SEMESTER - I			
CORE - II	**MATHEMATICAL PHYSICS - I**		
Code : 17PPHC12	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:5**

Course Outcomes

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Calculate the area of irregular shape by Green's theorem	PSO2	E
CO 2	Design feedback control systems with finite dimensional vector spaces	PSO2	C
CO 3	Apply special functions for Wireless communication and alternating current transmission	PSO5	A
CO 4	Understand the geometry interpretation of complex numbers	PSO6	U
CO 5	Resolve the incompleteness of the statistical interpretations relating to the summing of an infinite number of probabilities to yield a meaningful solutions	PSO2	C
CO 6	Be familiar with the main mathematical methods used in physics.	PSO 7	R

Unit I: Vector Calculus

Review of Vector Algebra – Gradient of a scalar field - Divergence of a vector function - Curl of a vector function – Gauss Divergence theorem – Stokes's theorem – Green's theorem (Proof only). Linear vector space: Liner independence of vector and dimension – Basis of expansion theorem – Inner product and unitary spaces –Orthonormal sets – Schmidt's orthogonalisation method.

Unit II: Linear Algebra

Matrices: Review - Special types - Transpose - Conjugate – Conjugate Transpose - Symmetric and AntiSymmetric - Hermitian and Skew-Hermitian - Determinant - Singular and Non-Singular - Adjoint – Inverse - Orthogonal - Unitary - Trace - Rank - Cramer's rule - Eigen values, Eigen-vectors: Characteristic equation of a Matrix - Cayley-Hamilton theorem.

Unit III: Special Functions I and Partial Differential Equations

Legendre Function: Legendre's Equation - Generating Function – Rodrigue's Formula – Orthogonality - Recurrence Formulae - Bessel Function: Bessel's Function of the First kind – Generating Function – Recurrence Formulae.

Introduction - Laplace equation (Cartesian - 3D only) – Heat flow equation (3D only) - Equation motion for the vibrating string (D'Alembert's solution only).

Unit IV: Complex Analysis

Complex variables– Limits and continuity – Differentiability –Analytic function- Cauchy-Riemann equations(necessary and sufficient condition, polar form)– Cauchy theorem – Cauchy

integral formula – Taylor's theorem – Laurent theorem - Singular points – Residues – Method of finding residues- Residue theorem – Evaluation of definite integrals(unit circle type & evaluation $\int_{-\infty}^{+\infty} \frac{f_1(x)}{f_2(x)}\, dx$ only).

Unit V: Group Theory

Group, subgroup, classes – invariant, subgroups, factor groups –homomorphism and isomorphism – grouprepresentation - reducible and irreducible representation – Schur's lemmas, great orthogonality theorem – character table.

Continuous Groups: Lie groups and lie algebra – SO (3) group – SU (2) and SU (3) unitary groups.

Books for study:

1. Satya Prakash, Mathamatical Physics, Sultan Chand & Sons, New Delhi.
2. H.K.Dass ,Mathematical Physics, S.Chand & Company LTD, Fourth Revised Edition 2004
3. Mathematical Physics, P.K. Chattopadhyay, New Age International Publishers, Reprint (2001)

Unit	Book No.	Chapters / Sections
I	1	1.1,1.2,1.4,1.5,1.7,1.9,1.12,1.16
II	1	2.2, 2.5-2.11, 2.14, 2.19, 2.23, 2.27, 2.31-2.32
III	1	6.7-6.11,6.17,6.21,6.22,8.2,8.11,8.13
IV	2	7.3-7.10,7.31-7.33, 7.39-7.47
V	3	8.1-8.7, 8.11-8.13

Books for reference:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and sons (Asia), 8th Edition (2005).
2. B. D Gupta, Mathematical Physics, Vikas Publishing house PVT LTD, Fourth Edition 2010

SEMESTER - II			
CORE IV	MATHEMATICAL PHYSICS II		
Code : 17PPHC21	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits: 4**

Course Outcomes

CO No.	Upon completion of this course, students will be able to	PSOs addressed	CL
CO 1	Analyse the experimental data with the aid of Fourier transform	PSO5	An
CO 2	Understand the basic of tensor calculus and to describe motion and deformation of body	PSO2	U
CO 3	Recall the basic notations of generating functions and special functions	PSO1	R
CO 4	Apply computational techniques to solve a wide range of numerical problems arising in physics	PSO3	A
CO 5	Explain the concepts of Green's functions and solve boundary value problems	PSO1	E
CO 6	Solve Linear Differential Equations of First and Second order	PSO2	A

Unit I: Probability and Integral Transforms

Probability: Probability – definitions - Binomial distribution, Poisson distribution – Gaussian distribution.

Integral Transforms: Fourier Series- Fourier integral – Fourier transform - Linearity – first and second shifting theorems – Laplace transform – transforms of derivative and integral – inverse Laplace transform – partial fractions.

Unit II: Tensors

Notations and conventions – tensors of second rank – equality and null tensor – addition and substraction – outer product of tensors – inner product of tensors – symmetric and antisymmetric tensor – Kronecker delta – quotient law – metric tensor – Cartesian tensor – isotropic tensor – stress, strain and Hooke's law.

Unit III: Special Functions II

Hermite functions: Hermite Differential Equation – Hermite Polynomials – Recurrence Formulae – Rodrigue's Formula – Orthogonality.Laguerre function: Differential equation – Laguerre polynomial – Generating Function – Rodrigue's Formula – Recurrence Relation – Orthogonal Property.

Unit IV: Numerical methods

Solution of Algebraic and Transcendental equations: Newton – Raphson's method - Solution of Linear Algebraic Equations: Gauss elimination, Interpolation: Lagrange's interpolation– Inverse interpolation – Finite differences– Newton's forward and backward interpolation - Numerical

Integration :Trapezoidal rule - Simpson's $1/3^{rd}$ and $3/8^{th}$ rule - Initial Value Problems:Solving first order differential equations using Runge-Kutta methods.

Unit V: Greens Function and Linear differential equations of first & Second Order

Green's function for one dimensional problems and properties – Green's function in higher dimensions. Application: Poisson's equation.

Linear differential equations –Equations of first order and higher degree-Linear differential equations of second order with constant coefficients – Method for finding the complementary function – Rules to find particular integral.

Books for study:

1. Satya Prakash, Mathematical Physics, Fourth revised Edition 2004, Sultan Chand &Sons.
2. Matrices and tensors in Physics, A.W. Joshi, New Age International Publishers, Revised Third Edition (1995), Reprint 2010.
3. Numerical Methods - A. Singaravelu, Meenakshi Agency, Chennai
4. P.K. Chattopadhyay, Mathematical Physics, New Age International Publishers, Reprint (2001) and [Unit-V Chapter 6].
5. H.K.Dass ,Mathematical Physics, S.Chand & Company LTD, Fourth Revised Edition 2004

Unit	Book No.	Chapters / Sections
I	1	11.2, 11.20, 11.21, 11.22,7.1,7.3, 7.5, 7.6, 7.10, 9.2, 9.3, 9.9, 9.11, 9.12, 9.15, 9.20
II	2	15.2, 15.5, 16.1-16.4, 16.6, 16.7, 17,18.1, 19.3-19.5
III	1	6.29, 6.31 - 6.33, 6.35 – 6.38
IV	3	1.1, 1.16, 1.53, 2.1, 2.13, 2.59, 2.61, 2.75, 3.27, 3.31, 4.54
V	4 5	6.2, 6.5, 6.6, 3.14-3.18

Books for reference:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and sons (Asia), 8^{th} Edition (2005).
2. B D Gupta, Mathematical Physics, Vikas Publishing house PVT LTD, Fourth Edition 2010

SEMESTER - I			
CORE - II	**Mathematical Physics – I**		
Code : 19PPHC12	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Vision

To make the students competent and capable problem solvers using techniques that requires mathematical skills and an understanding of limiting cases.

Mission

To analyze and visualize the solution in terms of special functions and how to use in practice the Bessel functions, Legendre polynomial.

Course Outcome:

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO 1	evaluate the area of irregular shape by Green's theorem.	2	Ev
CO 2	recall the basic and the special types of matrices.	1	Re
CO 3	understand the concepts of feedback control systems with finite dimensional vector spaces.	7	Un
CO 4	apply special functions for Wireless communication and alternating current transmission.	2	Ap
CO 5	understand the geometrical interpretation of complex numbers.	1	Un
CO 6	explain the characteristic equation of a matrix using Cayley Hamilton Theorem.	3	Ev
CO 7	recall the incompleteness of the statistical interpretations relating to the summing of an infinite number of probabilities to yield a meaningful solution.	2	Re
CO 8	apply group theory to various disciplines of Physics.	3	Ap

SEMESTER - I			
CORE - II	**Mathematical Physics – I**		
Code : 19PPHC12	**Hrs/Week: 6**	**Hrs/Semester: 90**	**Credits:4**

Unit I: Vector Calculus

Review of Vector Algebra – Gradient of a scalar field - Divergence of a vector function - Curl of a vector function – Gauss Divergence theorem – Stokes's theorem – Green's theorem (Proof only).

Unit II: Linear Algebra

Matrices: Review - Special types - Transpose - Conjugate – Conjugate Transpose - Symmetric and AntiSymmetric - Hermitian and Skew-Hermitian - Determinant - Singular and Non-Singular - Adjoint – Inverse - Orthogonal - Unitary - Trace - Rank - Cramer's rule - Eigen values, Eigen-vectors: Characteristic equation of a Matrix - Cayley-Hamilton theorem.

Unit III: Special Functions I and Partial Differential Equations

Legendre Function: Legendre's Equation - Generating Function – Rodrigue's Formula – Orthogonality - Recurrence Formulae - Bessel Function: Bessel's Function of the First kind – Generating Function – Recurrence Formulae.

Introduction - Laplace equation (Cartesian - 3D only) – Heat flow equation (3D only) - Equation motion for the vibrating string (D'Alembert's solution only).

Unit IV: Complex Analysis

Complex variables– Limits and continuity – Differentiability –Analytic function- Cauchy-Riemann equations(necessary and sufficient condition, polar form)– Cauchy theorem – Cauchy integral formula – Taylor's theorem – Laurent theorem - Singular points – Residues – Method of finding residues- Residue theorem – Evaluation of definite integrals(unit circle type & evaluation $\int_{-\infty}^{+\infty} \frac{f_1(x)}{f_2(x)} dx$ only).

Unit V: Group Theory

Group, subgroup, classes – invariant, subgroups, factor groups –homomorphism and isomorphism – group representation - reducible and irreducible representation – Schur's lemmas, great orthogonality theorem – character table.

Text Books:

1. Satya Prakash, Mathamatical Physics, Sultan Chand & Sons, New Delhi.
2. H.K.Dass, Mathematical Physics, S.Chand & Company LTD, Fourth Revised Edition 2004
3. P.K. Chattopadhyay, Mathematical Physics, New Age International Publishers, Reprint (2001)

Unit	Book No.	Chapters / Sections
I	1	1.1,1.2,1.4,1.5,1.7,1.9,1.12
II	1	2.2, 2.5-2.11, 2.14, 2.19, 2.23, 2.27, 2.31-2.32
III	1	6.7-6.11,6.17,6.21,6.22,8.2,8.11,8.13
IV	2	7.3-7.10,7.31-7.33, 7.39-7.47
V	3	8.1-8.7

Books for Reference:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and sons (Asia), 8th Edition (2005).
2. B. D Gupta, Mathematical Physics, Vikas Publishing house PVT LTD, Fourth Edition 2010

SEMESTER - II			
Core VIII	**Mathematical Physics II**		
Code : 19PPHC22	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Vision:

To introduce students to methods of mathematical physics and to develop required mathematical skills to solve problems in quantum mechanics, electrodynamics and other fields of theoretical physics.

Mission:

To enhance the knowledge in probability, integral transforms special functions, tensors and numerical methods.

Course Outcome

CO No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO - 1	analyse the experimental data with the aid of Fourier transform	4	An
CO - 2	understand the basic of tensor calculus and to describe motion and deformation of body	1	Un
CO - 3	recall the basic notations of generating functions and special functions	1	Re
CO - 4	apply computational techniques to solve a wide range of numerical problems arising in physics	2	Ap
CO - 5	explain the concepts of Laplace Integral	1	Un
CO - 6	solve mathematical problems arising in physics by a variety of mathematical techniques.	2	Cr
CO - 7	employ the knowledge of critical thinking and problem solving	5	Ap
CO - 8	employ correct method to solve a particular problem	2	Ap

SEMESTER - II			
Core VIII	**Mathematical Physics II**		
Code : 19PPHC22	**Hrs/Week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Unit I: Probability and Fourier's Integral Transforms

Probability: Probability– definitions - Binomial distribution, Poisson distribution, normal distribution.

Fourier Integral Transforms: Fourier transform- properties of FT-FT of a derivative-Finite FT

Unit II: Tensors

Notations and conventions–contravariant vector-covariant vector- tensors of second rank – equality and null tensor– addition and substraction – outer product of tensors– inner product of tensors– symmetric and antisymmetric tensor– metric tensor– Cartesian tensor– isotropic tensor– stress, strain and Hooke's law-Moment of inertia tensor.

Unit III: Special Functions II

Hermite functions: Hermite Differential Equation– Hermite Polynomials– Recurrence Formulae– Rodrigue's Formula-Laguerre function: Differential equation– Laguerre polynomial – Generating Function– Rodrigue's Formula– Recurrence Relation.

Unit IV: Numerical methods

Solution of non - linear equation: Newton – Raphson's method - Solution of Linear Algebraic Equations: Gauss elimination, Interpolation: Lagrange's interpolation– Inverse interpolation – Finite differences– Newton's forward and backward interpolation - Numerical Integration: Trapezoidal rule - Simpson's $1/3^{rd}$ and $3/8^{th}$ rule - Runge-Kutta method(Fourth order).

Unit V: Laplace's Integral Transforms

Laplace transform–properties of Laplace transform-Laplace transforms of derivative of a function– Laplace transform of integral - inverse Laplace transform–properties of inverse Laplace transform- Evaluation of ILT by convolution theorem- Method of partial fractions for evaluation of ILT

Unit	Book No.	Pages/sections
I	1	11.2,11.20,11.21,9.2,9.3,9.4,9.7
II	2	15.2,15.3,15.4,15.5,16.1,16.2,16.3,16.4,16.6,18.1,19.3,19.4,19.5,19.7
III	1	6.29,6.30,6.31,6.32,6.34,6.35,6.36,6.37
IV	3	1.1, 1.16, 1.53, 2.1, 2.13, 2.59, 2.61, 2.75, 3.27, 3.31
V	1	9.9,9.10,9.11,9.15,9.17,9.18,9.19,9.20

Text Books:

1. Satya Prakash, Mathematical Physics, Fourth revised Edition 2004, Sultan Chand &Sons.
2. Matrices and tensors in Physics, A.W. Joshi, New Age International Publishers, Revised Third Edition (1995), Reprint 2010.
3. Numerical Methods - A. Singaravelu, Meenakshi Agency, Chennai
4. P.K. Chattopadhyay, Mathematical Physics, New Age International Publishers, Reprint (2001) and
5. H.K.Dass ,Mathematical Physics, S.Chand & Company LTD, Fourth Revised Edition 2004.