


MATHEMATICAL METHODS AND ITS APPLICATIONS

PROF. P. N. AGARWAL
Department of Mathematics
IIT Roorkee

PROF. S. K. GUPTA
Department of Mathematics
IIT Roorkee

INTENDED AUDIENCE : UG students of technical universities/colleges.

COURSE OUTLINE :
This course is a basic course offered to UG student of Engineering/Science background. It contains ODE,PDE, Laplace transforms, Z-transforms, Fourier series and Fourier transforms. It plays an important role for solving various engineering sciences problems.Therefore, it has tremendous applications in diverse fields in engineering sciences.

ABOUT INSTRUCTOR :
Prof. P. N. Agarwal is a Professor in the Department of Mathematics, IIT Roorkee. His area of research includes approximation Theory and Complex Analysis. He delivered 13 video lectures on Engineering Mathematics in NPTEL Phase I and recently completed Pedagogy project on Engineering Mathematics jointly with Dr. Uaday Singh in the same Department. Further he has completed online certification course “Mathematical methods and its applications” jointly with Dr. S.K. Gupta of the same department. He taught the course on “Integral equations and calculus of variations” several times to MSc (Industrial Mathematics and Informatics) students. He has supervised nine Ph.D. theses and has published more than 187 research papers in reputed international journals of the world. Currently, he is supervising eight research students.

Prof. S. K. Gupta is an Associate Professor in the Department of Mathematics, IIT Roorkee. His area of expertise includes nonlinear, non-convex and Fuzzy optimization. He has guided three PhD thesis and have published more than 40 papers in various international journals of repute.

COURSE PLAN :
Week 1: Introduction to linear differential equations ,Linear dependence, independence and Wronskian of functions,Solution of second-order homogeneous linear differential equations with constant coefficients-I,Solution of second-order homogeneous linear differential equations with constant coefficients-II,Method of undetermined coefficients
Week 2: Methods for finding Particular Integral for second-order linear differential equations with constant coefficients-I,Methods for finding Particular Integral for second-order linear differential equations with constant coefficients-II, Methods for finding Particular Integral for second-order linear differential equations with constant coefficients-III,Euler-Cauchy equations,Method of reduction for second-order, linear differential equations
Week 3: Method of variation of parameters , Solution of second order differential equations by changing dependent variable, Solution of second order differential equations by changing independent variable,Solution of higher-order homogenous linear differential equations with constant coefficients, Methods for finding Particular Integral for higher-order linear differential equations
Week 4: Formulation of Partial differential equations, Solution of Lagrange’s equation-I, Solution of Lagrange’s equation-II,Solution of first order nonlinear equations-I,Solution of first order nonlinear equations--II
Week 5: Solution of first order nonlinear equations-III,Solution of first order nonlinear equations-IV,Introduction to Laplace transforms,Laplace transforms of some standard functions,Existence theorem for Laplace transforms

Week 6: Properties of Laplace transforms--I, Properties of Laplace transforms--II, Properties of Laplace transforms--III, Properties of Laplace transforms--IV, Convolution theorem for Laplace transforms--I
Week 7: Convolution theorem for Laplace transforms--II,Initial and final value theorems for Laplace transforms, Laplace transforms of periodic functions, Laplace transforms of Heaviside unit step function,Laplace transforms of Dirac delta function
Week 8: Applications of Laplace transforms-I, Applications of Laplace transforms-II, Applications of Laplace transforms-III, Z – transform and inverse Z-transform of elementary functions, Properties of Z-transforms-I
Week 9: Properties of Z-transforms-II, Initial and final value theorem for Z-transforms, Convolution theorem for Z- transforms, Applications of Z- transforms--I,Applications of Z- transforms-II
Week 10: Applications of Z- transforms--III, Fourier series and its convergence--I, Fourier series and its convergence--II, Fourier series of even and odd functions,Fourier half-range series
Week 11: Parsevel's Identity, Complex form of Fourier series, Fourier integrals, Fourier sine and cosine integrals, Fourier transforms
Week 12: Fourier sine and cosine transforms,Convolution theorem for Fourier transforms,Applications of Fourier transforms to BVP-I,Applications of Fourier transforms to BVP-II,Applications of Fourier transforms to BVP-III