

M.Sc. PHYSICS

Curriculum and Syllabi

2026

DEPARTMENT OF PHYSICS,
AMRITA SCHOOL OF PHYSICAL SCIENCES,
AMRITA VISHWA VIDYAPEETHAM, COIMBATORE, TAMIL NADU
FEBRUARY 2026

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1: Students will demonstrate knowledge of core Physics subjects including mathematical physics, quantum mechanics, electrodynamics, statistical physics, and be able to apply this knowledge to analyze a variety of physical phenomena and related subjects.

PSO 2: Students will acquire experimental skills which enable them to take precise measurements in physics labs and analyze the measurements to draw valid conclusions. In addition, students will exhibit skills in solving problems numerically using computer programming, plotting tools, and related software.

PSO 3: Students will show enhanced oral and written scientific communication skills, trained to confidently face a board of examiners and be able to think critically and work independently as well as in a team and play beneficial role in the society as a person with better scientific outlook.

PROGRAMME OUTCOMES (POs)

1. To inculcate strong science fundamentals with emphasis on Physics & Mathematics.
2. To equip the students in analytical and critical thinking to analyze and find solutions to scientific problems.
3. To prepare students to undertake complex problems and to design and develop solutions which enhance the existing scientific knowledge.
4. To expose the students to research and scientific presentation to an audience and thereby instill confidence to take up high standards of research and scientific communication.
5. To synergize the human values and scientific temper and thereby find solutions which will contribute to peace and prosperity to the entire nation and humanity.

CURRICULUM / Course Layout

SEMESTER I

Code	Course Title	L T P	Cr
26PHY501	Classical Mechanics	3 1 0	4
26PHY502	Quantum Mechanics I	3 1 0	4
26PHY503	Mathematical Physics I	3 1 0	4
26PHY504	Computational Physics	3 1 0	4
26PHY581	Advanced Physics Lab	0 0 3	1
22ADM501	Cultural Education	2 0 1	P/F
26PHY582	Simulation Lab	0 0 3	1
26CDS601	Career Development Skills I	0 0 3	P/F
Total Credits		**18**	

SEMESTER II

Code	Course Title	L T P	Cr
26PHY511	Quantum Mechanics II	3 1 0	4
26PHY512	Mathematical Physics II	3 1 0	4
26PHY513	Statistical Mechanics	3 1 0	4
26PHY514	Advanced Electrodynamics	3 1 0	4
26PHY515	Experimental Techniques	3 1 0	4
26PHY583	Advanced Electronics Lab	0 0 3	1
	Amrita Value Program	1 0 0	1
26CUL500	Integrated Amrita Meditation Technique	0-0-2	1
26CDS611	Career Development Skills II	0 0 3	1
Total Credits		**24**	

SEMESTER III

Code	Course Title	L T P	Cr
26PHY601	Atomic, Molecular and Optical Physics	3 1 0	4
26PHY602	Condensed Matter Physics	3 1 0	4
26PHY603	Nuclear and Particle Physics	3 1 0	4
26PHY604	Optics	3 1 0	4
26PHY681	Spectroscopy Lab	0 0 3	1
	Elective	3 0 0	3
26PHY696	Mini Project	0 0 3	1
Total Credits		**21**	

SEMESTER IV

Code	Course Title	L T P	Cr
26PHY698 / 26PHY699	Major Project/ Dissertation		18
26PHY697	Viva Voce	-	02
Total Credits		**20**	
TOTAL Credits for M.Sc. Physics		**83**	

List of Elective courses 26PHYXXX (LTP :: 3 0 0 = 3 credits)

26PHY631	Astronomy and Astrophysics	3 0 0 3
26PHY632	Introduction to Radiation Physics	3 0 0 3
26PHY633	Physics of Semiconductors	3 0 0 3
26PHY634	Physics of Nanomaterials	3 0 0 3
26PHY635	Nonlinear Dynamics	3 0 0 3
26PHY636	Advanced Classical Dynamics	3 0 0 3
26PHY637	Electrochemical Energy Storage Systems	3 0 0 3
26PHY638	Sustainable Physics: Principles and Applications	3 0 0 3
26PHY639	Compact Stars	3 0 0 3
26PHY640	Nanostructures: Theory and Applications	3 0 0 3
26PHY641	Thermodynamics of materials	3 0 0 3
26PHY642	Optoelectronics	3 0 0 3
26PHY643	Advanced Solar Cell Fabrication	3 0 0 3
26PHY644	Introduction to General Theory of Relativity	3 0 0 3
26PHY645	Physics of Radiation Therapy	3 0 0 3
26PHY646	X-Ray & Electron Diffraction Techniques	3 0 0 3
26PHY647	Micro and Nano Magnetism Materials and its Applications	3 0 0 3

Table 2 New names for Amrita Value Programmes for PG programmes			
Course Code	Title	L-T-P	Credits
22ADM502	Vedanta in day-to-day life	1-0-0	1
22AVP506	Message of Swami Vivekananda	1-0-0	1
22AVP508	Indian Arts and Literature	1-0-0	1
22AVP510	Appreciation of Kerala Mural Arts Forms	1-0-0	1
22AVP501	Message of Śrī Mātā Amritanandamayi Devi	1-0-0	1
22AVP502	Insights from the Ramayana	1-0-0	1
22AVP503	Insights from the Mahabharata	1-0-0	1
22AVP504	Insights from the Upanishads	1-0-0	1
22AVP505	Insights from Bhagavad Gita	1-0-0	1
22AVP512	Ancient Indian Science and Technology	1-0-0	1
22AVP507	Great Spiritual Teachers of India	1-0-0	1
22AVP509	Yoga and Meditation	1-0-0	1

26PHY501 Classical Mechanics 3 1 0 4

Course Outcomes:

Col Understand the basic conservation laws in physics and the concept of phase portrait
CO2 Understand and apply the Lagrangian formalism to simple dynamical systems
CO3 Apply Hamilton's equations and solve dynamical systems
CO4 Apply the properties of Poisson's bracket and canonical transformations for solving simple systems
CO5 Apply the theory of Rigid body dynamics and analyze the motion of rigid bodies
CO6 Apply small oscillation theory developed in getting the frequencies of different of modes of oscillations in a coupled systems

UNIT 1

Constrained Motion: Constraints, Classification of Constraints, Principal of Virtual Work, D'Alembert's principal and its applications.

UNIT 2

Lagrangian formulation: Generalized coordinates, Langrange's equations of motion, properties of kinetic energy function, theorem on total energy, generalized momenta, cyclic-coordinates, integrals of motion, Jacobi integrals and energy conservation, Concept of symmetry, invariance under Galilean transformation, velocity dependent potential.

UNIT 3

Hamilton's formulation: Hamilton's function and Hamilton's equation of motion, configuration space, phase space and state space, Lagrangian and Hamiltonian of relativistic particles and light rays.

UNIT 4

Canonical Transformations: Generating function, Conditions for canonical transformation and problem. **Poisson Brackets:** Definition, Identities, Poisson theorem, Jacobi-Poisson theorem, Jacobi identity,(Statement only), invariance of PB under canonical transformation.

UNIT 5

Central Force **Problem:**

Kepler's laws, Orbital Dynamics, Stability

Rotational Motion:
Rotating frames of reference, inertial forces in rotating frames, Larmour precision, electromagnetic analogy of inertial forces, effects of Coriolis force, Focoult's pendulum.

Text Books:

H. Goldstein, Classical Mechanics, Addison — Wesly, 2E, 1980.

Reference Books:

1. Landau and Lifshitz, Mechanics, Butterworth-Heinemann, 3, 1976
2. S T Thornton and J B Marion, Classical Dynamics of Particles and Systems, Brooks Cole, lE, 2009
3. Walter Greiner, Classical Mechanics: Systems of Particle and Hamiltonian Dynamics, Springer — Verlag, lE, 2004

26PHY502 Quantum Mechanics I 3 1 0 4

Objective

The course emphasize the students to familiarize the mathematical background (Hilbert space) required to understand the basic and applied quantum mechanics. The course further emphasize the students to understand the basic postulate and standard one dimensional problems of quantum mechanics. As outcome of the course, the students is expected to solve physical problems in few selected topics like quantum angular momentum, one and two body problems etc,.

Course Outcomes

Col Understand and familiarize the mathematical background (Hilbert space) in which the basic and applied quantum mechanics are framed.
CO2 Apply the various postulates of quantum mechanics to one and three dimensional problems.
CO3 Understand the basic concepts of angular momentum and improve problem solving Skills

UNIT 1:
Mathematical Introduction
Linear Vector Spaces : Basics, Inner Product Spaces , Dual Spaces and the Dirac

Notation, Subspaces, Linear Operators, Matrix Elements of Linear Operators, Active and Passive Transformations, The Eigenvalue Problem, Functions of Operators and Related Concepts, Generalization to Infinite Dimensions.

UNIT 2:

Review **of Classical Mechanics**
The Principle of Least Action and Lagrangian Mechanics, The Electromagnetic Lagrangian, The Two- Body Problem, The Hamiltonian Formalism, The Electromagnetic Force in the Hamiltonian Scheme, Cyclic Coordinates, Poisson Brackets, and Canonical Transformations, Symmetries and Their Consequences

The Postulates of Quantum Mechanics
The Postulates, Discussion of Postulates I-III, The Schrödinger Equation, The Free Particle, The Particle in a Box, The Continuity Equation for Probability, The Single-Step Potential, The Double-Slit Experiment, Absence of degeneracy in one dimensional bound states, Ehrenfest's theorem.

UNIT 3:

The Harmonic Oscillator
Review of the Classical Oscillator, Quantization of the Oscillator (Coordinate Basis), The Oscillator in the Energy Basis, Passage from the Energy Basis to the X Basis. Derivation of the Uncertainty Relations. (2 hours)

UNIT 4:

Systems with N Degrees of Freedom N- Particles in One Dimension, More Particles in More Dimensions, Identical Particle Symmetries and Their Consequences: Overview, Translational Invariance in Quantum Theory, Time Translational Invarianc e, Parity Invariance, Time-Reversal Symmetry

UNIT 5:
Rotational Invariance and Angular Momentum
Translations in Two Dimensions, Rotations in Two Dimensions, The Eigenvalue Problem of Angular Momentum in Three Dimensions, The Eigenvalue Problem of L^2 and L_z- Solution of Rotationally Invariant Problems
The Hydrogen Atom
The Eigenvalue Problem, The Degeneracy of the Hydrogen Spectrum, Numerical Estimates and Comparison with Experiment, Multi electron Atoms and the Periodic Table.

Text Books:

1. R Shankar, Principles of Quantum Mechanics, Pearson Índia (LPE), 2" Ed., 2005.

2. JJ Sakurai, Modern Quantum Mechanics, Pearson, l“
Ed., 1994. Referene Books:

- S Gasiorowicsz, Quantum Physics, Wiley India, 2E
- L I Schiff, Quantum Mechanics, TMH, 3E, 2010.
- David Griffiths, Introduction to Quantum Mechanics, Pearson India (LPE), 2E, 2005.

26PHY503 MATHEMATICAL PHYSICS I 3 1 0 4

Course Objectives: The purpose of the course is to introduce students to the methods of mathematical physics and to develop required mathematical skills to solve advanced problems in theoretical physics.

Course Outcomes

After completing the course, the student should be able to:

CO 1. Understand mathematical methods used in various advanced physics courses and apply the techniques in solving problems involved

CO 2. Understand the theory of vector calculus in orthogonal and general curvilinear coordinates and apply it to solve physically relevant problems

CO 3. Perform basic operations with tensors in algebra and calculus; formulate and express physical laws in terms of tensors, and simplify it by the use of coordinate transforms

CO4. Understand the properties of Dirac delta function, various special functions, Fourier series and integral transforms and application of the same in solving integrals and differential equations

UNIT 1: VECTOR CALCULUS

Coordinate transformations, Definition of vectors, Index notation, Cartesian Tensors, Kronecker delta, Levi-Civita tensor and its application in Vector algebra and calculus. The vector differential operators, Integrals of vectors, Integral forms of gradient, divergence and curl, Line, surface and volume integrals – Stoke’s, Gauss’s and Green’s theorem.

UNIT 2: CURVILINEAR COORDINATES:

Cartesian, spherical and cylindrical coordinates. General curvilinear coordinates, Coordinate curves, Scale factors, Unit vectors in curvilinear systems, Arc length, area elements, volume elements. Gradient, diver-gence, curl and Laplacian. Special orthogonal coordinate systems: Parabolic and cylindrical coordinates, Pa-raboloidal coordinates, Elliptic cylindrical coordinates and applications.

UNIT 3: TENSOR ANALYSIS

Definition and basic properties of tensors. Covariant, contravariant and mixed tensors. The summation con-vention, Fundamental operations with tensors. The line element and metric tensor. Tensor algebra, Christof-fel symbols and their transformation laws, Covariant differentiation. Tensor form of gradient, divergence and curl. Geodesic equation, Curvature tensors.

UNIT 4: DIRAC DELTA & GENERALISED FUNCTIONS, FOURIER SERIES & INTEGRAL TRANSFORMS

Introduction to Generalised functions, delta sequences. One dimensional Dirac delta function, properties and representations, higher dimensional Dirac delta function. Dirac Delta function in curvilinear coordinates. Heaviside unit step function. Applications and properties of Fourier series and its Complex form, Fourier representation of Dirac Delta. Integral transforms and properties, Parseval's theorem, Convolution theorem, applications. Green's function

UNIT 5: SPECIAL FUNCTIONS

Gamma, Beta and Error functions – definitions, properties and applications. Orthogonal functions, Bessel's equation, General solution for non-integer ν; general solution for integer ν; Bessel function of first kind and second, properties of Bessel functions, Integral representations. Recurrence Relation, Orthogonality, Ro-drigues Formula. Modified Bessel functions, Henkel functions. Equations transformed into Bessel's equa-tion. Other special functions: Legendre, Hermite, Laugerre functions-Recurrence relations and generating functions-. Applications.

Text Books:

1. Riley K F, Hobson M P, Bence S J, Mathematical Methods for Physics and Engineering, CUP, 3rd Ed, 2010
2. Arfken & Weber, Mathematical Methods for Physicists, Elsevier Indian Reprint, 7th Ed., 2012.

Reference Books:

1. M Boas, Mathematical Methods in Physical Sciences, Wiley Indian Reprint 3rd Ed, 2006.
2. Mathews J and Walker R L, Mathematical Methods of Physics, Pearson India, 2nd Ed, 2004.
3. C. W. Wong, Introduction to Mathematical Physics: Methods & Concepts, Oxford,.

26PHY504 COMPUTATIONAL PHYSICS 3 1 0 4

Course outcomes:

CO01: At the end of the course, students will be able to analyze different types of numerical errors, apply error propagation formulae, and evaluate the limitations of floating-point arithmetic in computational problems.

CO02: At the end of the course, students will be able to apply interpolation techniques and numerical differentiation methods to estimate functional values and derivatives from tabulated data.

CO03: At the end of the course, students will be able to implement numerical integration techniques to approximate definite and multiple integrals and assess their accuracy.

CO04: At the end of the course, students will be able to solve systems of linear equations, perform matrix inversion, and compute eigenvalues and eigenvectors using numerical methods.

CO05: At the end of the course, students will be able to solve ordinary and partial differential equations numerically and interpret their physical significance in scientific applications.

Unit I:

Computer Arithematic: Error Computation, Rounding off error, Truncation error, General

Formulae for errors, Floating point Arithematic and errors , Normalized floating point, Over flow and under flow, Error in series approximation, Numerical instability.

Unit II:

Interpolation: Equal Intervals: Finite difference calculus, Newton Gregory forward and backward interpolation formulae, Central difference interpolation, Stirling's interpolation, unequal interpolation: Divided difference, Lagrange's interpolation, Hermite's interpolation.

Numerical Differentiation: Derivatives using Newtons and Stirling's Formula, Maxima and minima of tabulated function.

Unit III

Numerical Integration: Quadrature for equally spaced arguments: Trapezoidal , Simpson's Weddle's rule and Romberg's method, Gauss Quadrature and Chebyshev's Formulae. Double integrals

Unit IV

Matrix Inversion: Triangularization method, Crout's method, Choleski's method, Inversion of complex matrices

Eigen values and Eigen Vectors: Power method, Inverse power method, Given's Method, House Holder's Method

Unit V

Ordinary Differential Equation: Initial Value problem : Runge-Kutta method , Simultaneous equations, Solution of second order equation

Partial Differential Equation : Elliptical: Laplace Parabolic: Heat and Hyperbolic: Wave equations equation

Text book:

Numerical Methods for Engineers, Steve Chapra and Canale, Mc Graw Hill, 6th edition**.**

26PHY581 Advanced Physics Lab 0 0 3 1

Course Outcomes:

At the end of this course, students should be able

CO l To gain expertise in the usage of instruments and improve their skills pertaining to it.

CO2 To gain expertise in the methods of error analysis and familiarize them to report their result with more precision.

CO3 To comprehend the theoretical concepts by doing the corresponding experiments.

CO4 To develop various skills such as observation, analysis, pictorial representation of the data

etc.

CO5 To verify or reproduce the concepts and results learnt in theory by experiments.

1. Mass susceptibility of paramagnetic Liquid substance by Quinkes's method
2. Studying the Hall Effect parameters
3. Elastics Constants — Elliptical and Hyperbolic Fringes
4. Verification of Bohr's theory Franck — Hertz Experiment.
5. Stefan's constant — Black body radiation
6. Van der Pauw method or Four Probe Method — Measurement of resistivity and Hall Coefficient of Thin Film
7. Electron charge by Millikan oil drop method.
8. Current-Voltage characteristics of dc glow discharge
9. Calibration of a vacuum gauge (Pirani) with the aid of McLeod gauge.

26PHY582 SIMULATION LAB 0 0 3 1

Course Outcomes

At the end of the course students will be able to

COl Apply numerical methods to solve problems related to mechanics, wave and optics

CO2 Analyze numerical data and their physical meaning

CO3 Plotting data using various graphic tools

(1) Motion of a Body Falling in Viscous Medium

(2) Motion of One-Dimensional Simple Harmonic Oscillator

(3) Motion of a Projectile Thrown Horizontally

(4) Motion of a Satellite

(5) Construction of Standing Wave

(6) Formation of Square Wave

(7) Dispersion of Light Wave

(8) Polarization of Light Waves

26PHY511 QUANTUM MECHANICS II 3 1 0 4

Course Outcomes

After completion of the course student should be able to:

COl Understand different aspects of the angular momentum, spin algebra and solve Problems related to angular momentum.

CO2 Apply the main approximation methods for stationary and time-dependent quantum mechanical problems.

CO3 Understand scattering theory and solve problems related to scattering.

UNIT 1:

Spin

Introduction, Nature of Spin, Kinematics of Spin, Spin Dynamics, Return of Orbital Degrees of Freedom.

UNIT 2:

Addition of Angular Momenta

Example, The General Problem, Irreducible Tensor Operators, Explanation of Some accidental Degeneracies.

Variational and WKB Methods

The Variational Method, TheWentzel-Kramers-Brillouin Method.

UNIT 3:

Time-Independent **Perturbation** Theory: The Formalism, Some Examples, Degenerate Perturbation Theory Time-Dependent **Perturbation** Theory, First-Order Perturbation Theory, Higher Orders in Perturbation Theory, A General Discussion of Electromagnetic Interactions, Interaction of Atoms with Electromagnetic Radiation.

UNIT 4:

Scattering Theory

Introduction, Recapitulation of One-Dimensional Scattering and Overview, The Born Approximation (Time-Dependent Description), Born Again (The Time-Independent Approximation). The Partial Wave Expansion, Two-Particle Scattering.

UNIT 5:

The Dirac **Equation**
The Free-Particle Dirac Equation, Electromagnetic Interaction of the Dirac Particle, More on Relativistic Quantum Mechanics.

TEXT BOOKS:

1. *R Shankar, Principles of Quantum Mechanics, Pearson Índia (LPE), 2E 2005*
2. *JJ Sakurai, Modern Quantum Mechanics, Pearson, lE, 1994*

REFERENCE BOOKS:

1. *S Gasiorowicsz, Quantum Physics, Wiley India, 2E*
2. *L I Schiff, Quantum Mechanics, TMH, 3E, 2010*
3. *David Griffiths, Introduction to Quantum Mechanics, Pearson India (LPE), 2E, 2005*

26PHY512 MATHEMATICAL PHYSICS II 3 1 0 4

Course Outcomes
After completing the course, the student should be able to

CO1. Understand mathematical methods used in various advanced physics courses and apply the techniques in solving problems involved
CO2. Understand the theory of complex functions, with conditions, theorems related to Complex differentiation and Integration and apply them in solving various types of real and complex integrals
CO3. Analyse and solve second order ordinary differential equations using Series solution method etc.
CO4. Sturm-Liouville Problem and Green's functions and its usage in Physics, solutions of differential equations in rectilinear and curved coordinates with special importance to PDEs of physically relevant systems; introduction to group theory.

UNIT 1: Complex Variables I
Complex numbers, Roots, Functions of a complex variable, Differentiation of a complex function, Cauchy-Riemann conditions, Analytic functions, Harmonic functions, Special Analytical functions, Multivalued functions and branch cuts, Singularities, and zeros of complex functions

UNIT 2: Complex Variables - II
Complex integrals, Contour integrals, Darboux inequality, Cauchy's theorem, Cauchy's integral formula, Derivatives of analytic functions, Taylor and Laurent series, Uniqueness and Convergence. Poles, Residues at Poles, Residue Theorem, Evaluation of integrals using the Residue Theorem, Jordan's lemma, Application of Residue Theorem. Applications of Complex variables.

UNIT 3: Ordinary Differential Equations (ODE) - Series Solution
Basics of series and first order ODE, Second-order linear ordinary differential equations, Ordinary and singular points, Series solution: Frobenius Method, second solution, the Wronskian method, the derivative method, series form of the second solution, Polynomial solution, Solutions of Legendre, Bessel equations etc. and properties.

UNIT 4: Partial differential equations
Partial differential equations (PDEs) in Physics: Laplace, Poisson, Helmholtz equations, treatment in curvilinear coordinates. Other PDEs of Mathematical Physics: diffusion and wave equations, Separation of variables and other methods, Applications.

UNIT 5: Sturm-Liouville theory
Learning Objectives

Study of Sturn-Lioville problem and its use in theoretical physics, Green's function techniques and familiarity with basics of group theory.

Sturm-Liouville Problem and its usage in Physics, Problems with Cylindrical symmetry: Bessel functions, Problems with Spherical Symmetry- Spherical Harmonics, Classical Orthogonal Polynomials.
Introduction to Green's function: Introduction to Green's function, Properties, Green's function in one-dimension, Application in differential equations, Eigen function expansion.
Elements of Group theory: Definition, Cyclic groups, group multiplication table, Isomorphic group, Representation, Special groups: SU(2), O(3).

Text Books:

1. K.F. Riley, M.P. Hobson, S.J. Bence, Mathematical Methods for Physics and Engineering, Cambridge University Press, 3rd Edition, 2018.
2. G. Arfken, H. Weber and F.E. Harris, Mathematical Methods for Physicists, Elsevier Indian Reprint, 7th Edition, 2012.

Reference Books:

1. M.L.Boas, Mathematical Methods in Physical Sciences, Wiley, 3rd Edition, 2006.
2. J. Mathews and R.L. Walker, Mathematical Methods of Physics, Pearson India, 2nd Edition, 2004.
3. C. W. Wong, Introduction to Mathematical Physics: Methods & Concepts, Oxford, 2nd Edition, 2013.

26PHY513 STATISTICAL MECHANICS 3 1 0 4

Course Outcomes:
COl Apply basic knowledge of Thermodynamics co-ordinates and potentials to systems
CO2 Understand the statistical nature with specific examples of binomial and Poisson distributions
CO3 Understand the concept of micro canonical ensembles and relations between partition function and thermo dynamical potentials
CO4 Application of statistical relations to study various phase transitions including liquid-solid, para, Ferromagnetism and Superconducting phase transitions

UNIT I:

Review of thermodynamic variables and thermodynamic potentials. Review of probability functions- random walk problem.
UNIT 2

Foundations of statistical mechanics-specification of states of a system-contact between statistics and thermodynamics-classical ideal gas-entropy of mixing and Gibb's paradox

UNIT 3

Micro canonical ensemble - phase space - trajectories and density of states - Lowville's theorem - canonical and grand canonical ensembles-partition function - calculation of statistical quantities - Energy and density fluctuations.

UNIT 4

Statistics of indistinguishable particles - Maxwell- Boltzman, Fermi Dirac and Bose Einstein statistics-properties of ideal Bose and Fermi gases-Bose-Einstein condensation

UNIT 5

Phase transitions- phase diagram for a real gas- Analogy of fluid and magnetic systems- Cluster expansion of classical gas - Landau theory of phase transition - critical indices - scale transformation and dimensional analysis.

Text Books:

1. F Reif, Foundations of Statistical and Thermal Physicss

2. Reference **Books**

3. Silivio Salinas, Introduction to Statistical Physics, Springer Indian Reprint, IE, 2006
4. Statistical Mechanics - R K Pathria
5. Statistical and Thermal Physics — Landau and Lifshitz

Statistical Physics- An Introductory course, Daniel J Amit and Yosef Verbin- World Scientific Co Pvt Ltd, 1995

26PHY514 ADVANCED ELECTRODYNAMICS 3 1 0 4

Course Outcomes:

COl : Understand energy and momentum associated with electromagnetic waves and the propagation of electromagnetic waves in linear medium

CO2: Apply the concept of propagation of em waves in wave guides to understand the Designing aspects of a simple microwave wave guide.

CO3 Understand the physical basis of simple dipole radiation and radiation reaction

CO4 Apply the concepts of relativistic principles to understand electrodynamics

CO5 Apply the concepts of electrodynamics in modern experimental techniques

UNIT 1:

The wave equation, Sinusoidal waves, Boundary conditions: Reflection and Transmission Polarization, The wave equation for E and B, Monochromatic plane waves, Energy and Momentum in Electromagnetic Waves, Propagation in linear media, Reflection and Transmission

at Normal Incidence, Reflection and Transmission at Oblique Incidence

UNIT 2:
Electromagnetic Waves in Conductors, Reflection at a Conducting Surface, The frequency dependence of Permittivity, Wave Guides, The waves in a Rectangular Wave Guide, The Coaxial Transmission Line

UNIT 3:
Definition of radiation, Electric dipole radiation, Magnetic dipole radiation, Radiation from an arbitrary source, Power radiated by a point charge, Radiation reaction, The physical basis of radiation reaction.

UNIT 4:
Einstein's postulates, Geometry of relativity, The Lorentz transformations, The Structure of space time, Proper time and proper velocity, Relativistic energy and momentum, Relativistic kinematics, Relativistic dynamics, Magnetism as a relativistic phenomenon, How the fields transform, The field tensor, Electrodynamics in tensor notation.

UNIT 5:
Applications of electrodynamics in modern experimental techniques, Basic charged particle optics, Theory of linear accelerators, Wancroft accelerators, pulsed drift tubes, rf linacs, circular accelerators and synchrotron radiation. Basic beam line equipment and design.

Textbooks

1. Introduction to electrodynamics — David J Griffiths, 4“' edition, Pearson

Reference books

1. J.D. Jackson, Classical Electrodynamics, 3E, Wiley, 2007
2. W, Greiner, Classical Electrodynamics, lE, Springer, 2006
3. The Physics of Particle Accelerators: An Introduction - Klaus Wille, Oxford University Press.

26PHY515 EXPERIMENTAL TECHNIQUES 3 1 0 4

Course Outcomes:

COl Understand the existing idea of probability to analyze continuous distribution functions
CO2 Apply error analysis and quantification of error propagation in linear/non-linear systems
CO3 Understand and apply Fourier transforms and their relevance in extracting signals from time domain and displaying in frequency domain
CO4 Understand the principles of diffraction, and various types of spectroscopy.

CO5 Interpret l D X-ray diffraction data, understand imaging modes in microscopes and interpretation of signals from various spectroscopic instruments

Unit I:

Error and data analysis:
Review of error analysis — estimate confidence intervals — statistical inferences — linear and non linear regression analysis including analysis of fits (χ^2 test), correlation analysis (R^2)

Unit II:

Review of Fourier Transforms:
Time domain and frequency domain spectra, Implementing Fast Fourier Transforms.

Unit III:

Xray diffraction and detectors
Production of X-rays, Scattering from an electron, atom and unit cell (calculation of structure factors), Powder X-ray diffraction and determination of crystal structures from diffraction data, particle and photon detectors: GM counter, Scintillation detector, Proportional counter

Unit IV:

Microscopy
Scanning electron microscopy and transmission electron microscopy — Discussion of electron sources, Secondary and Back scattered electrons, analytical electron microscopy, electron diffraction, amplitude and phase contrast microscopy.

Unit V:

Spectroscopy
Review of IR, EPR and NMR spectral lines including selection rules, calculation of g-factor, instrumentation for IR, EPR and NMR

Text Books:

For Error analysis (Unit I):
1. Bevington and Robinson, Data Reduction and Error Analysis for the physical sciences, 3" Ed., McGraw-Hill Education, 2002.
2. John. R Taylor, An introduction to error analysis: The study of uncertainties in physical measurements, 2‘d Ed., University Science

Books, 1997.

For Fourier Transforms (Unit II):

1. Erwin Kreyszig, Advanced Engineering Mathematics, l0"1 Ed., Wiley, 2015.
2. J. F James, A students guide to Fourier Transforms, 3'd Ed., Cambridge University Press, 2012.

For X-ray diffraction and detection (Unit III):

1. S S Kapoor and V S Ramamoorthy, Nuclear Radiation detectors, New Age International, 1993.
2. RamakanthHebbar, Basics of X-ray diffraction and its applications, 1" Ed., I. K. International Publishing House, 2011.
3. B E Warren, X-ray diffraction, New edition Ed., Dover Publications Inc. 1990.

For Microscopy (Unit IV):

1. Ray F Egerton, Physical Principles of Electron Microscopy: An introduction to SEM, TEM and AEM, Springer, 2005.

For Spectroscopy (Unit V):

1. Colin Banwell, Elaine Mccash, Fundamentals of Molecular spectroscopy, McGraw Hill Education, 4'h Ed., 1994.
2. "Instrumental methods of analysis" by Williams, Merrit, Dean and Settle ***(Chemistry section of our library)***

Reference books:

1. Schaums Series on Probability and Statistics
2. "Elements of X-ray diffraction", B. D. Cullity
3. "Transmission electron microscopy" by Williams and Carter
4. "X-ray diffraction : In crystals, Imperfect crystals and amorphous bodies" by A Guiner
5. "X-ray diffraction" by West

26PHY583 ADVANCED ELECTRONICS LAB 0 0 3 1

Course Outcomes

At the end of the course students will be able to:

COl Apply the technical knowledge gained from electronics courses that they have studied in design and analysis of circuits

CO2 Analyze and design simple circuits using diodes and transistors as well as higher level Circuits employing integrated-circuit operational amplifiers according to the required specifications and also to evaluate combinational and sequential logical digital circuits

CO3 Program and construct applications using a microcontroller (Arduino),

1. Design and study of CE amplifier with and without feedback,
2. Two stage amplifier, Power amplifier, Differential amplifier,
3. Construction of low order to higher order Mux and De Mux,
4. Construction and conversion of RS, JK D and T flip flops,
5. Phase shift oscillator, Colspit and Hartley Oscillators,
6. 555 timer (Astable, Monostable,Bistable)
7. Familiarization of Arduino and Raspberry Pi
8. First and Second order filters,
9. A/D and D/A converters, control of stepper motor.

TEXTBOOK/ REFERENCES:

Paul B. Zbar& Alert P Malvino, Basic Electronics - A text-Lab Manual.

26PHY601 ATOMIC, MOLECULAR AND OPTICAL PHYSICS 3 1 0 4

Unit I

One electron atoms -1:

Brief Review of Quantum mechanics. One electron atoms: Operators and observables, Angular momentum, Schrodinger equation for one electron atoms, energy levels, eigen function of the bound states, Expectation values and the Virial theorem.

Unit II

One electron atoms -2: Fine structure of Hydrogen like atoms, Zeeman Effect, Stark effect, Lamb shift, Hyperfine structure and isotope shifts.

Unit III

Molecular structure and Spectra:

Nature of Molecular structure, Electronic structure of Molecules, Building principle: determination of term manifold, LCAO approximation, Molecular Orbital theory treatment of H2 and H2 electronic energy levels, o and u — bonds, Formation of bonding and anti-bonding orbitals from atomic orbitals in simple diatomic molecules.

Unit IV

Molecular symmetry and vibrations: Properties of Symmetry, Point groups, Characters and representation groups, Reducible and irreducible representations, Normal co-ordinates and normal modes of vibration, Infrared and Raman spectra, Selection rules, Application of group theory to molecular vibrations

Unit V

Absorption and emission of radiation: Interaction of radiation with matter, Einstein's A and B coefficients, Beer's law for normal absorption, electric dipole approximation, width and shape of spectral lines, Homogenous and inhomogeneous broadening, natural broadening, Doppler broadening, Doppler broadening: estimation of half-widths, external effects — collision broadening and pressure broadening.

Text books

1. B. H. Bransden and C. J. Joachain, Physics of Atoms and Molecules, 2“ Ed., Prentice Hall, 2003.
2. C.J. Foot, Atomic Physics, l“ Ed., Oxford Master Series in Physics, 2004.

Reference books

1. Peter W. Atkins and Ronald S. Friedman, Molecular Quantum Mechanics, 5“' Ed., Oxford University Press, 2012.

Demtröder, Wolfgang, Atoms, Molecules and Photons: An Introduction to Atomic-Molecular- and Quantum Physics, Springer-Verlag Berlin Heidelberg, 2010.

26PHY602 CONDENSED MATTER PHYSICS 3 1 0 4

COl Acquire knowledge on Bravais lattices, symmetry, defects in crystals and the concepts of reciprocal lattice and diffraction

CO2 Comprehensive understanding on the basic approaches to the formation of electronic Band structure of materials and the Fermi surfaces

CO3 Understand the different theories of superconductivity and its applications

CO4 Describe the behaviour of the carriers in semiconductors, doping, formation of Junctions and their characteristics.

CO5 Acquire complete knowledge on the classical and quantum theories of the different types of magnetism and elucidate the exchange interaction and domain theories of ferromagnetism.

UNIT 1

Review **on crystal physics:** Crystal Structure and symmetry, Point and Space groups, Crystal systems, planes and direction, Structure Property-Relations, Diffraction of

waves by crystals, Scattered wave amplitude: Fourier analysis, Reciprocal Lattice vectors, Diffraction conditions, Laue equations, Brillouin zones: Reciprocal lattice to SC, BCC and FCC lattice, Fourier analysis of Basis: Structure and atomic Form factor.

Crystal defects: Classification of defects - Points defect - The Schottky defect - The Frenkel defect - colour centers - F center - other colour centers - Dislocations - Slip and plastic deformation - Shear strength of single crystals - Edge dislocation - Screw dislocation - Stress field around an edge dislocation.(5 hrs)

UNIT 2

Metals I : The **Free-Electron model**

Free electron gas in three-dimension, Heat capacity of the free electrons, Electrical conductivity; effects of Fermi surface, Motion in magnetic fields; cyclotron resonance and the Hall effect, Thermal conductivity in metals

UNIT 3

Energy **Bands in Solids and Fermi surfaces:** Nearly free electron model: Origin of Energy Gap, Brillouin zones, Bloch functions, Construction of Fermi surfaces, Tight binding method for energy bands, Wigner-Seitz method, Cohesive energy, Pseudopotential methods, Experimental methods in Fermi surface studies; Quantization of Orbits in a Magnetic field, De Haas-van Alphen Effect, Landau levels

Superconductivity: Meissner effect, London's equations, introduction to BCS theory and its predictions, Ginzburg-Landau theory, flux quantization, Josephson effects; application: SQUID

UNIT 4 Semiconductors

Semiconductors: energy band structure, intrinsic and extrinsic semiconductors, Fermi levels of intrinsic and extrinsic semi-conductors, Direct and indirect gap semiconductors, Effective mass, Hydrogenic model of impurity levels and p-n junctions: theory of I—V characteristics, Schottky- barrier.

UNIT 5 Magnetism

Langevin theory of diamagnetism and paramagnetism, Quantum theory of Diamagnetism of Mononuclear systems, Quantum theory of paramagnetism: Rare Earth Ions, Hund Rules, Iron group ions, Crystal field splitting, Cooling by Isentropic Demagnetization, Paramagnetic susceptibility of conduction electrons, Ferromagnetism and antiferromagnetism: Ferromagnetic order, Curre point and exchange integral, Temperature dependence of saturation magnetization, Ferrimagnetic order: Curie temperature and susceptibility of ferrimagnets, antiferromagnetic order, susceptibility below Nee1 temperature, Ferromagnetic domains.

Text Books/ References:

1. N.W. Ashcroft and N.D. Mermin, Solid Satate Physics, Brooks Cole, l E12003.
2. Ibach and Luth, Soil State Physics, Springer India, 3E, 2002.
3. M.Marder, Condensesd Matter Physics, Wiley Intersciences, lE, 2000.
4. *Charles Kittel, Introduction to Solid State Physics, Wiley, 8th Edition, Reprint. 2016*
5. M. Ali Omar, Elementary Solid State Physics: Principles and Applications, Pearson Education India.
6. Adrianus J. Dekker, Solid State Physics, Library of Congress Catalog Card No.: 57-8688, 1958.

26PHY603 NUCLEAR AND PARTICLE PHYSICS 3 1 0 4

Course Outcomes

After completion of the course student should be able to:

COl: Understand the key ideas and terminologies of nuclear physics.

CO2: Understand various nuclear models and solve various problems related to nuclear structure.

CO3: Analyze and solve problems related to nuclear reactions. CO4: Understand basic aspects of particle physics

UNIT I

Basic Concepts: History and Overview, Units and Dimensions, Nuclear Properties, Radius, Mass and Abundance of nuclides, Binding energy, Angular Momentum, Spin and Parity, Electromagnetic moments and Nuclear excited states

UNIT II

Nuclear Stucture: The Deuteron, Nucleon-Nucleon Scattering, Proton-Protron and Neutron-Neutron Interactions, Properties of Nuclear Forces, The Exchange Force Model, Nuclear Models, Liquid-Drop Model, Shell Model, Collective Model of the Nucleus

UNIT III

Radioactive Decav' Alpha Decay, The Q-value of alpha decay, Gamow's theory of alpha decay, Beta decay, Fermi theory of beta decay, Parity violation in beta decay, Gamma Decay, Internal conversion, Nuclear Isomers

Unit IV

Nuclear Reactions:The Optical Model, The Compound Nucleus and Direct Reactions, Resonance Reactions, Heavy-Ion Reactions, Nuclear Fission, Characteristics of

Fission, Energy in Fission, Nuclear Fusion, Characteristics of Fusion, Solar Fusion

Unit V

Particle Physics: Particle Interactions and Families, Symmetry and Conservation laws, Standard Model, Quark Dynamics, Grand Unified Theories

Text Book:

S. Krane, Introductory Nuclear Physics, 2'd Ed., Wiley India Pvt Ltd, 2013.

Reference **Book:**

V. Devanathan, Nuclear Physics, Narosa Publishing House, 2012

26PHY604 OPTICS 3 1 0 4

Course Outcomes:

CO1. Familiarize the fundamental principles and basic mathematical technique required to understand the optics and its related parameters

CO2 Understand the basic laws of geometrical optics and extend its knowledge in designing and utilization of various optical components

CO3 Understand basic laws of polarization and extending its knowledge in analyzing various polarization problems using Muller's and Jone's matrices

CO4. Acquire knowledge in interference and diffraction techniques and apply them to solve in various realistic problems.

CO5.Analyze the problems related to coherence, Fourier optics and its application

Unit 1

Review of basics: Wave motion in lD: harmonic waves, phase and phase velocity, superposition principle, complex representation; Wave equation: plane, cylindrical and spherical waves and wave- fronts; Maxwell equations, EM waves, photons, and light, energy and momentum transport, radiation pressure; Propagation of light in matter, Rayleigh scattering, origin of refractive index.

Unit 2

Review of (a selection of topics in) geometric optics: reflection, refraction, total internal reflection, beam splitting; Lenses, Stops, Mirrors, Prisms, Lens &Optical systems; Introduction to wave front shaping, analytical ray tracing, aberrations; Wave optics: superposition of waves having same and different frequencies, group and phase velocities; anharmonic periodic and aperiodic waves; pulses and wave packets, natural linewidth, coherence time and length.

Unit 3

Polarization: linear, elliptical and circular polarizations; Dichorism, Birefringence, polarization by scattering and reflection; Retarders; Circular polarizers; Basics of

optical activity, induced optical effects, modulators, and liquid crystals; Mathematical theory of polarization: polarization ellipse, Poincare sphere, Stokes parameters, Jones vectors & matrices.

Unit 4

Interference: introduction, conditions for interference, wavefront splitting and amplitude splitting interferometers, types and location of interference fringes, multiple beam interference, interferometry applications; Diffraction: Introduction, Fraunhofferand Fresnel diffraction, Kirchoffs scalar diffraction theory; diffraction by circular aperture, single, double and multiple slits, diffraction grating, resolving power.

Unit 5

Fourier Optics: Fourier transforms, optical applications; Basics of Coherence Theory - introduction, visibility, mutual coherence function, degree of coherence, stellar interferometry; Basic ideas on nonlinear optics: harmonic generation, optical rectification, frequency mixing, self-focusing.

TEXTBOOKS/ REFERENCES:

1. E. Hecht and A.R. Ganesan, Optics, 4E, Pearson, 2008 (Prescribed)
2. AjoyGhatak, Optics, 5E, Tata-McGraw Hill, 2012
3. J. Peatross& M. Ware, Physics of Light and Optics (Available online at:http://optics.byu.eds BYUOpticsBook 2013.pdfJ
4. G.R. Fowles, Introduction to Modern Optics, 2E, Dover, 1989

M. Born M & E. Wolf, Principles of Optics, 7th Expanded Ed., CUP, 1999 (Reference)

26PHY681 SPECTROSCOPY LAB 0 0 3 1

Course Outcome:

COl Enhance instrumentation skills by constructing simple instruments related to spectroscopy

CO2 Understand the principles of spectroscopic instruments.

CO3 Obtain and analyze atomic spectra of different elements.

1. Determination of Wavelength and distance between D1 & D2 of sodium vapor light using Michelson Interferometer
2. Thermal expansively using interferometric technique
3. Observation of hyperfine splitting of spectral lines - Fabry-Perot Interferometer
4. Determination of e/m of electron by Normal Zeeman effect using Fabry-Perot etalon
5. Mach-Zander Interferometer using a He-Ne laser.

6. Fourier Filtering
7. Measurement and analysis of fluorescence spectrum of 12 vapour
8. Measurement of optical spectrum of an alkali atoms or alkaline earth metals
9. Measurement of Band positions and determination of vibrational constants of N2 molecule
10. Electron Spin Resonance Spectroscopy.
11. Energy band gap of semiconductor by studying the luminescence spectra
12. Study of temperature variation of refractive index of a liquid using hollow prism and laser source.
13. Clausius — Mossotti equation using sugar solution.
14. Determination of Rydberg's constant from hydrogen spectrum

26PHY696 MINI PROJECT 0 0 3 1

The aim of mini project work is to give first exposure to students on research methodology. This can include literature survey, review, data collection, theoretical / experimental work on small part of research area chosen by the faculty guiding the mini project work.

Course Outcomes:

COl Apply basic knowledge in physics and mathematics; learn to use modern experimental tools to address the real world problems and challenges that need solutions

CO2 Understand the vast array of literature in the field of interest and exposed to various research challenges

CO3 Gain knowledge of designing and execution of a research problem

CO4 Enhance the presentation and communication skills

26PHY698/ 26PHY699 DISSERTATION 18

The aim of the project work is to give more detailed exposure to the student for research methodology. This can include literature survey, review, data collection, and theoretical/ experimental work on small parts of research in area chosen by the faculty guiding the project work. If the project to be carried out at other institutions/ laboratories, the experts from these institutions are to be associated in choosing the research topic and its execution.

Course Outcomes

At the end of this course, students will be able to

COl Understand and practice scientific recording and reporting.
CO2 Apply and put to use the methods of analytical, logical and scientific reasoning that
Have been taught in the various subjects to address a relevant real time problem with clear objectives, depth and a well articulated roadmap.
CO3 Gain better knowledge of the use of analytical, theoretical and experimental tools to solve/design/study a problem/system.
CO4 Enhance presentation and communication skills.

26PHY697 Viva-voce 1 cr

A comprehensive viva-voce will be conducted to assess the general understanding of the student in the basic courses that he/she has studied. It will not be topic-specific, but will cover both basic and PG level of physics. This is meant to evaluate the student's grasp on the subject, and also to help students face interviews.

CIR Course – PG – Paper I

Sem: 1	**26CDS101 Career Development Skills I**	**L-T-P-C: 0 0 3 P/F**

Pre-requisite:
An open mind and the urge for self-development, basic English language skills and knowledge of high school level arithmetic.

Course Objectives:

- To strengthen professional skills for academic and research environments.
- To enhance presentation skills for seminars, reviews, and academic discussions.
- To guide students in effective goal setting and time management for postgraduate studies.
- Support them in developing their problem solving and reasoning skills
- Inspire students to enhance their diction, grammar, verbal reasoning and communication skills

Course Outcomes:

CO1: Soft Skills - To develop a positive mindset, communicate professionally, manage time effectively, set personal goals and achieve them.
CO2: Soft Skills - To make formal and informal presentations with self-confidence.
CO3: Aptitude - To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.
CO4: Aptitude - To analyze, understand and apply suitable techniques to solve questions in data analysis.
C05: Verbal - To infer the meaning of words and use them in the right context. To have a clearer understanding of the nuances of English grammar and become capable of applying them effectively.
C06: Verbal - To identify the relationship between words using reasoning skills. To understand and analyze arguments and use verbal reasoning skills to arrive at conclusions and communicate ideas/perspectives convincingly.

CO-PO Mapping - MTech

PO / CO	PO1	PO2	PO3
CO1	2	1	-
CO2	2	1	-
CO3	2	1	-
CO4	2	1	-
CO5	1	2	-
CO6	2	2	-

CO-PO Mapping - PG **ASAS**

PO / CO	PO1	PO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	1	2
CO6	2	2

Syllabus

Soft Skills

Introduction: Campus to corporate transition based on the expectations of the corporate
Communication and listening skills: Professional & Academic Communication Skills, Interpersonal Communication in Teams, Cross-cultural & Global Communication, Netiquette in Corporate Settings, Communicating in Hybrid & Remote Teams
Assertiveness skills: Necessity of being Assertive, Passive Aggression & Aggressiveness, Assertive & Non-assertive differences, Dealing with demands, criticism &

Commented [M[1]: We have introduced
-Netiquette in corporate setting, effective communication strategies in Hybrid & Remote teams to cater the requirement of growing virtual work culture and recruitment process.
-Dealing with demands, criticism & compliments in Assertive Techniques to handle difficult conversations in effective way.
-Using AI & Digital Tools for Presentations -to expose them in ethical way of implementing it
-Importance of Perspective Taking in perceptions to highlight the importance of unbiased approach.

Compliments, Assertive Techniques

Presentation skills: Adult learning principles, Preparation, planning, practice delivery, Principles of Effective Technical Presentations, Verbal & Non-verbal Communication in Presentations, Effective Slide Design, Using AI & Digital Tools for Presentations

Presentations by the students

Perception: Locus of control, Bridging Self & Social perception, Attribution theories, Importance of Perspective Taking, Impression management

Goal setting & Time management: Aligning Personal, Academic & Career Goals, SMART Goals, SWOT Analysis, Time Management Strategies, Prioritization Techniques & Planning Tools, Avoiding Procrastination & Distractions

Verbal

Vocabulary: Familiarize students with the etymology of words, help them realize the relevance of word analysis and enable them to answer vocabulary based MCQ questions through practice in etymology, synonyms, antonyms, commonly confused words, and contextual usage.

Grammar: Train students to understand the nuances of English Grammar and thereby enable them to spot grammatical errors in sentences.

Reasoning: Stress the importance of understanding the relationship between words through analogy questions. Emphasize the importance of avoiding the gap (assumption) in arguments/ statements/ communication.

Oral Communication Skills: Improve the professional spoken communication by introducing corporate register, workplace expressions, and structured group activities such as debates and panel discussions.

Commented [A(2]: The verbal component of the course is structured into two integrated parts: **Verbal Ability** and **Communication Skills**. The **Verbal Ability** component focuses on strengthening students' vocabulary, grammar, and reasoning skills by equipping PG students with effective strategies for word analysis, grammatical accuracy, and logical relationships, thereby enabling them to perform competently in placement tests and other competitive examinations. The **Communication Skills** component emphasizes the application of these language skills in professional contexts, helping students develop confidence, clarity, and appropriateness in spoken communication through exposure to corporate register and structured group activities such as debates and panel discussions.

Aptitude

Numbers - Power Cycles, Divisibility, and HCF & LCM, **Percentages -** Profit, Loss & Discount, and Simple & Compound Interest, **Ratio, Proportion & Variation -** Alligations, Mixtures, and Partnership Problems, **Averages, Time and Work -** Pipes & Cistern, and Work Equivalence, **Time, Speed and Distance -** Boats & Streams, Races and Circular tracks, **Statistics -** Mean, Median, Mode, Standard Deviation and Quartile Deviation, **Data Interpretation -** Tables, Bar Diagrams, Line Graphs, Pie Charts, Caselets and Mixed Varieties, **Equations –** Linear and Quadratic Equations, **Logarithms, Inequalities, Puzzles -** Optimization Puzzles, Fermi Problems, Game-Based Puzzles, Sudoku, Anagrams, Futoshiki and Rebus Puzzles, **Speed Mathematics**, **Shortcuts.**

References

Soft Skills

1. Student's Guide For Career Planning, CIR, 2018
2. Andrew J DuRbin , "Applied Psychology: Individual and organizational effectiveness", Pearson- Merril Prentice Hall, 2004
3. Michael G Aamodt, "An Applied Approach, 6th edition", Wadsworth Cengage Learning, 2010

4. Robert Bolton, Dorothy Grover Bolton, “People Style at Work..and Beyond: Making Bad Relationships Good and Good”, Ridge Associates Inc., 2009
5. John Hayes “Interpersonal skills at work”, Routledge, 2003
6. Nord, W. R., Brief, A. P., Atieh, J. M., & Doherty, E. M., “Meanings of occupational work: A collection of essays (pp. 21- 64)”, Lexington, MA: Lexington Books, 1990
7. Mark J Martinko, “Attribution theory: an organizational perspective”, St. Lucie, 1995
8. Miles Hewstone,”Attribution Theory: Social and Functional Extensions”, Blackwell, 1983
9. Stephen Covey, “The habits of highly effective people”, Free press Revised edition, 2004
10. Kenneth H Blanchard ,”The 25 Best Time Management Tools & Techniques: How to Get More Done Without Driving Yourself Crazy” , Peak Performance Press, 1st edition 2005
11. Kenneth H. Blanchard and Spencer Johnson, “The One Minute Manager”, William Morrow, 1984

Verbal

1. Verbal Skills Workbook (PG), CIR
2. Erica Meltzer, “The Ultimate Guide to SAT Grammar”
3. Green, Sharon, and Ira K. Wolf, “Barron's New GRE”, Barron's Educational Series, 2011
4. Jeff Kolby, Scott Thornburg & Kathleen Pierce, “Nova’s GRE Prep Course”
5. Kaplan, “Kaplan New GRE Premier”, 2011-2012
6. Kaplan’s GRE Comprehensive Programme
7. Lewis Norman, “Word Power Made Easy”, Goyal Publishers, Reprint edition, 1 June 2011
8. Manhattan Prep, “GRE Verbal Strategies Effective Strategies Practice from 99th Percentile Instructors”
9. Pearson- “A Complete Manual for CAT”, 2013
10. R.S. Aggarwal, “A Modern Approach to Verbal Reasoning”
11. S. Upendran, “Know Your English”, Universities Press (India) Limited, 2015
12. Sharon Weiner Green, Ira K. Wolf, “Barron's New GRE, 19th edition (Barron's GRE)”, 2019
13. Wren & Martin, “English Grammar & Composition”
14. www.bbc.co.uk/learningenglish
15. www.cambridgeenglish.org
16. www.englishforeveryone.org
17. www.merriam-webster.com

Aptitude

1. Arun Sharma, “How to Prepare for Quantitative Aptitude for the CAT Common Admission Test”, Tata Mc Graw Hills, 5th Edition , 2012
2. Arun Sharma, “How to Prepare for Logical Reasoning for the CAT Common Admission Test”, Tata Mc Graw Hills, 2nd Edition, 2014
3. Arun Sharma, “How to Prepare for Data Interpretation for the CAT Common Admission Test”, Tata Mc Graw Hills, 3nd Edition, 2015

4. R.S. Aggarwal, “Quantitative Aptitude For Competitive Examinations”, S. Chand Publishing, 2015
5. R.S. Aggarwal, “A Modern Approach To Verbal & Non-Verbal Reasoning”, S. Chand Publishing, Revised -2015
6. Sarvesh Verma, “Quantitative Aptitude-Quantum CAT” , Arihant Publications, 2016
7. www.mbatious.com
8. www.campusgate.co.in
9. www.careerbless.com

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50
Pass / Fail		

*CA - Can be **presentations, speaking activities and tests.**

CIR Course – PG – Paper II

Sem: 2	26CDS111 Career Development Skills II	L-T-P-C: 0 0 3 1

Pre-requisite:

Willingness to learn, team spirit, foundational proficiency in English language and communication and knowledge of high school level arithmetic.

Course Objectives:

- To equip students with conflict management strategies for effective teamwork and collaboration.
- To prepare students for recruitment processes through interview etiquette, group discussions and professional conduct.
- Help students to sharpen their problem solving and reasoning skills
- Empower students to communicate effectively by using the correct diction, grammar, comprehension and verbal reasoning skills

Course Outcomes:

CO1: Soft Skills - To demonstrate good interpersonal skills, solve problems and effectively participate in group discussions.
CO2: Soft Skills - To write technical resumes and perform effectively in interviews.
CO3: Aptitude - To identify, investigate and arrive at appropriate strategies to solve questions in geometry, probability, permutations & combinations, and statistics by managing time effectively.
CO4: Aptitude - To investigate, understand and use appropriate techniques to solve questions in logical reasoning and data analysis by managing time effectively.
C05: Verbal - To be able to use diction that is more refined and appropriate and to be competent in knowledge of grammar to correct and improve sentences
C06: Verbal - To be able to examine, interpret and investigate passages and to be able to generate ideas, structure them logically and express them in spoken or written style that is comprehensible to the audience/recipient.

CO-PO Mapping - MTech

PO / CO	PO1	PO2	PO3
CO1	2	1	-
CO2	2	1	-
CO3	2	1	-
CO4	2	1	-
CO5	1	2	-
CO6	2	2	-

CO-PO Mapping - PG **ASAS**

PO / CO	PO1	PO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	1	2
CO6	2	2

Syllabus

Soft Skills

Corporate Culture and Managing Diversity: Understanding Corporate Culture & Organizational Values, Corporate Culture in Indian & Global Organizations

Unconscious Bias, Adapting to Corporate Culture as a New Professional, Diversity Policies & Best Practices

Critical Thinking & problem solving: Problem Identification & Problem Framing, Problem solving process, Handling Ambiguity & Open-Ended Problems, Brainstorming techniques for Critical Thinking, Agile Thinking & Continuous Improvement

Conflict Management: Intrapersonal, Interpersonal & Task-Based Conflict, Conflict Management Styles, Steps in Conflict Resolution, Conflict in Hybrid & Remote Work Environments, Learning from Conflict

Team building and working effectively in teams: Communication & Collaboration in Teams, Stages of Team Development, Diversity, Inclusion & Cultural Sensitivity in Teams, Trust, Accountability & Psychological Safety, Leadership Dynamics

Group discussion: Critical Thinking & Perspective Building, Clarity, Fluency & Professional Language, Body Language & Eye Contact, Handling Interruptions & Disagreements, Self-Reflection & Improvement

Interview skills: Types of Interviews (Technical, HR, Managerial, Research), Understanding Job Descriptions & Role Expectations, Competency-Based & Behavioural Interviews, STAR Technique for Behavioral Questions, AI-Based Interview Screening & Preparation, Interview Netiquette & Modern Interview Contexts

Mock Interview: One on one Mock interview process for all the students

Verbal

Vocabulary: Enhance vocabulary skills through focused practice in idioms, phrasal verbs, and sentence completion, with emphasis on contextual usage and MCQ-based strategies.

Grammar: Develop grammatical accuracy by training students to identify and correct sentence-level errors through sentence correction and cloze test practice.

Reasoning: Strengthen critical reasoning and logical thinking skills through systematic practice in critical reasoning questions and logical ordering of sentences.

Reading Comprehension: Equip students with effective strategies to analyze and respond to reading comprehension passages through guided discussion and practice.

Public Speaking Skills: Enhance oral communication through storytelling for professional success and personal branding, and assess speaking competence through individual speeches and open forum discussions on current affairs.

Writing Skills / Professional Communication: Develop formal writing competence with emphasis on professional email etiquette and the drafting of job application and workplace emails.

Aptitude

Commented [M[3]: We have introduced Corporate Culture and Managing Diversity to expose learners to advanced corporate values and the nuances of working in diverse teams. Agile Thinking helps handle ambiguity and enhance critical thinking through effective brainstorming. Team Building develops skills to work effectively across generations, while Interviewing Skills, including AI-Based Screening and modern interview contexts, prepare learners for the evolving recruitment landscape.

Commented [A(4]: The second-semester verbal course is designed as a progression to the next level from the first semester, building on the foundations established in the first semester. It deepens students' **verbal ability** by refining vocabulary, grammar, reasoning, and reading comprehension skills through higher-order, application-oriented practice aligned with placement tests, competitive examinations, and professional assessments. Simultaneously, the course advances **communication skills** by focusing on public speaking, professional writing, and workplace communication, enabling students to articulate ideas with clarity, confidence, and strategic intent. Through integrated practice in speaking, reading, and writing, the course prepares PG students to function effectively in complex academic, professional, and corporate environments.

Sequence, Series, Geometry - 2D, 3D, Coordinate Geometry, and Heights & Distance, **Permutations & Combinations –** Circular & Linear Arrangements and Derangements, **Probability -** Addition & Multiplication Theorems and Conditional Probability, **Logical Reasoning -** Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives, Clocks, Calendars, Cubes, Non-Verbal reasoning, Blood Relations, Direction Test, Syllogisms, Series, Odd One Out, Coding & Decoding, Cryptarithmetic and Input-Output Reasoning, **Data Sufficiency, Campus Recruitment Papers, Puzzles -** Lateral Thinking Problems, Riddles, Logical Puzzles, Deduction Puzzles, Calculation Puzzles, and Other Interview Puzzles, **Time Management Strategies**.

References

Soft Skills

1. Student's Guide for Career Planning, CIR
2. Thomas L. Quick, "Successful team building", AMACOM Div American Mgmt Assn, 1992
3. Brian Cole Miller, "Quick Team-Building Activities for Busy Managers: 50 Exercises That Get Results in Just 15 Minutes", AMACOM; 1 edition, 2003.
4. Patrick Lencioni, "The Five Dysfunctions of a Team: A Leadership Fable", Jossey-Bass, 1st Edition, 2002
5. How to Win Friends & Influence People, Dale Carnegie, 1998 Edition.
6. I'm OK--You're OK, Thomas A. Harris, 2012 Edition.
7. Personality Development and Soft Skills, Barun K.Mitra, Oxford, 2nd Edition
8. Effective Group Discussion, Theory and Practice, Gloria J. Galanes McGraw Hill, 15th Edition

Verbal

1. Verbal Skills Workbook (PG), CIR
2. "GMAT Official Guide" by the Graduate Management Admission Council, 2019
3. Arun Sharma, "How to Prepare for Verbal Ability And Reading Comprehension For CAT"
4. Joern Meissner, "Turbocharge Your GMAT Sentence Correction Study Guide", 2012
5. Kaplan, "Kaplan GMAT 2012 & 13"
6. Kaplan, "New GMAT Premier", Kaplan Publishing, U.K., 2013
7. Manhattan Prep, "Critical Reasoning 6th Edition GMAT"
8. Manhattan Prep, "Sentence Correction 6th Edition GMAT"
9. Mike Barrett "SAT Prep Black Book The Most Effective SAT Strategies Ever Published"
10. Mike Bryon, "Verbal Reasoning Test Workbook Unbeatable Practice for Verbal Ability, English Usage and Interpretation and Judgement Tests"
11. www.bristol.ac.uk/arts/skills/grammar/grammar_tutorial/page_55.htm
12. www.campusgate.co.in

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9. www.careerbless.com

Evaluation Pattern

Assessment	Internal	External
Continuous Assessment (CA)* – Soft Skills	30	-
Continuous Assessment (CA)* – Aptitude	10	25
Continuous Assessment (CA)* – Verbal	10	25
Total	50	50

*CA - Can be **presentations, speaking activities and tests.**

SYLLABUS

26CUL500 INTEGRATED AMRITA MEDITATION TECHNIQUE L-T-P-C 0-0-2-1

A. Nature of Course: Lab/Practical

B. Course Description:

The course introduces students to the Integrated Amrita Meditation Technique (IAM 20), a structured practice that combines yogic stretches, regulated breathing (pranayama), and guided meditation. The course integrates both theoretical understanding and experiential practice to enhance emotional balance, stress resilience, concentration, and overall holistic development.

Aligned with United Nations Sustainable Development Goal 3 (SDG 3): Good Health and Well-Being, the course promotes preventive mental health care, emotional well-being, and sustainable lifestyle practices among students. By fostering inner stability, self-awareness, and self-regulation, the programme supports academic excellence and contributes to the development of healthy individuals and communities.

The course is expected to improve student well-being, enhance academic focus and cognitive clarity, reduce stress-related indicators, and promote compassionate and

emotionally supportive culture.

C. Course Objectives:

- To promote overall health and well-being of students.
- To train students in the structured practice of IAM 20.
- To develop emotional regulation and stress management skills.
- To encourage reflective awareness and compassionate living.

D. Course Outcomes:

After successful completion of the course, students will be able to:

CO	Course Outcomes	owledge Level loom's Taxonomy)
01	plain principles and components of IAM 20	derstand (L2)
02	monstrate and correct meditation practice independently	pply (L3)
03	alyze personal stress patterns using meditation insights	alyse (L4)
04	aluate personal growth through daily practice	aluate (L5)

E. CO-PO Mapping: [affinity: 3 – high; 2- moderate; 1- slightly]

CO's	Program Outcomes (PO's)											ogram Specific Outcomes (PSF's)		
	01	02	03	04	05	06	07	08	09	010	011	O1	O2	O3
01	-	-	-	-	-	1	-	2	-	-	1	-	-	-
02	-	-	-	-	-	2	2	1	1	-	1	-	-	-
03	-	-	-	-	-	1	1	2	-	-	1	-	-	-
04	-	-	-	-	-	1	1	1	1	-	1	-	-	-

F. Syllabus

Unit 1: Foundations of Meditation (CO1)

- Meaning and purpose of meditation
- Demonstration and supervised training
- Overview of structure of IAM
- Guidance for safe and effective practice
- Importance of mental health

Unit 2: Theoretical Foundations (CO2)

- Structure and components of IAM: yogic stretches, regulated breathing, and guided

meditation
- Breath–mind connection
- Integration of IAM practice into daily routine and academic life
- Application of IAM for stress management, concentration, and holistic student development

Unit 3: IAM Practical Training (CO3)
- Preparatory stretches
- Pranayama components
- Guided meditation sequence
- Corrections and common challenges

Unit 4: Integration and Transformation (CO4)
- Building daily discipline
- Research evidence in higher education
- Compassion and mindful communication

G. Evaluation Pattern:

sessment	**ternal (60)**	**ternal (40)**
tendance	Marks	
ass Participation	Marks	
tivity	Marks	
actical Demonstration		Marks
va		Marks