syllabus

PRACTICAL II-ELECTRONICS PRACTICALS
(Examination at the end of second Semester)
Any Twelve Experiments

1. Design of Regulated and Dual Power Supply and Construction using fixed voltage regulator and 723.
2. Characteristics of UJT
3. UJT Relaxation Oscillator
4. FET –common source amplifier
5. FET –common drain amplifier
6. Op-Amp parameters
7. Wave Form Generators- using Op-Amp and Timer 555.
8. (i) Phase-Shift Oscillator (ii) Wien's Bridge Oscillator using Op-Amp
9. Op-Amp – log and antilog amplifier
10. Sign Changer, Scale Changer, Summer and Subtractor- Op-Amp
11. Analog Computer Setup-Solving Simultaneous Equations
12. Schmitt Trigger using discrete components and OP-AMP/ Timer 555

By Simulation and using ICs

13. Flip-Flops (RS, JK , D)
14. Counters- Digital ICs
15. Shift register- Digital ICs
16. (i) Write a C program to calculate the De Broglie's wave length $\left(\lambda = \frac{h}{p}\right)$

    (ii) Write a C program to prove Heisenberg's Uncertainty Principle
17. Write a C program to find the solution for the ground state of hydrogen atom
18. Write a C program to integrate a given function using Simpsons Rule.
19. Write a C program to study the Motion of a particle under the force f(x) = -x
20. Write a C program to calculate the bond length of NaCl

Course Designers:

1. Dr. N.Priyadharsini

PSGR
Krishnammal College for Women

DEPARTMENT OF PHYSICS

MASTER OF PHYSICS

2024-26 BATCH

MPS2305	MATHEMATICAL PHYSICS-II	Category	L	T	P	Credits
		Theory	73	2	-	5

Preamble

This course aims at the introduction of advanced mathematical tools such as transforms, probability distribution and group theory.

Prerequisite

- Basic Idea on Series and transforms, probability

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic theories and formulas in solving the physical problems.	K2
CLO2	Applications include boundary value problems in electrodynamics and diffusion, eigen value problems in quantum mechanics, and Green's function methods for scattering.	K3
CLO3	Analyse the nature of the problem	K4
CLO4	Capable of evaluating problem at higher order levels using advanced mathematical tools	K5
CLO5	Enhances the mathematical implementation in physics.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	S	S	M	M	S	M
CLO2	S	M	S	L	S	M	M
CLO3	S	M	S	M	S	M	L
CLO4	S	M	M	S	M	M	M
CLO5	S	M	M	S	S	M	S

S- Strong; M-Medium; L-Low

yllabus

Unit I – Fourier Series and Transform **15 Hrs**

Evaluation of the coefficients of Fourier series[1,2], Dirichlet's theorem, Dirichlet's condition, Half range series, change of interval, Fourier series in the interval (0 to T) and uses of Fourier series. Applications Half and full wave rectifier. Properties of Fourier series[3], Gibb's phenomeno n, Parseval's identity of Fourier series, Fourier sine and cosine transforms of derivatives.

Unit II – Laplace Transform **14 Hrs**

Properties of Laplace transforms[4,5], Laplace transform of the derivative of a function,

Laplace transform of integral, Laplace transform of periodic functions, Inverse Laplace transform, properties, Faltung theorem, Evaluation of inverse Laplace transform by convolution theorem, applications of Laplace transform.

Unit III – Dirac Delta Function and Green's Function **15 Hrs**

Dirac delta function, properties, Fourier transform of delta function, Laplace transform ofdelta function, derivative of delta function, completeness condition in terms of Dirac delta function, three dimensional Dirac delta function.

Green's function for one dimensional case, general proof of symmetry property of Green's function, Eigen function, Green's function for Poisson's equation and solution of Poisson's equation.

Unit IV – Probability **14 Hrs**

Mathematical definition of priori probability[6], sample space[7], mutually exclusive events [8], theorem of total probability[8], compound events and theorems of compound probability, binomial and multinomial theorem of probability, Laplace-de-Moivre limit theorem, Measures of central tendency, measures of dispersion, Karl Pearson's coefficient of correlation, standard deviation. Theoretical distribution- Binomial, Poisson and Normal distribution.

Unit V – Group Theory **15 Hrs**

Concept of a group, abelian group, generation of finite group, cyclic group, group multiplication table [9,10]**,** rearrangement theorem, subgroups, cosets, conjugate elements and classes, product ofclasses, complexes, Isomorphism, homomorphism, permutation groups,Cayley's theore m, representation of groups square and triangle only, reducible and irreducible representations, orthogona lity theorem

Books for Study:

1. Sathya Prakash, Mathematical Physics with Classical mechanics, Sultan Chand & Sons, 6thEdition
2. B S Rajput, Mathematical physics, Pragati Prakashan,21stEdition

Reference Books:

1. Dass.H.K,Mathematical Physics, S.Chand and Company Pvt. Ltd,6th Edition
2. Erwin Kreyzig, Advanced Engineering Mathematics, Wiley India Private Limited,8th Edition
3. Eugene Butkov, Mathematical Physics, Addison Wesley London 1973,1st Edition
4. .GuptaMathematical Physics, Vikas Publishing House Pvt. Ltd,2006,3rd Edition
5. Joshi A.W, Elements of Group Theory for Physicists, John Wiley & Sons (Asia) Pvt. Ltd3rd Edition
6. Weber and George. B.Arfken, Mathematical methods for Physicists, Hans. J , AcademicPress,6th Edition

E-content

1. https://www.youtube.com/watch?v=52r-fBTWcww
2. https://www.youtube.com/watch?v=x04dnqg-iPw
3. https://www.youtube.com/watch?v=FQdhWQ9Z6mk
4. https://www.youtube.com/watch?v=zModDQ-ST30
5. https://www.youtube.com/watch?v=M-dy4MJAnN0
6. https://www.youtube.com/watch?v=CDwDliZsFS4
7. https://www.youtube.com/watch?v=leVm6xuKdlU

8. https://www.youtube.com/watch?v=sMh8tsW_b_I
9. https://youtu.be/S2Bsw0aix6g
10. https://www.youtube.com/watch?v=yF5t2BwMiwU

Pedagogy

Chalk and talk, PPT, Seminar, Group discussion, e-contents

Course Designers:

1. Mrs.S.Subanya
2. Mrs.D.Niveditha

MPS2306	QUANTUM MECHANICS-I	Category	L	T	P	Credits
		Theory	73	2	-	5

Preamble

The aim of this course is to build a strong base on the basic facts of quantum mechanics and to make students understand the methods that are required for the accurate description of various microscopic systems.

Prerequisite

- Fundamental knowledge on classical mechanics
- Basic idea on operators and wave equations

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the central concepts and basic formalisms of quantum mechanics; and the set of mathematical tools needed to formulate problems in quantum mechanics.	K2
CLO2	Solve problems in one, two and three dimensions, such as barrier potentials, harmonic oscillator, rigid molecule, hydrogen atom etc., and on systems of identical particles, e.g. determine the symmetry properties of the wave function, and the total spin.	K3
CLO3	Establishing the relations and validating various results. Inspecting on the quantum effects on various spectra. Comparing the properties of various quantities, methods and so on. Give concise physical interpretations, and arguments for the validity of the methods.	K4
CLO4	Integrate several components of the course like quantum states, symmetries, angular momentum etc in the context of finding solution to the problems in atomic and molecular physics	K5
CLO5	Present the tools, methodologies, language and conventions of quantum mechanics from this course to prove and test ideas and explanations on various problems involving many body systems.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	S	S	M	L	L	L

CLO2	S	S	S	S	S	M	M
CLO3	S	S	S	S	S	M	M
CLO4	S	S	S	S	S	S	M
CLO5	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

Unit I **15 hrs**

General formalism of quantum mechanics: Linear Vector Space[1]- Linear Operator- Eigen Functions and Eigen Values[2]- Hermitian Operator- Postulates of Quantum Mechanics-Simultaneous Measurability of Observables- General Uncertainty Relation- Dirac's Notation- Equations of Motion; Schrodinger[3], Heisenberg and Dirac representation- momentum representation.

Unit II **14 hrs**

Energy Eigen value problems Particle in a box – Linear Harmonic oscillator[4]- Tunnelling through a barrier- particle moving in a spherically symmetric potential- System of two interacting particles-Rigid rotator[5]- Hydrogen atom[6]

Unit III **15 hrs**

Angular Momentum Orbital Angular Momentum-Spin Angular Momentum-Total Angular Momentum Operators[7]-Commutation Relations of Total Angular Momentum with Components[8]- Ladder operators- Commutation Relation of Jz with J+ and J- - Eigen values of J^2, Jz- Matrix representation of J2, Jz, J+ and J- - Addition of angular momenta- Clebsch Gordon Coefficients – Properties.

Unit IV **15 hrs**

Approximate Methods: Time Independent Perturbation Theory in Non-Degenerate Case- Ground State of Helium Atom-Degenerate Case-First order perturbation theory for Degenerate level[9]-Stark Effect in Hydrogen[10] – Spin-orbit interaction[11]-Variation Method & its Application to Hydrogen Molecule- WKB Approximation.

Unit V **14 hrs**

Many Electron Atoms Indistinguishable particles – Pauli principle- Inclusion of spin – spin functions for two-electrons- The Helium Atom[13] – Central Field Approximation - Thomas-Fermi model of the Atom[14] - Hartree Equation - Hartree-Fock equation.

Books for Study & Reference:

1) P.M. Mathews & K. Venkatesan, A Text Book of Quantum Mechanics, Tata McGraw Hill2010.
2) G. Aruldhas , Quantum Mechanics , Prentice Hall of India 2006.
3) David J.Griffiths, Introduction to Quantum Mechanics, Pearson Prentice Hall 2005.
4) L.I Schiff, Quantum Mechanics, McGraw Hill 1968.
5) A. Devanathan, Quantum Mechanics, Narosa Publishing, New Delhi.
6) R.Shankar, Principles of Quantum Mechanics, Springer 2005.

Reference for E-content

1. https://www.youtube.com/watch?v=y3ARLfm-52w
2. https://www.youtube.com/watch?v=cUUFIk0ISuY

3. https://www.youtube.com/watch?v=lMFgfqRZYoc
4. https://www.youtube.com/watch?v=4FjX_TTzHYw
5. https://www.youtube.com/watch?v=iNqnrJ5JjZg
6. https://www.youtube.com/watch?v=ACY-Wbudg0o
7. https://www.youtube.com/watch?v=xoCHe0mtxu0
8. https://www.youtube.com/watch?v=0ROXdIoJZZQ
9. https://www.youtube.com/watch?v=GWCXKzDY-Y0
10. https://www.coursera.org/lecture/approximation-methods/stark-effect-Khbgm
11. https://www.youtube.com/watch?v=UI_xLwq_W2U
12. https://www.youtube.com/watch?v=DpNZ70Uam0M
13. https://www.youtube.com/watch?v=Mc7i0OeFr1Q

Pedagogy

Chalk and Talk lectures, Group Discussion, Seminar, Interaction, Power Point Presentation

Course Designers

1. Dr.G.Praveena

MPS2307	ELECTROMAGNETIC THEORY	Category	L	T	P	Credits
		Theory	73	2	-	5

Preamble

Students will develop a physical understanding of electromagnetic fields and waves to unify their understanding of electricity and magnetism

Prerequisite

- Undergraduate-level course in electricity and magnetism
- Mathematical methods

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Summarize the fundamentals of Electrostatics and Magnetostatics	K2
CLO2	Analyse the concept of Electrodynamic fields	K3
CLO3	Apply the concept of electromagnetic theory in electromagnetic waves	K4
CLO4	Understand the transverse behaviour of electromagnetic waves in different geometrics of wave guides	K5
CLO5	Formulate electromagnetic wave equations for different propagating media and to determine the flow of energy and wave velocity	K6

Mapping with Programme Learning Outcomes

CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7
CLO1	S	S	S	S	S	L	L
CLO2	S	S	S	L	S	L	L
CLO3	S	S	M	S	S	L	M
CLO4	S	M	L	S	S	L	L
CLO5	S	S	S	L	S	L	L

S- Strong; M-Medium; L-Low

Syllabus

Unit I: Electrostatics and Magnetostatics **14 Hrs**

Coulomb's Law[1],Gauss's Law and applications[2],potentialfunction,field due to a continuous distribution of charge, equi-potential surfaces, Poison's equation[3], Laplace's equation[4],methodof electrical images-spherical conductor when earthed, insulated conducting sphere near a point charge capacitance, electro-static energy, boundary value problems with dielectrics, the electro-static uniqueness theorem for field of a charge distribution

Unit II: Magnetostatics **14 Hrs**

Lorentz force, electric current-Ampere's law and applications[5]-Long straight wire, Circular coil, Solenoid, Ampere's law for a current element -Ampere's law in differential vector form - Biot-Savart law[6], Magnetic scalar potential– Importance – Applications – magnetic dipole, Circular coil and Vector potential – Importance - Applications- Magnetic dipole, Long current carrying wire, equation of continuity-magnetization

Unit III: Applied Electromagnetic Waves **15 Hrs**

Equationofcontinuityfortimevaryingfields–inconsistencyofampere'slaw- Maxwell's equations – derivations[7] – electromagnetic waves in free space – uniform plane wave propagation and its characteristics –wave equations for conducting medium–Maxwell's equation in phasor form[8] – wave propagation in lossless, conducting and dielectric media – depth of penetration.

Unit IV: Electromagnetic Waves in Bounded Media & Power Flow **15 Hrs**

Poynting's theorem - statement and proof[9] – Interpretation of Poynting's vector – Power flow for a plane wave – power flow in a concentric cable and conductor having resistance –Instantaneous, average and complex Poynting vector – power loss in a plane conductor and a resonator -Boundary conditions – proof – reflection of plane waves by a perfect conductor for normal and oblique incidence – reflection of plane waves by a perfect dielectric for normal and oblique incidence– Brewster's angle[10]

Unit V: Guided Waves and Wave Guides **15 Hrs**

Wavesbetweenparallelplanes–Transverseelectricwaves-Transversemagneticwavescharacteristics of TE and TM waves–Transverse electromagnetic waves–Attenuation in parallel plane guides – attenuation for TE waves, TM waves and TEM waves[11] – Rectangular guides – Transverse magnetic waves and Transverse electric waves in rectangular guides – Field configurations for dominant TM and TE modes - Impossibility of TEM wave in wave guides[12] –Transmission line analogy for waveguides- Q factor of wave guides.

Text Books

1. Chopra Agarwal, Electromagnetic Theory, K.NathandCo.,5th edition.
2. EdwardC, Jordan & KeithG., Balmain, Electromagnetic Waves and Radiating Systems, Prentice Hall of India, New Delhi, 1997, 2nd Edition.
3. Gupta, Kumar, singh, Electrodynamics, Pragati Prakashan, Meerut, 20th edition.

Reference Books

1. D.Griffiths, Introductionto Electrodynamics,PrenticeHallofIndia,NewDelhi,1999,3rd Edition.

2. J.D.Jackson, Classical electrodynamics, Wiley-Eastern Ltd-NewDelhi,1999, 3rd Edition.

E-content

1 https://www.physicsclassroom.com/class/estatics/Lesson-3/Coulomb-s-Law
2 https://collegedunia.com/exams/applications-of-gauss-law-physics-articleid-10
3 https://www.youtube.com/watch?v=lVRIw36CAWs
4 https://www.youtube.com/watch?v=XtHif0xNhjE
5 https://www.youtube.com/watch?v=UUfZR33FblY
6 http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/Biosav.html
7 http://hyperphysics.phy-astr.gsu.edu/hbase/electric/maxeq.html
8 https://eng.libretexts.org/Bookshelves/Electrical_Engineering/Electro-Optics/Book%3A_Electromagnetics_I_(Ellingson)/09%3A_Plane_Waves_in_Loseless_Media/9.01%3A_Maxwell%E2%80%99s_Equations_in_Differential_Phasor_Form
9 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://marwaricollege.ac.in/study-material/525532270Poynting%20vector%20and%20poynting%20theorem.pdf
10 https://vlab.amrita.edu/index.php?brch=189&cnt=1&sim=333&sub=1
11 chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://hsic.sjtu.edu.cn/Assets/userfiles/sys_eb538c1c-65ff-4e82-8e6a-a1ef01127fed/files/Lec6%20Transmission%20Lines%20and%20waveguides%EF%BC%88I%EF%BC%89.pdf
12 https://www.youtube.com/watch?v=G8u2WEBF7MY

Pedagogy

Chalk and Talk, ppt, Video lecture, group discussion, seminar, Interaction, problem solving

Course Designers

1. Dr.N.Priyadharsini
2. Dr. S. Shanmuga Sundari

MPS23CE	COURSERA - PYTHON FOR DATA SCIENCE AND ARTIFICIAL INTELLIGENCE	Category	L	T	P	Credits
			60			3

Preamble

The objective of introducing this paper is to give the students a working knowledge of the most popular and widely used programming languages of modern days, namely 'Python' language.

- **Python for Data Science , AI and Development (17hrs)**

  Python basics- Python Data Structures- Python Programming Fundamentals-Working with Data in Python- APIs, and Data Collection

- **Introduction to Artificial Intelligence (9 hrs)**

  AI and its Applications- AI concepts, Terminology and application areas- Issues , concerns and Ethical Considerations- The future with Ai and Ai in Action

- **Tools for Data Science (14hrs)**

  Overview of Data Science Tools-Languages of Data Science-Packages, APIs, Datasets and Models-Jupyter Notebooks and JupyterLab-RStudio & GitHub-Create and Share your Jupyter Notebook- IBM Watson Studio

- **Python Programming Essentials (10hrs)**

  Python as a Calculator-Functions-Logic and Conditionals-Python Modules

- **Python Basics : Selection and Iteration (8hrs)**

  Fundamentals-Operators- Conditionals-Loops

DEPARTMENT OF PHYSICS

MASTER OF PHYSICS

2024-26 BATCH

PSGR
Krishnammal College for Women

MASTER OF SCIENCE IN PHYSICS
CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)
SCHEME AND SYLLABUS OF 2024-2026 BATCH
SEMESTER - III

Semester	Course code	Title of the Course	Course Type	Instructions Hours/week	Total contact hours	Tutorials	Duration of exam in hours	Maximum marks			Credits
								CA	ESE	Total	
III	MPS2411	Condensed Matter Physics	CC	4	58	2	3	25	75	100	4
III	MPS2312	Quantum Mechanics –II*	CC	4	58	2	3	25	75	100	5
	MPS2313	Atomic and Molecular Spectroscopy	CC	4	58	2	3	25	75	100	4
	MPS2314/ MPS2315	Advanced Microprocessor and Microcontrollers / Nuclear Physics II	DSE	4	58	2	3	25	75	100	4
	MPS23S1	Research Methodology	ACC	2	28	2	3	-	100	100	3
	MPS24P3	Advanced Practical	CC	5	75	-	6	25	75	100	4
	MPS23P4	Special Electronics Practical	CC	5	75	-	6	25	75	100	4
	MNM22CS2	Cyber Security II	AECC	2	30	-	-	100	-	100	Grade
	MPS24COM	Comprehensive Examination	GC	-	-	-	2	100	-	100	Grade
I - III	17MONL1	Online Course	ACC	-	-	--	-	-	-	-	

***Open Book Examination**

CC – Core Courses **DSE – Discipline Specific Elective**
ESE – End Semester Examination **CA – Continuous Assessment**
ACC– Additional Credit Course **GC -- General Course**
AECC – Ability Enhancement Compulsory Course

Examination System

Pattern:

Semester system will be followed. A semester consists of a minimum of 90 working days excluding the days of conduct of ESE. There will be Continuous Internal Assessment (CA) to evaluate the performance of students in each course and the End Semester Examination will be held at the end of every semester.

Weightage assigned to various components of Continuous Internal Assessment

Theory

CIA Test	: 5 marks **(conducted for 45 marks after 50 days)**
Model Exam	: 7 marks **(conducted for 75 marks after 85 days)**
Seminar/Assignment/Quiz	: 5 marks
Class Participation	: 5 marks
Attendance	: 3 marks
Total	**: 25 Marks**

Practical

Lab Performance	: 7 marks
Regularity	: 5 marks
Model Exam	: 10 marks
Attendance	: 3 marks
Total	**: 25 marks**

CA Question Paper Pattern and distribution of marks - (First 3 Units)

Core and Elective Courses

CA Question from each unit comprising of

One question with a weightage of 2 Marks:2 x 3 = 6

One question with a weightage of 5 Marks (Internal Choice at the same CLO level): 5 x 3 =15

One question with a weightage of 8 Marks (Internal Choice at the same CLO level) :8 x 3 =24

Total :45 Marks

Cyber Security II

Quiz	: 60 marks
Case Study	: 20 marks
Poster	: 20 marks
Total	**: 100 marks**

End Semester Examination – Question Paper Pattern and Distribution of Marks

Core and Elective Courses

ESE Question Paper Pattern: 5 x 15 = 75 Marks

Question from each unit comprising of
One question with a weightage of 2 Marks : 2 x 5=10
One question with a weightage of 5 Marks (Internal Choice at the same CLO level): 5 x 5 =25
One question with a weightage of 8 Marks (Internal Choice at the same CLO level): 8 x 5 =40

Research Methodology

Section A - 5 questions (Internal choice) :25 marks

Section B - 5 questions (Internal choice) :75 marks

Total : 100 Marks

Criteria for Attendance:

3 Marks (Attendance 75% - 80% - 1 Marks, 81% - 90% - 2 Marks, 91% - 100% - 3 Marks)

Course Code	Course Title	Category	L	T	P	Credit
MPS2411	CONDENSED MATTER PHYSICS	Theory	58	2	-	4

Preamble

The objective of introducing this paper is to provide an in-depth knowledge of crystal structure, properties of crystals, superconductivity and different dielectric related properties.

Prerequisite

1. Quantum Mechanics
2. An undergraduate level course in solid state physics

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the fundamentals of crystal structure, vibrational and electrical properties	**K2**
CLO2	Apply reciprocal lattice to the crystal structure and explain how it gives rise to band structure and Brillouin zone. Apply quantum mechanics for theoretical and numerical calculations	**K3**
CLO3	Analyse the microscopic structure of the material and how it is mirrored in macroscopic aspect	**K4**
CLO4	Evaluate the structure of materials by crystal structure and band theory	**K5**
CLO5	Create an ability to identify relevant principles, mathematical techniques and laws when dealing with problems in condensed matter physics	**K6**

Mapping with Programme Learning Outcomes

COs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	S	S	M	S	L	M
CLO2	S	S	S	M	M	M	M
CLO3	S	L	S	M	S	L	M
CLO4	S	S	S	M	M	L	M
CLO5	S	M	S	M	S	L	M

S- Strong; M-Medium; L-Low

Syllabus

Unit I : Crystal Lattices and Lattice vibrations 13Hrs

Basics of Lattices-Reciprocal Lattice- Graphical demonstration of the Reciprocal Lattice-Vector algebraic discussion of Reciprocal Lattice-Spacing of planes of crystal lattice-**relation between crystal lattice axes and crystal Reciprocal Lattice axes[1]** - Reciprocal Lattice to Sc, Bcc and Fcc strucutres- Lattice vibration- Concept of phonon- Momentum of phonons-Inelastic scattering of photons by phonons- Inelastic scattering of X-rays by phonons- Inelastic scattering of neutrons by phonons.

Influence of Crystals in Ancient India:

Rasashastra & Alchemy[2] - Gemology & Ayurveda- Metallurgy & Temple Architecture [3,4]- Crystal Purification & Piezoelectric Crystals -Ayurvedic metallic preparations as nanocrystals in medicine[5] and materials science[4].

Unit II: Quantum Free Electron Theory of Solids 11Hrs

Quantum theory of free electrons[6]- Fermi theory- density of states in1D and 3D- **Band Theory: Failure of Sommerfeld's free electron theory-Band theory of solids[7]**- Kronig - Penney model- construction of one, two and three dimensional Brillouin zones - Extended, Reduced and Periodic zone schemes – Number of possible wave function in a band-motion of electron in one dimensional periodic potential- Effective mass of an electron - **Distinction between metals, semiconductors, and insulators using band theory.[8]**

Unit III: Ferroelectrics 11Hrs

Electric polarization – structural phase transtition – **Ferro electric crystals[9]** – classification of ferroelectrics crystal – Displacive Transition: soft optical phonon – Landau theory of the phase transition: second order transition and first order transition – **Antiferro electricity and ferro electric domains –Piezo electricity[10]** – ferro elasticity.

Unit IV: Diamagnetism and Paramagnetism 11Hrs

Langevin diamagnetism equation – **quantum theory of diamagnetism of mono nuclear systems[11] –** Paramagnetism – quantum theory of paramagnetism: rare earth ions – Hund rule – Iron group ions – Crystal field splitting – Quenching of the orbital angular momentum – spectroscopic splitting factor - Van Vleck temperature – independent Paramagnetism cooling by isotropic demagnetization – Paramagnetic susceptibility of conduction electron.

Unit V: Ferromagnetic Order 12 Hrs

Currie point and exchange integral – temperature dependence of the saturation magnetization – saturation magnetization at absolute zero - **Magnons: Quantization of spin waves thermal excitation of magnons[12]** – Neutron Magnetic scattering – Ferri magnetic orders: Curie temperature and susceptibility of ferrimagnetisms – iron garnets – Anti ferromagnetic order: susceptibility below the Neel temperature – anti ferromagnetic magnons – Ferromagnetic domains: an isotropic energy– transition region between domains.

Text Book

S. No	Authors	Title of the Book	Publishers	Year & Edition
1	Pillai.S.O	Solid State Physics	New Age Publishers	2022, 10th Edn
2	Saxena, Gupta	Solid State Physics	Pragati Prakashan	2008, 12th Edn

3	Dr. Ravindra Kumar ·	Fundamentals of Historical Geology and Stratigraphy of India	Wiley Eastern	1985, 1st Edn
4	Rakesh Shastri	Indian Gemmology 1st edition	Sahni publications	1995,1st Edn
5	Chittrabrata, Patil and Nupur Dasgupta.	An Ancient Indian System of Rasayana uvarnatantra: A Treatise on Alchemy, pp. 45–46,	Kalpaz Publications, New Delhi.	2009,1st Edn
6	Debiprasad Chattopadhyaya	Science and society in ancient India	Research India Publications	1978, 1st Edn

Reference Books

S. No	Authors	Title of the Book	Publishers	Year & Edition
1	Charles Kittel	Introduction to solid state physics	Wiley India Pvt Ltd	2010, 7th Edn
2	Wahab	Solid State Physics	Narosa Publishing House	2011, 2nd Edn
3	Vagbhata	Rasaratna Samuchchaya,Year 1939	Chowkhamba Sanskrit Series office-2003-25,gyan books private limited.	1939,1st Edn

Reference for E-content

1. https://nptel.ac.in/courses/113106032/4%20-%20Crystal%20structure.pdf
2. https://www.youtube.com/watch?v=NYVSI83KiKU
3. https://www.youtube.com/watch?v=LcoUFX3_A1s
4. https://www.differencebetween.com/difference-between-polymorphism-and-allotropy/
5. https://www.youtube.com/watch?v=ZIK4Nvxdfu8
6. https://www.youtube.com/watch?v=-0OogxCtjN0
7. https://archive.nptel.ac.in/courses/113/104/113104081/
8. https://onlinecourses.nptel.ac.in/noc18_mm11/preview

9. file:///C:/Users/lenovo/Downloads/9781461492863-c1.pdf
10. https://www.youtube.com/watch?v=kygXzJa7tX4
11. https://phys.libretexts.org/Bookshelves/Electricity_and_Magnetism/Book%3A_Electromagnetics_II_(Ellingson)/06%3A_Waveguides/6.01%3A_Phase_and_Group_Velocity
12. https://slideplayer.com/slide/9087707/-free
13. https://www.youtube.com/watch?v=L-eOdZFt9BY
14. https://www.youtube.com/watch?v=gNdIQVJhFoM
15. https://www.youtube.com/watch?v=ots5zxbrlUk
16. https://www.youtube.com/watch?v=EjSskbYMWEM
17. https://www.youtube.com/watch?v=CMbCRqstf6c
18. https://www.researchgate.net/publication/382956886_Application_of_Ayurvedic_Bhasma_for_the_Treatment_of_Cancer
19. https://www.youtube.com/watch?v=TPzambf0mJ4&list=PLruuLJ6AZrhinH_ah4XHRtbNUeAjlVmyn&index=20
20. Rao, Ramachandra. P. and Goswami N.G. Metallurgy in India: A Retrospective; (ISBN: 81; 87053-56-7); Article: 'Ferrous metallurgy in Ancient India', pp. 52–91.
21. Pal, Sanjoy Kumar. 2015. The Ayurvedic Bhasma: The Ancient Science of Nanomedicine, Recent Patents on Nanomedicine. Vol. 5, No. 1. pp. 12–18.

Pedagogy

Chalk and Talk, PPT, Seminar, Group Discussion, Interaction and E-content

Course Designer

1. Dr. G. Praveena
2. Dr. P. Maheswari

Course Code	Course Title	Category	L	T	P	Credit
MPS2312	QUANTUM MECHANICS-II	Theory	58	2	-	5

Preamble

The aim of this course is to build a strong base on the advanced concepts in quantum mechanics and to make students understand the methods that are required for the accurate description of various microscopic systems.

Prerequisite

1. Basics of time dependent and Independent Perturbation theories
2. Ideas on quantum field theory and relativistic wave equation

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the concepts of perturbation theory and approximation methods; and the set of mathematical tools needed to formulate problems in quantum mechanics.	K2
CLO2	Solve problems in and on systems of identical particles, e.g. determine the symmetry properties of the wave function, and the total spin.	K3
CLO3	Establishing the relations and validating various results. Comparing the properties of various quantities, methods and so on. Give concise physical interpretations, and arguments for the validity of the methods.	K4
CLO4	Integrate several components of the course like quantum states, symmetries in the context of finding solution to the problems in molecular and elementary particle physics	K5
CLO5	Present the methodologies, language and conventions of quantum mechanics from this course to prove and test ideas and explanations on various problems involving various systems of particles	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	S	L	L	L	L	L
CLO2	S	S	S	S	S	M	M
CLO3	S	S	S	S	S	M	M
CLO4	S	S	S	S	S	S	M
CLO5	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

Syllabus

Unit I: Time Dependent Perturbation Theory **12 hrs** Time Dependent Perturbation Theory- Introduction-First Order perturbation- Harmonic perturbation-Transitions to continuum states- Fermi's Golden rule-Transition Probability-**Selection Rules for Dipole Radiation[1,2,3]**-Adiabatic Approximation-**Sudden approximation[4].**

Unit II: Scattering Theory **11 hrs**

Scattering cross section - Scattering amplitude -**Laboratory and centre of mass coordinate systems[5]** – Partial waves - Phase Shifts - Scattering by Coulomb and**Yukawa potential[6]**– Born approximation -Validity of Born approximation.

Unit III: Theory of Radiation (Semi Classical Treatment) **11hrs**

Laser Theory - Einstein's Coefficients - Spontaneous and Induced Emission of Radiation from Semi Classical Theory[7,8]-Radiation Field as an Assembly of Oscillators-Interaction with Atoms-Emission and Absorption Rates-Density Matrix and its Applications.

Unit IV: Elements of field quantization **12 hrs**

Quantization of the Wave Fields –**Quantization of Lagrangian[9]**and Hamiltonian equation-Quantization of the Non-relativistic Schrodinger equation-**Number operators- Creation and Destruction–Anti Commutation Relations[10]**-Quantization of the electromagnetic field (Energy and Momentum).

Unit V: Relativistic Quantum Mechanics **12 hrs**

Klein Gordon Equation- Interpretation of the Klein Gordon Equation-Charge and Current Density-**Application to the Study if Hydrogen like atom[11]-Dirac's relativistic equation for a free particle[12]**-Dirac matrices-Dirac's equation in Electromagnetic Field-Negative energy states.

Text Books:

S. No	Authors	Title of the Book	Publishers	Year & Edition
1	G. Aruldhas	Quantum Mechanics	PHI	2011, 2nd Edn
2	David J. Griffiths	Introduction to Quantum Mechanics	Pearson Prentice Hall	2007, 2nd Edn
3	Mathews and Venkatesan	A textbook of Quantum Mechanics	TMH	2012, 2nd Edn
4	SathyaPrakash& Swati Saluja	Quantum Mechanics	Kedarnath Ramnath Publishers	2011, 2nd Edn

Reference books:

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	A.K. Ghatak and S. Loganathan	Quantum Mechanics	McMillan	2011, 4th Edn
2	Gupta, Kumar, Sharma	Quantum Mechanics	Jai Prakash Nath & Co	2010, 29th Edn
3	Schiff	Quantum Mechanics	TMH	2010, 2nd Edn

Reference for E-content:

- https://quantummechanics.ucsd.edu/ph130a/130_notes/node422.html
- http://web.phys.ntnu.no/~stovneng/TFY4215_2019/lecturenotes/lecturenotes16.pdf
- https://farside.ph.utexas.edu/teaching/qm/Quantum/node86.html
- http://electron6.phys.utk.edu/PhysicsProblems/QM/6-Time dependent%20approximations/sudden.html
- https://youtu.be/ywPp6DaX47Y
- https://youtu.be/7KVHMxo___4
- https://www.youtube.com/watch?v=049abZcKErY&t=2193s
- https://www.youtube.com/watch?v=5Kia0HHmkHY
- https://www.physics.purdue.edu/~clarkt/Courses/Physics662/ps/qftch21.pdf
- https://www.chm.uri.edu/dfreeman/chm532/aa.pdf
- https://youtu.be/zVnJ4NAfJzE
- https://youtu.be/2d2wP6MSiqM

Pedagogy

Chalk and Talk lectures, Group Discussion, Seminar, Interaction, Power Point Presentation

Course Designers:

Dr. G. Praveena

Course Code	Course Title	Category	L	T	P	Credit
MPS2313	ATOMIC AND MOLECULAR SPECTROSCOPY	Theory	58	2	-	4

Preamble

To develop the relevant knowledge of analytical tools to elucidate the various kinds of molecular structure and understand the instrumental aspects of specific spectroscopic techniques

Prerequisite

1. Basic principles on spectroscopy, Quantum and classical mechanics

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Attain basic knowledge about the interactions of electromagnetic radiation and matter and their applications in spectroscopy	K2
CLO2	Identify the specific and suitable molecular spectroscopy methods for solving given scientific problem	K3
CLO3	Apply formalisms based on molecular symmetry to predict spectroscopic properties	K4
CLO4	Examine and analyze spectroscopic data collected by various analytical methods discussed in the course.	K5
CLO5	Solve problems related to the structure, purity and concentration of chemicals and to study molecular interactions by choosing suitable spectroscopic methods and interpreting corresponding data.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	S	S	S	M	S	M
CLO2	S	S	S	S	S	M	M
CLO3	S	S	S	M	S	S	M
CLO4	S	S	S	M	S	S	M
CLO5	S	S	M	S	S	S	S

S- Strong; M-Medium; L-Low

Unit I: Atomic & Microwave Spectroscopy 11hrs

Quantum states of an electron in an atom

Interaction of light with matter - Spectra of Alkali Metal Vapours-*Normal Zeeman Effect-Anomalous Zeeman Effect*-Magnetic Moment of Atom and the G Factor - Lande's 'g' Formula - Paschen Back Effect-Hyperfine Structure of Spectral Lines.

Microwave Spectroscopy: The Rotation of molecules- Rotational spectra- Diatomic molecules- poly atomic molecules-**Techniques and Instrumentation- Chemical analysis by Microwave Spectroscopy[1].**

Unit II: Infrared & Raman Spectroscopy 12hrs

Infra-red spectroscopy:

The Vibrating Diatomic molecule- the diatomic vibrating rotator- the vibration-rotation spectrum of Carbon Monoxide- breakdown of the Born-Oppenheimer Approximation: the interaction of rotation and vibrations-**The vibrations of Polyatomic molecule[2,3,4]-** Techniques and Instrumentation.

Raman Spectroscopy:

* Introduction- Pure rotational Raman Spectra*- Vibrational Raman Spectra- Polarization of Light and the Raman Effect- **Structure Determination from Raman and Infra-red spectroscopy- techniques and Instrumentation[2,3,4].**

Unit III: Electronic Spectra: Fluorescence & Phosphorescence Spectroscopy 12hrs

Electronic Excitation of Diatomic Species-Vibrational Analysis of Band Systems of Diatomic Molecules- Deslandres Table-Intensity Distribution- Franck Condon Principle-Rotational Structure of Electronic Bands-Resonance and Normal Fluorescence-Intensities of Transitions-Phosphorescence Population of Triplet State and Intensity-**Experimental Methods-Applications of Fluorescence and Phosphorescence[5,6,7].**

Unit IV: NMR & NQR Spectroscopy 11hrs

NMR Spectroscopy: Quantum Mechanical and Classical Description-Bloch Equation-Relaxation Processes-Experimental Technique-Principle and Working of High Resolution NMR Spectrometer-**Chemical Shift- NMR Imaging- Interpretation of certain NMR spectra (Ethanol, 1 – Nitropropane, methyl ethyl ketone)[8].**

NQR Spectroscopy: Fundamental Requirements-basic Principle - Half integral spins- Experimental Detection of NQR Frequencies-Determination of molecular structure.

Unit V: ESR & Mossbauer Spectroscopy 12hrs

ESR Spectroscopy: Basic Principles Theory of ESR-Resonance conditions--**Experiments-ESR Spectrometer-Applications[9,10]-** ESR Spectrum-Crystalline solids and free radicals in liquids- Hyperfine Structure

Mossbauer Spectroscopy: Mossbauer Effect-Recoilless Emission and Absorption-

Mossbauer Spectrum-Experimental Methods[11]- Hyperfine Interaction-Chemical Isomer Shift-Magnetic Hyperfine and Electric Quadrupole Interaction

Text Book

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Straughen& S. Walker	Spectroscopy: Volumes I, II and III	Springer Publishers	1976, 1st Edn
2	Aruldhas	Molecular Structure and Spectroscopy	Prentice Hall Private Ltd	2007, 2nd Edn
3	Banwell	Fundamental of molecular spectroscopy	Tata Mc Graw Hill Publishing Company	2015, 4th Edn
4	B.K. Sharma	Spectroscopy	Krishna's Educational Publishers	2014, 23rd Edn
5	Y.R. Sharma	Elements of Organic Spectroscopy	S. Chand Publishers	2014, Revised Edn

Reference Books

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Barrow	Introduction to molecular spectroscopy	Tata McGraw-Hill Publishers	1962, International student Edn
2	R. Wilfred Sugumar	Molecular and Atomic Spectroscopy	MJP Publishers	2008, 1st Edn

Reference for E-content:

16. https://www.youtube.com/watch?v=ullasT35FyY
17. https://www.youtube.com/watch?v=xi_KmMCd66U&list=PL9AUXQTZw3Su3ipjaPbC7iDVgzJ44n8XW&index=4
18. https://www.youtube.com/watch?v=qo1RMoaqs2A&list=PL9AUXQTZw3Su3ipjaPbC7iDVgzJ44n8XW&index=5
19. https://www.youtube.com/watch?v=XPBUhnwCEUc&list=PL9AUXQTZw3Su3ipjaPbC7iDVgzJ44n8XW&index=6
20. https://www.youtube.com/watch?v=SbRsfUJ0jw4
21. https://www.youtube.com/watch?v=L7ACivhHQeo
22. https://www.youtube.com/watch?v=9sUrrffI7Xs
23. https://drive.google.com/file/d/0B2518YmfGRksRmN3UzVSdWZzWU0/view?usp=sharing&resourcekey=0-auAHZINd51hIVcJaEwfHig
24. https://www.youtube.com/watch?v=Xfg2VRtSUjk
25. https://www.youtube.com/watch?v=F5hOI2XUkgE
26. https://slideplayer.com/slide/6374537/

Pedagogy

Chalk and Talk, PPT, Seminar, Group Discussion, Interaction and E-content

Course Designers:

1. Dr.N.Priyadharsini

2. Dr.G.Vanitha

Course Code	Course Title	Category	L	T	P	Credit
MPS2314	ADVANCED MICROPROCESSOR AND MICROCONTROLLER	Theory	58	2	-	4

Preamble

To make the students aware of the development of advanced microprocessors and microcontrollers and give them training in writing program in assembly language of 8085.

Prerequisite

Basic idea on assembly language

Course Learning Outcomes

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

Mapping with Programme Learning Outcomes

CLO Number	CLO Statement	Knowledge Level
CLO1	Understanding the basic concepts of architecture and assembly language programming of 8085 microprocessor and microcontroller	K2
CLO2	Apply the acquired knowledge in the mnemonics of 8085 to write microprocessor programs	K3
CLO3	Analyze the interfacing concepts and explaining the memory and addressing modes	K4
CLO4	Write a assembly language program with 8085 & 8051	K5
CLO5	Create a program with interfacing conceptsof real world input and output devices	K6

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	M	S	M	S	S	L
CLO2	S	S	M	S	M	M	M
CLO3	S	S	M	M	S	M	M
CLO4	S	S	M	S	M	S	M
CLO5	S	S	S	S	S	M	S

S- Strong; M-Medium; L-Low

Syllabus

Unit I: Microprocessor Architecture and Instruction set **12hrs**

8 bit Microprocessor -8085 microprocessor architectures–8085 pin description-Microprocessor – Communications and Bus timings–**Control Signals**[1] –**Example of an 8085 based Microcomputer** [2,3]**–** Instruction set**– Data transfer Operations**[4]**– Arithmetic Operations** [5] **- Logical Operations** [6] **– Branch Operations** [7]**–** Instruction format

Unit II: Software Programs (using 8085) **11hrs**

Addition – Subtraction – Multiplication – Division – BCD Arithmetic – Choosing the biggest and smallest numbers from a list – Time delays – **Illustrative Programs- Hexadecimal counter**[8] **– Square wave generator**[9]

Unit III: 16& 32 Bit Microprocessors **12hrs**

16 bit Microprocessors–Intel 8086-pin description for minimum mode-pin description for maximum mode–Internal Architecture–programming model–**memory segmentation**[10]– **Instructionset**[11]–**Co processing** [12]**–Memory interfacing–I/O interfacing**[14]**–Intel 80186** [15] **and 80286-32 bit Microprocessors – Intel 80386/80486 – Intel Pentium processor** [16]

Unit IV: Inter facing memory and I/O devices **12hrs**

Basic Interfacing concepts–Memory-Mapped I/O–Programmable Peripheral Interface(8255A) – 8254 Programmable Interval timer – DMA Controller – **8259A Programmable InterruptController.**[17,18]

Unit V: 8051 Microcontroller **11hrs**

Architecture–Microcontroller 8051 data memory hardware programs and–**Externalmemory**[19]**– counters** [20, 21]**–** serial data I/O **– interrupts.**[22]

Text Book

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Gaonkar	Microprocessor Architecture Programming and Applications	Penram International Publishing	2013, 9th Edn

Reference Books

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Kenneth J. Ayala	The 8051 Microcontroller, architecture,	Thomson Delmar Learning	2004, 3rd Edn

		programming and applications		

1. References For E-Content:

2. https://slideplayer.com/slide/12329568/
3. https://slideplayer.com/slide/3944521/
4. https://slideplayer.com/slide/6029325/
5. https://youtu.be/eTVL_T3Gjr0
6. https://youtu.be/0OGZF9-TqQM
7. https://youtu.be/5xbo6efNPng
8. https://youtu.be/vi4yZOWgDc8
9. https://youtu.be/NfLotcMpA3Q
10. https://slideplayer.com/slide/9428542/
11. https://youtu.be/8qGYdGLbwpc
12. https://youtu.be/66F1Qb03Ad0
13. https://youtu.be/3_ggsKT6QaA
14. https://slideplayer.com/slide/10023207/
15. https://slideplayer.com/slide/2289810/
16. https://slideplayer.com/slide/1509837/
17. https://youtu.be/FgkdNCuySDI
18. https://slideplayer.com/slide/2327129/
19. https://slideplayer.com/slide/5851064/
20. https://youtu.be/dM2swIpGk0Y
21. https://slideplayer.com/slide/3944927/

Pedagogy

Chalk and Talk, PPT, Seminar, Group Discussion, Interaction and E-content

Course Designers:

Dr J. Balavijayalakshmi

Course Code	Course Title	Category	L	T	P	Credit
MPS23S1	RESEARCH METHODOLOGY	Theory	28	2	-	3

Preamble

This paper aims to develop the skills of students in doing research and compiling their results in an effective manner.

Prerequisite

1. Basic problem solving skills
2. Competency in handling software
3. Skill in creative writing

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand the basic concepts of research and its methodologies	K2
CLO2	Acquire competency in various research tools and techniques	K3
CLO 3	Identify appropriate research topicsand define appropriate problem andparameters	K4
CLO 4	Implement a research project based on the acquired research skills	K5
CLO5	Develop original research work adhering to ethical research practices	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	M	S	L	S	L	S
CLO2	S	M	S	L	S	L	S
CLO3	S	M	S	L	S	M	S
CLO4	S	M	S	L	S	M	S
CLO5	S	M	S	L	S	M	S

S-Strong;M-Medium; L-Low

Syllabus

Unit 1: Research objectives **5Hrs**

Types of research– Research approaches – Significance of research – Research methods versus methodology – Research and scientific method – Research process – Criteria of good research – Problems encountered by researchers in India.

Unit 2: Identification of Research Problem **6Hrs**

Selecting the Research problem – Necessity of defining the problem – Goals andCriteria for identifying problems for research– Techniques involved in defining the problem –Source of research problems

Unit 3: Use of tools / techniques for Research **6Hrs**

Statistical and graphical packages (MS Excel, Origin / Sigma plot, gnu plot) - Methods to search required information effectively–Reference Management Software like Zotero/mendeley–Software for paper formatting like MS Office– Software for detection of Plagiarism.

Unit 4: Interpretation and Report writing **6Hrs**

Meaning of Interpretation – Techniques of Interpretation – Precautions in Interpretation – Significance of Report writing – Different steps in writing report – Layout of the research reports – Mechanics of Writing a research report

Unit 5: Research Ethics and Responsible Conduct in Research **5Hrs**

Brief history and analytical basis of research ethics– responsible conduct in research (Honesty in Science: Integrity, Authorship, Conflicts of Interest, Privacy and Confidentiality, Informed Consent, Risk/Benefit Assessment)–The legal regulation of research ethics in India (From UGC, MHRD and other governing agencies)– Regulatory requirements relevant to international

Research.

Text Book

S. No	Authors	Title of the Book	Publishers	Year & Edition
1	C R Kothari Gaurav Garg	Research Methodology-Methods and Techniques	New age International limited	2024, 4th Edn
2	Ranjith Kumar	Research Methodology-A step by step Guide for beginners	SAGE Publication India Pvt limited	2019, 5th Edn
3	P. Ramadass A. Wilson Aruni	Research & Writing	MJP Publisher	2022, 1st Edn

Reference Books

S. No	Authors	Title of the Book	Publishers	Year & Edition
1	Dr. Priti R. Majhi Dr. Prafull K. Khatua	Research Methodology (Concepts, Methods, Techniques & SPSS)	Himalaya Publishing house	2019, 2nd Edn
3	Role of the Ethics Committee: Helping To Address Value Conflicts or Uncertainties Author links open overlay panel Mark P. Aulisio, Robert M. Arnold			
4	Research Regulatory Compliance 1st Edition (Mark Suckow, Bill Yatese Book ISBN:9780124200654)			
5	Recent research ethics policy from Government of India.			

Pedagogy

Chalk and talk, PPT, Seminar, Group discussion, Interaction, Demonstration, Hands-on

Course Designers

1. Dr. A. Saravanapriya
2. Dr. P. Maheswari

Course Code	Course Title	Category	L	T	P	Credit
MPS24P3	ADVANCED PRACTICALS	Practical	-	-	5	4

Preamble

The aim of this course is to make the students have hands on training in doing experiments in Optics and Electricity and Magnetism.

Prerequisite

Experience in calibrating and handling instruments

Course Learning Outcomes

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

CLO Number	CO Statement	Knowldge Level
CLO 1	Understand the basics of experimental physics	K2
CLO 2	Explore the concepts involved in the thermodynamics, heat and modern optics	K3
CLO 3	Inculcate strong laboratory skills	K4
CLO 4	Enhance the present day requirements in industries, research fields.,	K5
CLO 5	Create the knowledge of theories involved in physics using practical experiments	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO 1	S	S	M	S	M	M	L
CLO 2	S	M	S	M	M	S	M
CLO 3	S	S	M	M	S	M	M
CLO 4	S	M	M	S	M	S	S
CLO 5	S	S	M	M	M	S	S

S- Strong; M-Medium; L-Low

ADVANCED PRACTICALS
(Examination at the end of Second Semester)
Any Twelve Experiments

1. AlO Band
2. (i) Identification of prominent lines – Fe arc
   (ii) Identification of prominent lines – Brass arc
3. Absorption spectrum-$KMnO_4$
4. Michelson Interferometer
5. Susceptibility of a given solid by Guoy method
6. Susceptibility of a given liquid by Quincke's Method
6. Compressibility of a Liquid-Ultrasonic Method
7. Variation of Hall Effect with temperature
8. Thickness of a film- Ellipsometer
9. Faraday effect Apparatus-Determination of Verdet's Constant
10. Diffraction of light by (i) Single slit (ii) Double slit (iii) Transmission grating
    (iv) Single wire (v) Cross wire (vi) Wire mesh
11. Determination of dielectric constant of a substance
12. Resistivity by Four-probe method and band gap of semiconductor
13. Kelvin's Double Bridge-Determination of Very Low Resistance & Temperature
    Coefficient of Resistance.
14. Analysis of X-ray diffraction pattern
15. Study of FTIR spectrum and TGA
16. Determination of Particle Size using (NPTA) Demo

Course Designers:

Dr. M. Lavanya

Course Code	Course Title	Category	L	T	P	Credit
MPS23P4	**SPECIAL ELECTRONICS**	Practical	-	-	5	4

Preamble

The aim of this course is to make the students practically learn the applications of the Op amp, IC 555 Timer and Microprocessors and to study the functioning of A/D Converters, D/A Converters and Microprocessor.

Prerequisite

Skill in constructing electronic circuits

Course Learning Outcomes

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

CLO Number	CO Statement	Knowledge Level
CLO 1	To make the student understand the basic concepts in IC's, digital devices and Microprocessor	K2
CLO 2	Various applications of electronic devices and circuit systems	K3
CLO 3	Inculcate strong laboratory skills	K4
CLO 4	Enhance the present day requirements in industries, research fields.	K5
CLO 5	To produce electronic professionals who can be directly employed or start his/her own work as Electronic circuit Designer	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO 1	S	S	M	S	M	S	M
CLO 2	S	M	S	M	M	S	M
CLO 3	S	S	M	M	S	M	M
CLO 4	S	M	S	M	S	M	M
CLO 5	S	M	S	M	M	S	M

S- Strong; M-Medium; L-Low

SPECIAL ELECTRONICS
(Examination at the end of Second Semester)

Any Twelve Experiments

1. Op-Amp: Simultaneous Addition & Subtraction
2. Op-Amp: Instrumentation Amplifier-Light Intensity-Inverse Square Law
3. Op-Amp: (i) V to I & I to V Converter
4. Op-Amp: Analog Computation-First Order Differential Equation
5. Op-Amp Comparator-Zero Crossing Detector, Window Detector, Time Marker
6. IC 555 Timer Application- Monostable & Astable multivibrator, voltage controlled oscillator
7. A/D Converters-Any One Method
8. D/A Converters-Binary Weighted & Ladder Methods
9. IC Counters with Feedback
10. Microprocessor: LED Interfacing
11. Microprocessor: Stepper Motor Interfacing
12. Microprocessor: ADC Interface-Wave Form Generation
13. Microcontroller: Blinking of LEDs either 8051 or 16F84
14. Microcontroller: Controlling LED with switch.
15. Microcontroller: DC motor control.
16. Microcontroller: triangle wave generator-Using 8085 Simulator
17. Write an assembly language program to perform
    (i) simple arithmetic operations – addition, subtraction, multiplication and division.
    (ii)increment and decrement
18. Write an assembly language program to arrange the given set of numbers in
(i) ascending and descending order
(ii) Maximum and minimum of numbers.
19. Write an assembly language program to perform (i) Binary to BCD conversion
(ii)BCD to Binary conversion.Op amp – Integrator, differentiator, Time marker

Books for Study &Reference :

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Dennis Roddy & John Coolen	Electronic Communication	PHI	1977, 4th Edn
2	George Kennedy	Electronic Communication systems	McGraw Hill Publications	2011, 5th Edn

Course Designers:

Dr.J.Balavijayalakshmi

PSGR Krishnammal College for Women

Affiliated to Bharathiar University \ Autonomous \ College of Excellence \ Accredited with A++ Grade \ Ranked 9th in NIRF

DEPARTMENT OF PHYSICS

CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK (LOCF)

MASTER OF SCIENCE - PHYSICS
2024-26 BATCH
SEMESTER – IV

PSGR Krishnammal College for Women

Affiliated to Bharathiar University \ Autonomous \ College of Excellence \ Accredited with A++ Grade \ Ranked 9th in NIRF

MASTER OF SCIENCE IN PHYSICS
CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK (LOCF)
SCHEME & SYLLABUS OF EXAMINATION
2024-2026 BATCH

Semester	Course Code	Title of the Course	Course Type	Instructions Hours/week	Contact Hours	Tutorial	Duration of exam	Examination marks			Credits
								CA	ESE	Total	
IV	MPS2310	Laser Physics	CC	4	58	2	3	25	75	100	3
	MPS2316	Nuclear and Particle Physics	CC	5	73	2	3	25	75	100	4
	MPS2417	Advanced Materials and Characterization	CC	5	73	2	3	25	75	100	5
	MPS16AC1/ MPS24AC2	Communication systems/ Analytical Physics	ACC	-	-	-	3	25	75	100	5*
	MPS23PROJ	Project and Viva Voce	DSE	16	240	-	-	25	75	100	5
I-IV	17MONL1	Online Course	ACC	-	-	-	-	-	-	-	-

SEMESTER - IV

CC – Core Courses **DSE – Discipline Specific Elective**
ESE – End Semester Examination **CA – Continuous Assessment**
ACC– Additional Credit Course

*** Credits Applicable to Candidates who take up Advanced Level Course Examination**

Examination System

Pattern:

Semester system will be followed. A semester consists of a minimum of 90 working days excluding the days of conduct of ESE. There will be Continuous Internal Assessment (CA) to evaluate the performance of students in each course and the End Semester Examination will be held at the end of every semester.

Weightage assigned to various components of Continuous Internal Assessment

Theory

CIA Test : 5 marks **(conducted for 45 marks after 50 days)**
Model Exam : 7 marks **(conducted for 75 marks after 85 days)**
Seminar/Assignment/Quiz : 5 marks
Class Participation : 5 marks
Attendance : 3 marks
Total : 25 Marks

Practical

Lab Performance : 7 marks
Regularity : 5 marks
Model Exam : 10 marks
Attendance : 3 marks
Total : 25 marks

CA Question Paper Pattern and distribution of marks - (First 3 Units)
Core and Elective Courses
CA Question from each unit comprising of
One question with a weightage of 2 Marks:2 x 3 = 6
One question with a weightage of 5 Marks (Internal Choice at the same CLO level): 5 x 3 =15
One question with a weightage of 8 Marks (Internal Choice at the same CLO level) :8 x 3 =24
Total :45 Marks

End Semester Examination – Question Paper Pattern and Distribution of Marks
Core and Elective Courses
ESE Question Paper Pattern: 5 x 15 = 75 Marks
Question from each unit comprising of

One question with a weightage of 2 Marks : 2 x 5=10
One question with a weightage of 5 Marks (Internal Choice at the same CLO level): 5 x 5 =25
One question with a weightage of 8 Marks (Internal Choice at the same CLO level): 8 x 5 =40

Research Methodology

Section A - 5 questions (Internal choice) :25 marks

Section B - 5 questions (Internal choice) :75 marks

Total : 100 Marks

Criteria for Attendance:

3 Marks (Attendance 75% - 80% - 1 Marks, 81% - 90% - 2 Marks, 91% - 100% - 3 Marks)

PSGR
Krishnammal College for Women KCW

Affiliated to Bharathiar University \ Autonomous \ College of Excellence \ Accredited with A++ Grade \ Ranked 9th in NIRF

APPROVED

MASTER OF SCIENCE IN PHYSICS
CHOICE BASED CREDIT SYSTEM (CBCS) &
LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK (LOCF)
SCHEME & SYLLABUS OF EXAMINATION
2024-2026 BATCH
SEMESTER - IV

Semester	Course Code	Title of the Course	Course Type	Instructions Hours/week	Contact Hours	Tutorial	Duration of Examination	Examination marks			Credits
								CA	ESE	Total	
IV	MPS2310	Laser Physics	CC	4	58	2	3	25	75	100	3
	MPS2316	Nuclear and Particle Physics	CC	5	73	2	3	25	75	100	4
	MPS2417	Advanced Materials and Characterization	CC	5	73	2	3	25	75	100	5
	MPS16AC1/ MPS24AC2	Communication systems/ Analytical Physics	ACC	-	-	-	3	25	75	100	5*
	MPS23PROJ	Project and Viva Voce	DSE	16	240	-	-	25	75	100	5
I-IV	17MONL1	Online Course	ACC	-	-	-	-	-	-	-	-

CC – Core Courses **DSE – Discipline Specific Elective**
ESE – End Semester Examination **CA – Continuous Assessment**
ACC– Additional Credit Course

*** Credits Applicable to Candidates who take up Advanced Level Course Examination**

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
MPS2310	LASER PHYSICS	THEORY	58	2	-	3

Preamble

The main objective of this course is to provide a wide knowledge about the Fundamentals of lasers, characteristics, types of laser beams and applications.

Prerequisite

- Basic knowledge of Optics, Electromagnetism and Quantum mechanics

Course Learning Outcomes

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

CLO Number	CLO Statement	Knowledge Level
CLO1	Understand and explain the principles and design considerations of various lasers, modes of their operation and areas of their application.	K2
CLO2	Apply skills in applying the basics of Gaussian beam and solve numericals using ABCD law.	K3
CLO3	Analyse laser devices, its characteristics at a quantitative level.	K4
CLO4	Evaluate problems at higher order levels.	K5
CLO5	Innovate and design new types of laser beams for commercial applications.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	M	M	S	S	M	M
CLO2	M	S	M	M	S	M	M
CLO3	M	S	M	M	S	M	M
CLO4	M	S	M	M	S	M	M
CLO5	S	S	S	S	S	S	M

S- Strong; M-Medium; L-Low

Syllabus

Unit –I **11 Hrs**

Lasers: Fundamentals and Types

Basic Construction and Principle of Lasing- *Einstein Relations and Gain Coefficient[1,2] - Creation of a Population Inversion*- Three-Level System - Four-Level System -Threshold Gain Coefficient for Lasing- Laser types-He-Ne Laser-CO_2 Laser- Nd:YAG Laser-Semiconductor Laser.

Unit – II **12 Hrs**

Laser Operation

Optical Resonator- **Laser Modes- Axial modes- Transverse modes[3,4]-** Modification in Basic Laser Structure- Basic Principle of Mode Locking- Active Mode Locking -Passive Mode Locking- Q Switching- Pulse Shaping-application of lasers in SMILE surgery

Unit – III **11 Hrs**

Laser Beam Characteristics

Introduction to Gaussian Beam**-width-Divergence-Radius of Curvature-Rayleigh Range-Guoy Phase[5]** –formulation of ABCD matrix method –ABCD matrix of some optical system-ABCD Law for Gaussian Beam-The Complex Radius of Curvature

Unit – IV **12 Hrs**

Focusing of laser beam

Diffraction- limited spot size-tight focusing of light angular spectrum representation of optical near field-aplanatic lens-Focusing of higher-order laser modes-Radially polarized doughnut mode-Azimuthally polarized doughnut mode-applications-applications-near field optical recording-**optical tweezers[6,7]- STED microscopy[8,9]**

Unit – V **12 Hrs**

Surface Plasmons

Introduction-Optical properties of noble metals- **Drude–Sommerfeld theory**- Surface Plasmon polaritons at plane interfaces- Properties of surface plasmon polaritons- Excitation of surface plasmon polaritons- **Surface plasmon sensors[10]**.

Text Book

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Dr. M.N. Avadhanulu Dr. P.S. Hemne	An Introduction to Lasers theory and applications	S. Chand	2013 and 2nd Edn
2	Subhash Chandra Singh, Haibo Zeng, Chunlei Guo and Weiping,Cai,	Nanomaterials: Processing and Characterization with Lasers	Wiley-VCH Verlag GmbH & Co. KGaA	2012 and 1st Edn
3	L. Novotny and B. Hecht	Principles of Nano optics	Cambridge University Press	2006 and 1st Edn

Reference Books

S. No	Authors	Title of the Book	Publishers	Year & Edition

1	Orazio Svelto	Principles of lasers	Springer	2008 and 4th Edn
2	Walter Koechner	Solid state Laser Engineering	Springer	2006 and 2nd Edn
3	B.B. Laud	Lasers and Nonlinear Optics	New Age International (P) Ltd	2011and 3rd Edn
4	Bahaa E. A. Saleh, Malvin Carl Teich	Fundamentals of Photonics	John Wiley & Sons, Inc.,	1995 and 1st Edn
5	R.G. Driggers, C. hoffman Marcel Dekker	Encyclopedia of Optical Engineering,	Springer	2003 and 2nd Edn
6	W.M. Steen, J. Mazumder	Laser Material Processing	Springer	2010 and 3rd Edn

References For E-Content

1.https://youtu.be/2Oswmij538Q
2.https://youtu.be/jRqkhRgooxA
3. https://youtu.be/PK4yFaGHSFc
4.https://youtu.be/A9_ythcyuGo
5.https://youtu.be/gJcN2VDBJxI
6.https://youtu.be/ByY3-EpryPM
7.https://youtu.be/MU4eOJw2sBQ
8.https://youtu.be/OLczG3zUULQ
9.https://youtu.be/13VXGX2yR3k
10.https://youtu.be/QeT73pfvWrQ
11.https://youtu.be/YyBGiZZSslY
12.https://youtu.be/kCE-BvHuFHU
13.https://youtu.be/sM-VI3alvAI
14.https://youtu.be/4eet-rjAHic
15.https://youtu.be/p0AOPJcnoBg

Pedagogy

Chalk and talk, PPT, Seminar, Group discussion, Interaction

Course Designers

1. Dr. M. Lavanya

2. Mrs. S. Subanya

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
MPS2316	NUCLEAR AND PARTICLE PHYSICS	THEORY	73	2	-	4

Preamble

The objective of introducing this paper is to provide an in-depth knowledge of nuclear structure, nuclear models, nuclear reactions and different elementary particles.

Prerequisite

- Basic idea on nuclear models, elementary particles

Course Learning Outcomes

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

CLO. Number	CLO Statement	Knowledge Level
CLO1.	Understand the concepts in nuclear and particle physics	K2
CLO2.	Applying conservation principles to determine the type of reaction taking place and the possible product outcome	K3
CLO3.	Analyze the properties of stable nucleus and explore different types of nuclear models	K4
CLO4.	Expand and evaluate the theoretical predictions for nuclear reactions.	K5
CLO5.	Acquire quantum mechanical reasoning in classification of particles in subatomic level.	K6

Mapping with Programme Learning Outcomes

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO1	S	L	M	L	M	L	M
CLO2	S	S	S	M	M	M	M
CLO3	S	L	S	S	S	L	M
CLO4	S	S	M	S	M	L	M
CLO5	S	M	S	M	S	L	M

S- Strong; M-Medium; L-Low

Syllabus

Unit I : Nuclear Disintegration Studies **15 Hrs**

Alpha Decay: **Properties of Alpha particles**[1] - velocity and energy of alpha particles- Geiger Nuttal Law – Gamow's theory of alpha decay.

Beta Decay: **Properties of Beta particles**[1]-Fermi theory of beta decay- **Curie plot**[3]- Forms of interaction and selection rules-electron capture

Gamma Transitions: **absorption of Gamma rays by matter**[2]- interaction of Gamma rays with matter – the measurement of Gamma ray energies- Dumond bent crystal spectrometer-internal conversion.

Unit II: Elements of Nuclear Structure and Systematics **15 Hrs**

Theories of Nuclear composition (Proton electron theory) –**Mass Spectroscopy[4]- Bainbridge and Jordan mass spectrograph[5]** – Nier's mass spectrometer – Deuteron – magnetic and quadrupole moment of deuteron – ground state of deuteron – excited state of deuteron – the **meson theory of nuclear forces – Yukawa potential[6].**

Unit III: Properties of Stable Nucleus and Nuclei Models **14 Hrs**

Semi-empirical mass formula – Nuclear models- **liquid drop model, Semi empirical mass formula[7]**, **Shell models[8,9]** – Magic numbers – Single particle method- **Collective model[8]**- magnetic moments and shell model- prediction of angular moments of nuclear grounds state.

Unit IV: Nuclear Reaction Studies **14 Hrs**

Conservation laws for nuclear reactions- Nuclear Energy – Reaction dynamics- Q equation- **Breit Wigner one level dispersion formula[10]**- Photonuclear reaction – fission process – cross sections – **Bohr Wheeler theory[11]**.

Unit V: Elementary Particles **15 Hrs**

Classification of elementary particles[12] – Fundamental interaction – Electromagnetic, strong , weak and gravitational interactions – Parameters of elementary particles – Conservation laws – **CPT theorem – Okubo mass formula for SU (3) symmetry[13]** – Quarks theory- Unification theory-**Standard Model[14]** - Higgs Bosons (Elementary ideas).

Text Book

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Pandya and Yadav	Nuclear and Partic Physics	B S Agarwaal	2010 and 3rd Edn
2	Tayal D.C	Nuclear Physics	Umesh Prakashan, Gujarat	2011and reprint
3	Arthur Beiser	Concepts of Modern Physics	McGraw hill Book Company	2012 and 3rd Edn
4	David Griffiths	Introduction to elementary particles	Prentice Hall	1999 and 2nd Edn

Reference Books

S. No	Authors	Title of the Book	Publishers	Year & Edition
1.	Bernard L. Cohen	Concepts of Nuclear Physics	Tata McGraw Hill	1978 and 1st ,Edn
2	Kenneth S. Krane	Introductory Nuclear Physics	John Wiley & Sons	1988 and 2nd,Edn
3	Sharma	Nuclear Physics	K. Nath & Co-Meerut 160	1992 and 2nd Edn

4	F. Reif	Statistical Physics	McGraw – Hill, Special Indian Edition	2008 and 2nd Edn

References For E-Content

1. https://www.youtube.com/watch?v=c9WfZJYUWv0
2. https://www.youtube.com/watch?v=u0L3vG9XSyw
3. https://www.youtube.com/watch?v=yjJr5WDUVzk
4. https://www.youtube.com/watch?v=SQucmCTpdgg
5. https://www.youtube.com/watch?v=FFoMoif_2bg
6. https://www.youtube.com/watch?v=_iUJdeRYw5M
7. https://www.youtube.com/watch?v=lYe_vWk0GN0
8. https://www.youtube.com/watch?v=2Tb5DSFPwkU
9. https://www.youtube.com/watch?v=2cb5xsKvvWk
10. https://www.youtube.com/watch?v=vcnbcPDBEKs
11. https://www.youtube.com/watch?v=CDR-U-e6bR4
12. https://www.youtube.com/watch?v=RYF1lZ2_0Ho

Pedagogy:

Chalk and talk, PPT, Seminar, Group discussion, Interaction

Course Designers:

1. Mrs.S.Subanya

COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	CREDITS
MPS2417	ADVANCED MATERIALS AND CHARACTERIZATION	THEORY	73	2	-	5

Preamble

This course aims to introduce students to advanced materials, their synthesis methods, and modern characterization techniques. It equips learners with the skills to analyze structural, optical, electrical, and thermal properties of materials, preparing them for research and applications in emerging technologies.

Prerequisite

- Basic Knowledge on Material Science and spectroscopy techniques

Course Learning Outcomes

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

CLO. Number	CLO Statement	Knowledge Level
CLO1.	Classify advanced materials and explain their structure–property relationships.	**K2**
CLO2.	Demonstrate knowledge of synthesis techniques for bulk and nanomaterials, including eco-friendly methods.	**K3**
CLO3.	Apply XRD and microscopic techniques (FESEM, AFM, HRTEM) for structural and morphological analysis.	**K4**
CLO4.	Interpret optical spectra (UV-Vis, PL, FTIR, Raman) for electronic and vibrational properties of materials.	**K5**
CLO5.	Analyze electrical, thermal, and transport properties of materials using advanced characterization methods.	**K6**

Mapping with Programme Learning Outcomes

COs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7
CLO 1	S	M	L	L	L	L	L
CLO 2	S	M	M	L	M	S	L
CLO 3	M	M	L	S	S	L	L
CLO 4	M	M	L	S	S	L	L
CLO 5	M	S	L	S	S	M	L

S- Strong; M-Medium; L-Low

Unit I – Introduction to Advanced Materials **15 Hrs**

Classification of Materials: Structural, Functional, Smart, Biomaterials, Nanomaterials[1] -**Metal Oxides** for semiconductors, photo catalysts and sensor applications-**Polymers**: Conducting polymers, polymer nanocomposites -**Carbon-based Materials**[2,3]: Graphene, fullerenes, carbon nanotubes (CNTs)- Metamaterials and 2D materials -**Nanostructured Materials**: Quantum dots, nanowires, nanocomposites, core–shell structures, hybrid nanomaterials –**Structual** Functionalization :Ligand attachment, polymer wrapping, metal/oxide coatings for tailored properties -Applications in ionic batteries ,drug delivery systems and biosensors)

Unit II –Material Synthesis **14 Hrs**

Solid-state reaction methods (perovskites, oxides) -Melt growth techniques (single crystals of oxides/semiconductors) - Hydrothermal and solvothermal synthesis , **Top-down approaches**[4,5]: Lithography, ball milling, laser ablation, **Bottom-up approaches**[6]: Sol–gel, Chemical Vapor Deposition, Molecular Beam Epitaxy (MBE), Atomic Layer Deposition (ALD), Plasma assisted synthesis, **Green Synthesis**[7,8]: Eco-friendly synthesis using plant extracts, microbes, enzymes – focus on oxides and metallic nanoparticles

Unit III – Structural and Microscopic Analysis **15 Hrs**

X-ray Diffraction (XRD)[9,10]: Powder XRD, Debye–Scherrer method, indexing, particle size (Scherrer equation), lattice constants, shape defects, microstrain, single-crystal diffraction

Microscopic Analysis : Field Emission Scanning Electron Microscope (FESEM)[11,12] - EDAX analysis - Atomic Force Microscopy (AFM) and High Resolution Transmission Electron Microscopy (HRTEM)[13,14]**- [Experimental setup, Principle and working only].**

Unit IV – Spectroscopic Techniques **14 Hrs**

UV–Vis Spectroscopy[15]: Band gap calculation, **Photoluminescence**, electroluminescence **FTIR Spectroscopy**: Vibrational modes, instrumentation, spectral characterization - X-ray Photoelectron Spectroscopy (XPS), **Raman Spectroscopy**[16] **[Working Principle, Experimental setup and Spectral Analysis only].**

Unit V – Electrical and Thermal Analysis **15 Hrs**

Electrical Analysis: DC & AC conductivity, I–V characteristics, four-probe method, Hall effect measurements--**Thermal Analysis**: Thermogravimetric Analysis (TGA) [17]-Differential Thermal Analysis (DTA)[18]**-Differential Scanning Calorimetry (DSC)**[19,20]**:** Instrumentation, specific heat capacity **[Experimental setup, Working Principle, Analysis and Applications only].**

Text Book

S.No	Authors	Title of the Book	Publishers	Year & Edition
1.	C. Kittel	Introduction to Solid State Physics	Wiley	2005 and 8th Edn
2.	T. Pradeep	A Textbook of Nanoscience and Nanotechnology	Tata McGraw Hill	2012 and 3rd Edn
3.	Sulabha K. Kulkarni	Nanotechnology Principles and Practices	Capital Publishing Company	2011 2nd Edn
4.	Mick Wilson	Nanotechnology	Basic Science and Emerging Technologies	2008 and 1stEdn (Reprinted)
5.	B.D. Cullity & S.R. Stock	Elements of X-Ray Diffraction	Pearson	2014 and 3rd Edn.
6.	C.N. Banwell & E.M. McCash	Fundamentals of Molecular Spectroscopy	McGraw Hill	2017 and 4th Edn.
7.	R.S. Khandpur	Hand book of Analytical Instruments	Tata McGraw Hill	2006 and 2nd Edn
8.	William Merritt Dean Settle	Instrumental Methods and Analysis	CBS Publishers & Distributors Pvt Ltd	2005 and 7th Edn

Reference Books

S.No	Authors	Title of the Book	Publishers	Year & Edition
1.	G.A. Ozin & A.C. Arsenault	Nanochemistry: A Chemical Approach to Nanomaterials	RSC Publishing	2005 and 8th Edn
2.	C.N.R. Rao, A. Müller & A.K. Cheetham	The Chemistry of Nanomaterials: Synthesis, Properties and Applications	Wiley-VCH	2004 and 8th Edn
3.	K.K. Chattopadhyay & A.N. Banerjee	Introduction to Nanoscience and Nanotechnology	PHI Learning	2009 and 5th Edn
4.	S. S. Shukla & R. S. Dubey	Introduction to Green Nanotechnology	Cambridge University Press	2017 and 9th Edn.
5.	D. Williams & C.B. Carter,	Transmission Electron Microscopy: A Textbook for Materials Science	Springer,	2009 and 3rd Edn.
6.	D.A. Skoog, D.M. West, F.J. Holler & S.R. Crouch	Fundamentals of Analytical Chemistry	Cengage	2014 and 9th Edn.
7.	D. Wendlandt,	Thermal Methods of Analysis	Wiley	1986 and 2nd Edn
8.	Y. Leng,	Characterization: Introduction to Microscopic and Spectroscopic Methods	Wiley-VCH	2013 and 2nd Edn

Reference for E-content

1. https://www.youtube.com/watch?v=XBwhTF87DAc
2. https://www.youtube.com/watch?v=9Kqi9_v3A7Y
3. https://www.youtube.com/watch?v=OjBudmbTqI4
4. https://www.youtube.com/watch?v=YhuUFLzJSsg
5. https://www.youtube.com/watch?v=5yGWFw-w7jA
6. https://www.youtube.com/watch?v=q5qfK-Sx-fo
7. https://www.youtube.com/watch?v=iUNU16kqCWw
8. https://www.youtube.com/watch?v=ERTV2wgDkYk
9. https://www.youtube.com/watch?v=dJMXrW28djs

10. https://www.youtube.com/watch?v=Qv1JTNPIPcU
11. https://www.youtube.com/watch?v=xSe40Nr8qPk
12. https://www.youtube.com/watch?v=YvMn4fmDUaA
13. https://www.youtube.com/watch?v=xKW81LSPZK0
14. https://www.youtube.com/watch?v=YgiugW6SoMM
15. https://www.youtube.com/watch?v=Mig9b5hra-k
16. https://www.youtube.com/watch?v=AVDWcbZUzO8
17. https://www.youtube.com/watch?v=xkQ3qXIaNWU
18. https://www.youtube.com/watch?v=7MEhvE_9ep0
19. https://www.youtube.com/watch?v=KIw7zIVbmhM
20. https://www.youtube.com/watch?v=q52bE4fBTJI

Pedagogy

Chalk and talk, PPT, Seminar, Group discussion, Interaction

Course Designers:

1. Dr J Balavijayalakshmi
2. Mrs.D Niveditha

ADVANCED LEARNER'S COURSE

COMMUNICATION SYSTEMS

Subject Code: MPS16AC1

Credits: 5

Objective:

The aim of this course is to acquire knowledge about different modulations and various communication systems.

Unit I: **Amplitude Modulation**

Introduction-Amplitude modulation- Amplitude modulation index-Modulation index for sinusoidal AM-Frequency spectrum for sinusoidal AM-Average power for sinusoidal AM-Effective voltage and current for sinusoidal AM – Double sideband suppressed carrier(DSBSC) modulation- Amplitude modulator circuits- Amplitude demodulator circuits. Single sideband principles- Balanced modulators- SSB generation-SSB reception- Modified SSB systems- Signal to noise ratio for SSB - Companded SSB.

Unit II: Angle Modulation

Introduction – Frequency modulation – Sinusoidal FM- Frequency spectrum for sinusoidal FM-Average power for sinusoidal FM- Modulation index for sinusoidal FM- Phase modulation- Equivalence between PM and FM – Sinusoidal PM- Digital PM- Angle modulator circuits- FM Transmitters- Angle modulation detectors.

Unit III: **Pulse and Digital Modulation**

Pulse amplitude modulation (PAM)- Pulse code modulation(PCM)- Pulse frequency modulation(PFM)- Pulse time modulation (PTM)- Pulse position modulation (PPM)-Pulse width modulation(PWM)

Digital communication- Introduction- Synchronization -Asynchronous transmission-Probability of Bit error in baseband transmission –Digital carrier systems.

Unit IV:**Satellite and Fibre Optic Communications**

Kepler's first law- Kepler's second law- Orbits- Geostationary orbits- Power systems-Altitude control- Satellite station keeping- Antenna look angles- Limits of visibility-Frequency plans and polarization- Transponders –Multiple access methods.

Fibre optic communications introduction-Light sources for fibre optics- Photodetectors-Connectors and Splices- Fibre optic communication link.

Unit V: Antennas And Microwave Tubes

Basic considerations – Wire radiators in space- Terms and definitions- Effects of ground on antennas- antenna coupling at medium frequencies- Directional high frequency antennas-Microwave antennas- Wideband and special- purpose antennas. Multicavity Klytstron- Reflex Klystron- Magnetron- Travelling-wave tube.

Text Book

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Dennis Roddy & John Coolen	Electronic Communication	PHI	1977 and 4th Edn
2	George Kennedy	Electronic Communication systems	McGraw Hill Publications	2011 and 5th Edn

ADVANCED LEARNER'S COURSE (ALC)

ANALYTICAL PHYSICS

Subject Code: MPS24AC2

Credits: 5

Objectives:

The objective is to prepare students for competitive examinations, promote critical thinking, and support their progression into research and higher education roles.

Unit I

Linear algebra: Vector spaces-basis-linear independence- eigenvalues & eigenvectors-diagonalization- trace- determinant- rank- Pauli matrices.

Complex Analysis

Analytic functions, Cauchy–Riemann conditions, Cauchy integral theorem & formula, Taylor & Laurent series, Residues & residue theorem

Unit II

Differential Equations (ODEs & PDEs): First-order & second-order ODEs Sturm–Liouville's theory (orthogonality of Eigen functions)**,** PDEs: separation of variables -Heat equation-Wave equation-Laplace equation

Special Functions: Legendre polynomials- Spherical harmonics- Bessel functions-Hermite polynomials- Laguerre polynomials.

Unit III

Schrödinger Equation & 1D Potentials: Particle in a box - Step potential & barrier penetration -Finite potential well- Harmonic oscillator (energy spectrum, wave functions, Hermite polynomials).

Angular Momentum & Spin: L2, Lz commutation relations- ladder operators- Spin-½ - Pauli matrices - Addition of angular momenta- Clebsch–Gordan coefficients.

Unit IV

Uncertainty Principle & Operators: Commutators- Canonical conjugates- Ehrenfest's theorem

Hydrogen Atom

Radial equation- Quantum numbers- degeneracy- Selection rules for transitions

Approximation Methods

Time-independent perturbation theory -Time-dependent perturbation theory- transition probabilities- Fermi's Golden Rule- Variational method- WKB approximation.

Unit V

Nuclear Forces and Reactions: Nature of nuclear force-Nucleon-nucleon interaction- Types of nuclear reactions- Nuclear fission and fusion

Radioactivity and Weak Interaction: Alpha, beta, and gamma decay- Selection rules for decays-Parity violation in weak interaction-Symmetries: Charge (C), Parity (P), Time reversal (T).

Particle Physics and Quantum Numbers: Quark model and particle types (baryons, mesons)-Quantum numbers: spin, charge, isospin, strangeness, Gellmann-Nishijima formula-Classification of fundamental forces.

*** 3 Years GATE Question papers (For Examination)**

Text Books

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	Dr. Surekha Tomar	CSIR NET/SET Physical Sciences	UPKAR's	2024 and 6th Edn
2	W.Melemnganba Chenglei	UGC CSIR NET/SET Physical Sciences	Arihant Publications Ltd	2024 and 5th Edn

Reference Books

S.No	Authors	Title of the Book	Publishers	Year & Edition
1	K. F. Riley, M. P. Hobson, and S. J. Bence	Mathematical Methods for Physics and Engineering: A Comprehensive Guide	Cambridge University Press	2006 and 3rd Edn
2	Nouredine Zettili	Quantum Mechanics: Concepts and Applications	John Wiley & Sons	2022 and 3rd Edn
3	Arthur Beiser	Concepts of Modern Physics	McGraw-Hill / Tata McGraw-Hill Higher Education	2009 and 6th Edn

Course Designers:

1.Dr.P.Maheswari

2.Dr.A.Saravanapriya