ENGINEERING MATHEMATICS III

ENSH 201

Lecture	**: 3**	**Year : II**
Tutorial	**: 2**	**Part : I**
Practical	**: 0**	

Course Objectives:

The objective of this course is to equip students with understanding and practical application of Fourier series, Fourier transform, function of complex variable, partial differential equations and obtaining mathematical models and Z- transform.

1 Fourier Series and Fourier Transform (12 hours)

1.1 Review of periodic, odd and even functions

1.2 Fourier series of a function over an interval of length 2ℓ and 2π; Euler's formula, Dirichlet's condition for uniform convergence of Fourier series, Fourier series of discontinuous functions

1.3 Half range Fourier sine and cosine series

1.4 Complex form of Fourier series; frequency and amplitude of a function

1.5 Fourier integral theorem, Fourier sine and cosine integrals, complex form of Fourier integral

1.6 Fourier transform, Fourier sine transform, Fourier cosine transform and their inversion formulas

1.7 Fourier transform of the derivative of a function

1.8 Relation between Fourier and Laplace transform

2 Functions of Complex Variable (12 hours)

2.1 Intuitive idea of limit, continuity and differentiability of functions of complex variable

2.2 Analytic functions, the Cauchy Reimann equations both in Cartesian and polar form, construction of analytic functions

2.3 Harmonic functions, the orthogonal system

2.4 Application of analytic functions in flow problems

2.5 Transformation (Mapping), conformal mapping, translation, rotation and magnification; inversion, bilinear transformation

2.6 Complex integration, simply and multiply connected regions, Cauchy's integral theorem and formula

2.7 Series of complex terms, power series, circle of convergence and radius of convergence, Taylor's and Laurent's series

2.8 Zeros, singularities, poles; residue at poles, Cauchy's residue theorem and evaluation real and improper integrals

3 Partial Differential Equations (5 hours)

3.1 Definition and formation of partial differential equations
3.2 Partial differential equations solvable by direct integration
3.3 Linear partial differential equation of the first order, Lagrange's linear equations and their solution
3.4 Nonlinear partial differential equation of first order; equations of the form $f(p,q)=0$, $z=px+qy+f(p,q)$, $f(z,p,q)=0$, $f_1(x,p)=f_2(y,q)$
3.5 Charpit's method of solving nonlinear partial differential equations of first order

4 Modelling through Partial Differential Equation (10 hours)

4.1 Second order partial differential equation and classification
4.2 One-dimensional wave equation
4.3 One-dimensional heat equation
4.4 Two-dimensional heat equation, Laplace equation in Cartesian form
4.5 Mass balance equation; equation of continuity in fluid dynamics, Navier-Stoke's equation
4.6 Momentum balance equation; Euler's equation of motion for inviscid fluid flow

5 Z- transform and its Applications (6 hours)

5.1 Representation of a sequence and basic operations
5.2 Definition and existence of Z-transform, Z-transform of standard sequences
5.3 Properties of Z-transform; linearity, change of scale, shifting properties, initial and final value theorems
5.4 Differentiations of Z-transform
5.5 Inverse Z-transform; partial fraction and residue methods
5.6 Convolution of sequences, convolution of Z- transform
5.7 Difference equations, application of Z-transform to solve difference equations and to find the sum of series

Tutorial (30 hours)

1. Problems related to find period and identify odd and even functions
2. Exercises on Fourier series representation over intervals 2l and generalization into 2π
3. Exercises related to Fourier series for discontinuous functions
4. Exercises related to half range Fourier series
5. Exercises related to complex form of Fourier series
6. Exercises related to Fourier integral, Fourier sine and cosine integral
7. Exercises related to Fourier transform, Fourier sine and cosine transform and inversion
8. Exercises related to Fourier transform of derivatives and boundary value problems.

9. Exercises on application of C-R equations and construction of analytic functions
10. Exercises on application of analytic functions to flow problems
11. Exercises on mapping covering example of each mapping
12. Exercises on application of Cauchy integral theorem and formula
13. Exercises related to expansion of a function in Taylor and Laurent series
14. Exercises related to complex integration by using Cauchy's residue theorem
15. Exercises on solution of partial differential equation by direct integration
16. Exercises related to Lagrange's equation and PDE's as mentioned in 3.4
17. Exercises related to solution of one dimensional wave equation, one dimensional heat equation, two dimensional equation
18. Exercises related to Z-transform, application of properties
19. Exercises related to inverse Z-transform
20. Exercises related to solve difference equations by Z-transform
21. Exercises related to find sum of series by Z- transform

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Marks distribution*
1	12	18
2	12	18
3	5	6
4	10	10
5	6	8
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Jeffery A. (2002). Advanced Engineering Mathematics (2nd edition). San Diego: Harcourt Academic Press.
2. O'Neill, P.V. (2011). Advanced Engineering Mathematics (7th edition). India: Thompsons, USA/Baba Baghanath Printers.
3. Kreyszig, A. (2020). Advanced engineering Mathematics (10th edition). USA: Wiley Publications.
4. Sastry S.S. (2014). Engineering Mathematics vol I and II (4th edition). India: PHI Learning Pvt. Ltd.
5. Wylie C., Barrett L. (1988). Advanced Engineering Mathematics (5th edition). McGraw Hill.
6. Dutta, D. (2006). A text book of Engineering Mathematics Vol I and II (2nd edition). India: New Age International Publishers.
7. Ogata, K. (2015). Discrete Time Control System (2nd edition). Pearson Publications.
8. Sharma, Sanjay. (2017). Signals and Systems (9th edition). India: S.K.Kataria and Sons.