Principles of Engineering Analysis I & II

EGM 6321 & 6322

Instructor Dr. Thomas L Jackson

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Credit Three hours

Spring Term:
Time Tuesday 1:55 – 2:45 pm
Thursday 1:55 – 3:50 pm
Location CSE E122
Office Hours M 2:30 – 4 pm
Tu 3 – 4 pm

Grading: Homework will be assigned regularly and due at the beginning of class. Only selected homework problems will be graded, and at random.

Honor Code: It is assumed that the Florida Student Code will be followed at all times, including during completion of homework and during exams.

Suggested books

1. Butkov, *Mathematical Physics*, (1968).
2. Churchill and Brown, *Complex Variables and Applications*, 5th Edition, (1990).
3. Boyce and DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 4th Edition, (1986).
4. Drazin, *Nonlinear Systems*, (1992).
5. Churchill and Brown, *Fourier Series and Boundary Value Problems*, 4th Edition, (1987).
6. Churchill, *Operational Mathematics*, (1972).
7. Haberman, *Elementary Applied Partial Differential Equations*, 2nd Edition, (1987).
8. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems*, (1968).
9. Greenberg, *Foundations of Applied Mathematics*, (1978).

Course Outline for EGM 6321 and 6322

1. Complex Variables – Churchill and Brown, 5th Edition, 1990
    a. Complex numbers – definition, algebraic properties, geometric interpretation, triangle inequality, polar form, exponential form, Euler's formula, powers and roots (Chapter 1)
    b. Analytic functions – mappings, derivative, Cauchy-Riemann equations, analytic functions, singular point, harmonic functions (Chapter 2)
    c. Elementary functions – exponential, trigonometric, hyperbolic, logarithmic and its branches, Riemann surfaces (Chapter 3)
    d. Integration – basic rules, contour integration, Cauchy-Goursat Theorem, simply and multiply connected domains, Cauchy Integral Formula (Chapter 4)
    e. Residues – Laurent series, residues, Residue Theorem, residues at poles, improper real integrals, Cauchy Principal Value, Inverse Laplace Transform, Jordan's inequality (Chapters 5 and 6; Butkov, 1968, Chapter 2)
    f. Application of complex variables to two-dimensional potential flows
2. Ordinary Differential Equations (ODE)
    a. Brief Review – classification, 1st order equations, 2nd order linear equations, Wronskian, constant coefficient, nonhomogeneous problems (Boyce and DiPrima, 4th Edition, 1986, Chapters 1-3)
    b. Second order linear ODE – variable coefficients, singular points, Fuchs' Theorem, Frobenius method (Butkov, 1966, Chapter 3)
    c. First order systems
        i. Linear systems – brief review, eigenvalues, eigenvectors, Wronskian, trajectories (Boyce and DiPrima, 4th Edition, 1986, Chapter 7)
        ii. Nonlinear systems – autonomous systems, phase plane, critical points, trajectories, almost linear systems, direct method of Liapaunov (Boyce and DiPrima, 4th Edition, 1986, Chapter 9; Drazin, 1992, Chapter 6)
        iii. Introduction to bifurcation theory – stability, turning point, transcritical bifurcation, pitchfork bifurcation, Hopf bifurcation (Drazin, 1992, Chapter 1)
3. Fourier Series
    a. Orthogonal functions (Churchill and Brown, 4th Edition, 1987, Chapter 5)
    b. Fourier expansion, Fourier cosine series, Fourier sine series, complex form (Butkov, 1968, Chapter 4; see also Churchill and Brown, 4th Edition, 1987, Chapters 3-5)
4. Laplace Transform
    a. General linear integral transformations, Laplace transforms, inverse Laplace transform, properties of Laplace transforms, Dirac delta function, convolution, properties of convolution, application to PDEs (Churchill, 1972, Chapters 1-3; see also Butkov, 1968, Chapter 5)
5. Fourier Transform
    a. Discrete and continuous spectrum, Fourier transform, properties, convolution, Fourier Integral Theorem, Fourier sine and cosine transforms, application to PDEs (Butkov, 1968, Chapter 7; see also Churchill, 1972, Chapters 11-13)

6. Partial Differential Equations (PDE)
    a. Classification
    b. Methods for solving hyperbolic, parabolic, and elliptic PDEs, Separation of Variables
    c. Strum-Liouville eigenvalue problems
    d. Method of characteristics, expansions waves, shocks, Whitman's equal-area principle
    e. Haberman, 2nd Edition, (1987); Dennemeyer (1968)
7. Green's Functions
8. Variational Methods
9. Perturbation Methods