ADVANCED ENGINEERING MATHEMATICS

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INTENDED AUDIENCE : UG and PG students of technical institutions/ universities/colleges.

COURSE OUTLINE :

This course is a basic course offered to UG/PG students of Engineering/Science background. It contains Analytic Functions, applications to the problems of potential flow, Harmonic functions, Harmonic conjugates, Milne's method, Complex integration, sequences and series, uniform convergence, power series, Hadamard's formula for the radius of convergence, Taylor and Laurent series, zeros and poles of a function, meromorphic function, the residue at a singularity, Residue theorem, the argument principle and Rouche's theorem, contour integration and its applications to evaluation of a real integral, integration through a branch cut, conformal mapping, application to potential theory, review of unilateral and bilateral Z-transforms and their properties, application of calculus of residues for the inversion formula of Z- transforms and Laplace transforms, review of Fourier integrals and Fourier transforms, Finite Fourier transforms, discrete Fourier transforms and applications, basic concepts of probability, Bayes theorem, probability networks, discrete and continuous probability distribution, joint distribution, correlation coefficient, applications to problems of reliability, queueing theory, service time for a customer in a facility and life testing, testing of hypotheses. This course has tremendous applications in diverse fields of Engineering and Sciences such as Signal processing, Potential theory, Bending of beams etc.

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 thesis and has published more than 187 research papers in reputed international journals of the world. Currently, the professor is supervising eight research students.

COURSE PLAN :

Week 1: Analytic Functions, Cauchy-Riemann Equations, Harmonic Functions, Harmonic Conjugates and Milne's Method, Applications to the problems of potential flow-I, Applications to the problems of potential flow-II
Week 2 : Complex integration, Cauchy's theorem-I, Cauchy's theorem-II , Cauchy's Integral Formula for the Derivatives of an Analytic Function , Morera's theorem, Liouville's theorem and Fundamental Theorem of Algebra
Week 3 : Winding Number and Maximum Modulus Principle, Sequences and Series, Uniform Convergence of Series, Power Series, Taylor series
Week 4: Laurent Series,Zeros and Singularities of an Analytic Function,Residue at a Singularity,Residue Theorem,Meromorphic Functions
Week 5 : Evaluation of real integrals using residues-I, Evaluation of real integrals using residues-II , Evaluation of real integrals using residues-III, Evaluation of real integrals using residues-IV, Evaluation of real integrals using residues-V
Week 6 : Bilinear Transformations, Cross ratio, Conformal Mapping-I, Conformal Mapping-II, Conformal mappings from half plane to disk and half plane to half plane-I
Week 7: Conformal mappings from disk to disk and angular region to disk, Application of Conformal mapping to potential theory, Review of Z-transforms-I, Review of Z-transforms-II, Review of Z-transforms-III
Week 8: Review of bilateral Z-transforms, Finite Fourier transforms, Fourier integrals and Fourier transforms, Fourier Series, Discrete Fourier transforms-I
Week 9: Discrete Fourier transforms-II, Basic concepts of probability, Conditional probability, Bayes theorem and Probability networks, Discrete probability distribution
Week 10: Binomial distribution, Negative binomial distribution and Poisson distribution, Continuous probability distribution, Poisson Process, Exponential distribution
Week 11: Normal distribution , Joint distribution-I, Joint probability distribution-III, Joint probability distribution-III, Correlation and regression-I
Week 12: Correlation and regression-II, Testing of hypotheses-I, Testing of hypotheses-II, Testing of hypotheses-III, Application to Queueing Theory and Reliablility Theory