

Module 1

Chapter 1 : Laplace Transform 1-1 to 1-34

Syllabus :

- 1.1 : Definition of Laplace transform, Condition of Existence of Laplace transform.
- 1.2 : Laplace Transform (L) of standard functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and $t^n, n \geq 0$.
- 1.3 : Properties of Laplace Transform : Linearity, First Shifting Theorem, Second Shifting Theorem, Change of scale property, Multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof).
- 1.4 : Evaluation of real improper integrals by using Laplace Transformation.

1.1	Laplace Transform.....	1-1
1.1.1	Definition of Laplace Transform.....	1-1
1.1.2	Conditions for Existence of Laplace Transform ...	1-1
1.2	Properties of Laplace Transform	1-3
1.2.1	Linearity Property	1-3
1.2.2	Change of Scale Property	1-5
1.2.3	First Shifting Property	1-6
1.2.4	Second Shifting Property.....	1-11
1.2.5	Effect of Multiplication by 't'	1-11
1.2.6	Effect of Division by 't'	1-17
1.2.7	Laplace Transform of Derivative.....	1-21
1.2.8	Laplace Transform of Integral.....	1-24
1.3	Evaluation of Integral using Laplace Transform.....	1-28

Module 2

Chapter 2 : Inverse Laplace Transform 2-1 to 2-16

Syllabus :

- 2.1 : Definition of Inverse Laplace Transform, Linearity property, Inverse Laplace Transform of standard functions, Inverse Laplace transform using derivatives.

- 2.2 : Partial fractions method to find Inverse Laplace transform.
- 2.3 : Inverse Laplace transform using Convolution theorem (without proof).

2.1	Inverse Laplace Transform.....	2-1
2.1.1	Definition of Inverse Laplace Transform.....	2-1
2.1.2	Linearity Property for Inverse Transform	2-1
2.1.3	Shifting Theorem.....	2-2
2.2	Partial Fraction Method	2-4
2.3	Convolution Theorem.....	2-7
2.4	Evaluation of Inverse Laplace Transform using Derivative : ($\log, \tan^{-1}, \cot^{-1}, \tan^{-1}$).....	2-10

Module 3

Chapter 3 : Fourier Series 3-1 to 3-54

Syllabus :

- 3.1 : Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).
- 3.2 : Fourier series of periodic function with period 2π and $2l$.
- 3.3 : Fourier series of even and odd functions.
- 3.4 : Half range sine and cosine series.

3.1	Dirichlet's Conditions.....	3-1
3.2	Fourier Series.....	3-1
3.2.1	Parseval's Identity	3-1
3.3	Fourier Series Expansion in Different Intervals ...	3-1
3.3.1	Examples based on Fourier Series in $(0, 2l)$ with Period $2l$	3-3
3.3.2	Example based on Fourier Series in $(-l, l)$ with Period $2l$	3-12
3.3.3	Examples based on Fourier Series in $(0, 2\pi)$ with Period 2π	3-17
3.3.4	Examples based on Fourier Series in $(-\pi, \pi)$ with Period 2π	3-30
3.3.5	Examples based on Even and Odd Functions in $(-\pi, \pi)$	3-41
3.4	Half Range Series $(0, l)$	3-47

Module 4

Chapter 4 : Complex Variables 4-1 to 4-31

Syllabus :

- 4.1 : Function $f(z)$ of complex variable, Limit, Continuity and Differentiability of $f(z)$, Analytic function : Necessary and sufficient conditions for $f(z)$ to be analytic (without proof).
- 4.2 : Cauchy-Riemann equations in Cartesian coordinates (without proof).
- 4.3 : Milne-Thomson method : Determine analytic function $f(z)$ when real part (u), imaginary part (v) or its combination ($u + v / u - v$) is given.
- 4.4 : Harmonic function, Harmonic conjugate and Orthogonal trajectories.

4.1	Complex Variables	4-1
4.1.1	Function $f(z)$ of Complex Variable	4-1
4.1.2	Limit of Function of Complex Variable	4-1
4.1.3	Continuity of Function $f(z)$ of Complex Variable..	4-1
4.1.4	Differentiability of Function $f(z)$ of Complex Variable	4-1
4.1.5	Analytic Function	4-1
4.1.5(A)	Necessary and Sufficient Condition for $f(z)$ to be Analytic.....	4-1
4.2	Cauchy-Riemann (C-R) Equations in Cartesian Form	4-2
4.2.1	Examples based on C-R Equations.....	4-6
4.3	Milne-Thompson Method.....	4-9
4.4	Harmonic Function	4-21
4.5	Finding Harmonic Conjugate	4-22
4.6	Orthogonal Trajectories	4-27

Module 5

Chapter 5 : Matrices 5-1 to 5-38

Syllabus :

- 5.1 : Characteristic equation, Eigen values and Eigen vectors, Properties of Eigen values and Eigen vectors. (No theorems/ proof)

- 5.2 : Cayley-Hamilton theorem (without proof): Application to find the inverse of the given square matrix and to determine the given higher degree polynomial matrix.
- 5.3 : Functions of square matrix.
- 5.4 : Similarity of matrices, Diagonalization of matrices.

5.1	Characteristic Equation, Eigen Values and Eigen Vectors.....	5-1
5.1.1	Characteristic Equation	5-1
5.1.2	Eigen Values	5-1
5.1.3	Eigen Vectors.....	5-2
5.2	Cayley-Hamilton Theorem.....	5-11
5.3	Similarity of Matrices	5-18
5.3.1	Algebraic Multiplicity and Geometric Multiplicity	5-18
5.3.2	Diagonalization of Matrix	5-19
5.4	Function of a Square Matrix	5-32

Module 6

Chapter 6 : Numerical Methods for PDE 6-1 to 6-28

Syllabus :

- 6.1 : Introduction of Partial Differential equations, Method of separation of variables, Vibrations of string, Analytical method for one dimensional heat and wave equations. (only problems)
- 6.2 : Crank Nicholson method.
- 6.3 : Bender Schmidt method.

6.1	Introduction to Partial Differential Equations	6-1
6.1.1	One Dimensional Wave Equations -Equations of Vibrating String.....	6-1
6.1.2	Solved Examples.....	6-4
6.1.3	One-Dimensional Heat Flow	6-13
6.1.4	Solved Examples.....	6-15
6.2	Crank Nicolson Method	6-21
6.3	Bender Schmidt Method.....	6-25