ME5010: Mathematical Methods for Engineers

Timings: Tuesday: 2:30 PM to 4:00 PM, Friday: 4:00 PM to 5:30 PM; **Venue**: LH2

Instructor: Dr. Ashok Kumar Pandey, Room No. 6**. Contact**: ashok@iith.ac.in ; 040-23016085

Vectors, operations and operators, identities; Cartesian tensors: definition, notation, transformation matrix, orthogonal properties, order of a tensor, operations, contraction, quotient rule, vector identities and theorems in tensor form. 6 Lectures

Function, functional and an introduction to integral of calculus, Euler-Lagrange equation. Introduction to Integral equations, classifications, solution methodology. 3- Lectures

Laplace transforms, translation formula, jump discontinuity, application to the solution of differential equation and integral equation. Fourier transfer, Fourier series, Parsevals theorem. 5- Lectures

First and second order ODEs with constant coefficients, Numerical solution: Euler and Runge Kutte method, stability and convergence criteria of the numerical solution, Initial value problem and boundary value problem for homogenous as well as nonhomogenous equations: Integrating factor based method, variation of parameter, shooting method, etc., Sturm-Liouville problem, Eigen function and Green's function. 7- Lectures

PDEs: Classification of pdes, Canonical forms of pdes, analytical solution: separable variable, Fourier series and transform based solution. 2- lectures

Linear algebraic equations: matrix form, matrix operations, determinants, Cramer's rule, Inverse, singularity, inconsistent equations, Gauss elimination, Gauss-Seidel, LU decomposition, finding inverses, eigen-values and eigenvectors, orthogonalization, Gram-Schmidt procedure, singular value decomposition (without proof) . 2- lectures

References:

1. Aristotle D. Michal, Matrix and Tensor Calculus: With Applications to Mechanics, Elasticity and Aeronautics, 2008, Dover
2. Rutherford Aris, Vectors, Tensors and the Basic Equations of Fluid Mechanics, 1990, Dover.
3. A.I. Borissenko and I.E. Tarapov, Vector and Tensor Analysis with Applications, 1979, Dover.
4. Donald Danielson, Vectors and Tensors in Engineering and Physics: 2nd Edition, 2003, Westview Press, 2nd Edition.
5. J. David Logan, Applied Mathematics, 2013, Wiley.
6. Erwin Kreyszig, Advanced Engineering Mathematics, Edition: 10th , John Wiley & Sons
7. G. Strang, Differential equations and Linear Algebra, 2014, Wellesley-Cambridge Press (http://math.mit.edu/dela/)
8. G. Strang, Introduction to Linear Algebra, 2009, Wellesley-Cambridge Press. (http://math.mit.edu/linearalgebra/)
9. Arther Muttak, Online lecture notes, http://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/ .
10. http://ocw.mit.edu/courses/mathematics/

Grades policy:

1. Attendence : 10% (<80% =0; 80%=8; 90%=9; 100%=10)
2. Quiz (biweekly exam) or Assignment: 15% (*Every alternate Wednesday from 4:00 – 5:00 PM in LH2*)
3. Mid exam: 35%
4. Final exam: 40%