DIFFERENTIAL EQUATIONS-III (TRANSFORMS & BOUNDARY VALUE PROBLEMS)

Total marks:150 (Theory: 75, Internal Assessment: 25+ Practical: 50)
5 Periods (4 lectures +1 students' presentation),
Practicals(4 periods per week per student)

(1st, 2nd& 3rd Weeks)

Introduction: power series solution methods, series solutions near ordinary point, series solution about regular singular point. Special functions: Bessel's equation and function, Legendre's equation and function.
[1] Chapter 8: 8.1-8.3
[2]Chapter 8: 8.6,8.9

(4th, 5th& 6th Weeks)

Sturm Theory: Self-Adjoint equation of the second order, Abel's formula, Sturm separation and comparison theorems, method of Separation of variables: The Laplace and beam equations, non-homogeneous equation.
[3] Chapter 11: 11.8
[2] Chapter 7: 7.7, 7.8

(7th , 8th& 9th Weeks)

Boundary Value Problem: Introduction, maximum and minimum Principal, Uniqueness and continuity theorem, Dirichlet problem for a circle, Neumann Problem for a circle.
[2] Chapter 9: 9.1-9.4, 9.6

(10th,11th& 12th Weeks)

Integral transform-introduction, Fourier transforms, properties of Fourier transforms, convolution Theorem of Fourier transforms, Laplace transforms, properties of Laplace transforms, convolution theorem of Laplace transforms
[2] Chapter 12: 12.1-12.4, 12.8-12.10

REFERENCE :

1.C.H. Edwards and D.E. Penny, *Differential Equations and Boundary value Problems Computing and Modelling,* Pearson Education India, 2005.

2.TynMyint-U, LokenathDebnath, *Linear Partial Differential Equations for Scientists and Engineers,* 4th edition, Springer, Indian reprint, 2006.
3. S.L. Ross, *Differential Equations,* 3rd edition, John Wiley and Sons, India, 2004.

Suggested Reading

1. Martha L Abell, James P Braselton, *Differential equations with MATHEMATICA,* 3rd Edition, Elsevier Academic Press, 2004.

LIST OF PRACTICALS FOR DE-III (*MODELLING OF FOLLOWING USING MATLAB/MATHEMATICA/MAPLE*)

1. Plotting of [0,1]. Legendre polynomial for n=1 to 5 in the interval Verifying graphically that all roots of $P_n(x)$ lie in the interval [0,1].
2. Automatic computation of coefficients in the series solution near ordinary points.
3. Plotting of the Bessel's function of first kind of order 0 to 3.
4. Automating the Frobeniusseries method.
5. Use of Laplace transforms to plot the solutions of
   a. Massspring systems with and without external forces and draw inferences.
   b. LCR circuits with applied voltage. Plot the graph of current and charge w.r.t. time and draw inferences.
6. Find Fourier series of different functions. Plot the graphs for *n* = 1-6. Draw inferences for the solutions as *n* tends to infinity.
7. Finding and plotting Laplace transforms of various functions and solving a differential equation using Laplace transform.
8. Finding and plotting Fourier transforms of various functions, and solving any representative partial differential equation using Fourier transform.
9. Finding and plotting the convolution of 2 functions and verify the Convolution theorem of the Fourier Transform/Laplace Transform.
10. Solve the Laplace equation describing the steady state temperature distribution in a thin rectangular slab, the problem being written as:

$$\nabla^2 u = 0, \qquad 0 < x < a, 0 < y < b,$$
$$u(x,0) = f(x), \qquad 0 \le x \le a,$$
$$u(x,b) = 0, \quad 0 \le x \le a,$$

$u_x(0,y) = 0,\ u_x(a,y) = 0,$

for prescribed values of a and b, and given function f(x).