MA847 SPECIAL FUNCTION AND MATHEMATICAL METHODS 4-0-0-4

Course outcome /Learning Objectives:

- To demonstrate the importance of modern asymptotic methods via discussing the main ideas and approaches used in the theory of asymptotic expansions to simplify and to solve different mathematical problems which involve large or small parameters.
- The student who have taken this course and completed all of the requirements are expected to have requisite knowledge of special functions, Fourier transform and asymptotic expansions that can be used to solve partial differential equations and boundary value problems.

Special Functions and Fourier transform: Gamma Function, error Function and related functions, Bessel function. Fourier integral and Fourier transform: Fourier integral Representations, Proof of the Fourier integral theorem, Fourier transform pairs, and Properties of the Fourier Transform, Transforms of More Complicated Functions, Convolution Integrals of Fourier, and Transforms Involving Generalized Functions Hilbert Transform.

Application involving Fourier transform: Boundary Value Problems, Heat Conduction in Solids, Mechanical Vibrations, Potential Theory, Hydrodynamics, Elasticity in Two Dimensions.

Asymptotic expansions: Asymptotic expansion of functions, power series as asymptotic series, Asymptotic forms for large and small variables. Uniqueness properties and Operations, Asymptotic expansions of integrals; Method of integration by parts (include examples where the method fails), Laplace method and Watson's lemma, method of stationary phase and steepest descent.

Regular and singular perturbation methods: Parameter and co-ordinate perturbations. Regular perturbation solution of first and second order differential equations involving constant and varia -ble coefficients, Including Duffings equation, Vanderpol oscillator, small Reynolds number flow. Singular perturbation problems, Matched asymptotic expansions, simple examples. Linear equation with variable coefficients and nonlinear BVP's, Problems involving Boundary layers. Poincare – Lindstedt method periodic solution. WKB method, turning points, zeroth order Bessel function for large arguments, solution about irregular singular points.

TEXT BOOKS/ REFERENCES:

1. I.N. Sneddon – The Use of Integral Transforms, Tata Mc Graw Hill, Publishing Company Ltd, New Delhi, 1974.

2. A.H. Nayfeh – Perturbation Methods, John Wiley & Sons New York, 1973.

3. R.P. Kanwal- Linear Integral Equations Theory and Techniques, Academic Press, New York, 1971.

4. C.M. Bender and S.A. Orszag – Advanced Mathematical Methods for Scientists and Engineers, Mc Graw Hill, New York, 1978.
5. H.T. Davis – Introduction to Nonlinear Differential and Integral Equations, Dover Publications, 1962.
6. Don Hong, J. Wang and R. Gardner - Real Analysis with Introduction to Wavelets and Applications, Academic Press Elsevier, 2006.
7. R.V. Churchill - Operational Mathematics, Mc Graw Hill, New York, 1958.