TRANSFORM TECHNIQUES AND COMPLEX VARIABLES

(Common to the branches Civil, ECE, EEE, Mechanical, Mechanical (Robotics))

Course Code: 20BM1106

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Course Outcomes: At the end of the course, the student will be able to
CO1: evaluate Fourier series and Fourier transform of a function **(L3)**
CO2: solve partial differential equations, heat flow and wave propagation problems **(L3)**
CO3: discuss the Z- transform technique and use it to solve difference equations **(L2)**
CO4: examine continuity, differentiability and analyticity of a complex valued function **(L3)**
CO5: evaluate the integral of a complex function over a simple closed contour **(L5)**

UNIT-I **10 Lectures**

Fourier series and Fourier Transforms:

Dirichlet's conditions, Fourier series, conditions for a Fourier expansion, functions of any period, odd and even functions - half range series. Fourier integrals, Fourier cosine and sine integrals, Fourier transform, Fourier sine and Fourier cosine transforms and properties. (Sections 10.1 – 10.8, 22.1 – 22.4 of the textbook)

Learning Outcomes:

At the end of this unit, the student will be able to

- evaluate the Fourier series expansion for different periodic functions (L5)
- analyze the properties of a Fourier transform (L4)
- determine the Fourier transform of a function (L3)

UNIT-II **10 Lectures**

Partial Differential Equations:

First order partial differential equations, solutions of first order linear and nonlinear PDEs. Method of separation of variables, solution of wave, heat and Laplace's equation in Cartesian coordinates
(Sections 17.1 – 17.3, 17.5, 17.6, 18.1-18.7 of the textbook)

Learning Outcomes:

At the end of this unit, the student will be able to

- discuss first order linear partial differential equations (L2)
- solve a boundary value problem and initial value problem by method of separation of variables (L3)
- determine a solution for wave, heat and Laplace's equations (L3)

UNIT-III **10 Lectures**

Z-Transforms:

Definition of Z-transform, elementary properties, linearity property, damping rule, shifting to the right and left, multiplication by n, initial value theorem, final value theorem, inverse Z-transform, convolution theorem (without proof) (Sections 23.1-23.12 of the textbook)

Learning Outcomes:

At the end of this unit, the student will be able to

- explain the properties of Z-transforms (L2)
- apply convolution theorem to find inverse Z-transform (L3)
- determine the solution of a difference equation using Z-transformations (L3)

UNIT-IV **10 Lectures**

Complex Variables-Differentiation:

Continuity, differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate function (Sections 20.1-20.5 of the textbook)

Learning Outcomes:

At the end of this unit, the student will be able to

- test the continuity and differentiability of a function of complex variable (L5)
- discuss the analyticity of a complex variable function (L2)
- determine the harmonic conjugate of a harmonic function (L3)

UNIT-V **10 Lectures**

Complex variables-Integration:

Contour integrals, Cauchy theorem (without proof), Cauchy integral formula (without proof), Taylor's series, zeros of analytic functions, singularities, Laurent's series, residues, Cauchy residue theorem (without proof) (Sections 20.12-20.14, 20.16-20.18 of the textbook)

Learning Outcomes:

At the end of this unit, the student will be able to

- calculate Taylor and Laurent series the Taylor and Laurent series (L3)
- determine the nature of the singularities and calculate residues (L3)
- evaluate certain integrals using the Cauchy residue theorem (L5)

Textbook:

B.S. Grewal, "*Higher Engineering Mathematics*", 44th edition, Khanna publishers, 2017.

Reference Books:

1. Erwin Kreyszig, "*Advanced Engineering Mathematics*", 9th edition, John Wiley & Sons, 2006.
2. J. W. Brown and R. V. Churchill, "*Complex Variables and Applications*", 7th edition, Mc-Graw Hill, 2004.
3. Web References: https://nptel.ac.in/courses/111/106/111106111/
   https://nptel.ac.in/courses/111/107/111107056/