ST.JOSEPH'S COLLEGE FOR WOMEN (AUTONOMOUS), VISAKHAPATNAM

VII SEMESTER	**PHYSICS**	TIME:3Hrs/week
PH 7403(4)	**MATHEMATICAL PHYSICS**	Max.Marks:100
w.e.f. 20AH Batch	**SYLLABUS**	

Course Objectives:

- *To provide students with a strong foundation in the Mathematical principles, and enable students to apply the knowledge of special functions, integral transforms, tensors, numerical techniques and complex variables in Physics.*

Course Outcomes:

- *Upon the successful completion of the course, students will be able to:*
- *CO1: Develop proficiency in solving Legendre, Bessel, and Hermite differential equations using various techniques, including power series, generating functions, and recurrence relations.*
- *CO2: Summarize the properties of Fourier transforms, Laplace transform, their significance*
- *in analyzing Square wave, sawtooth wave and triangular waves, linear differential equations and their applications.*
- *CO3: Apply tensor theory to model and analyze physical phenomena, including strain, thermal expansion, and piezoelectricity.*
- *CO4: Analyze the physical significance of various Numerical methods and techniques in solving differential equations.*
- *CO5: Discuss the basic concepts of complex functions, complex differentiation, and complex integration in evaluating definite integrals*

SYLLABUS

UNIT - I: Special Functions **12 Hrs**

Beta and Gamma Functions – Definitions and properties – Evaluation of integrals, Legendre, Bessel and Hermite differential equations– Solutions– Generating functions– Orthogonal properties of Legendre, Bessel and Hermite Functions (Proof not necessary) – Recurrence relations– (Proof for Legendre polynomials only).

UNIT - II: Integral Transforms **15 Hrs**

Fourier Transforms: Properties of Fourier transforms – Fourier sine and cosine transforms-Power in Fourier series – Modulation theorem, Fourier transform of impulse function, Constants, Unit step function and Periodic functions.

Laplace Transforms: Definition and notation – Properties of Laplace transforms – Laplace transforms of Dirac delta function and periodic functions (Square wave, sawtooth wave and triangular wave) –Inverse Laplace transforms– properties– Solution of linear differential equations with constant coefficients - Applications to LCR circuits and resonance of simple pendulum.

UNIT III: Tensors **12 Hrs**

Definition – Contravariant, Covariant and Mixed tensors – Dummy suffix notation-Addition, subtraction, contraction, inner product, outer product, symmetric and anti-symmetric tensors - Application of Tensor theory to strain, thermal expansion and piezoelectricity.

UNIT- IV: Numerical Techniques **14 Hrs**

Solution of an equation – Bisection method, Regular False method, Newton – Rhapson method Solutions of simultaneous– Gauss elimination method and Gauss-Seidel method – Interpolations- Newton's interpolation and Lagrange's interpolation, Curve fitting – Method of Least squares Numerical differentiation and integration – Trapezoidal rule and Simpson's 1/3 rule – Solutions of differential equations– Euler's method and Runga-kutta Methods.

UNIT–V: Complex Variables **13 Hrs**

Functions–Complexdifferentiation-Analyticfunction-Cauchy–Riemannequations – Derivatives of elementary functions – Singular points and classification. Complex integration -Cauchy's theorem

– Integrals of special functions – Cauchy's integral formula – Taylor's and Lorentz theorem (statements only) – Residues, calculations of residues - Residue theorem – evaluation of definite integrals.

List of Activities:

1. Assignments
2. Student Seminars
3. Problem solving Sessions

Recommended Books

1. Mathematical physics,B.D.Gupta,4thedition,Vikaspublishinghouse,2010
2. Mathematical physics, B.S. Rajput,Pragati PrakashanMeerut,2017

3. Theory and Properties of Complex Variables, Schaum'soutline series, Murray R.Spiegel, Seymour Lipschutz, John J. Schiller, Dennis Spellman, McGraw-Hill, 1976

4. Applied Fourier analysis, Hweipiao Hsu, UnitechDivision,1984

5. An Introduction to Mathematical Physics, Suresh Chandra, Mohit Kumar Sarma Alpha Science International, 2013.

Reference Books

1. Special Functions for Scientists and Engineers, W.W. Bell, Dover Publications,2013

2. Laplace Transforms, Murray Spiegle, Schaum' soutline series, Mc Graw Hill, International Book Company, NY, 2005

3. Applied Mathematics for Engineers, Louis A. Pipes, Lawrence R. Harvill, Courier Corporation,2014

4. Complex Variables and Applications, Brown and Churchill, McGraw–Hill,2013

5. Mathematical Methods for Physics and Engineering ... K. F. Riley, University of Cambridge,