

Indian Institute of Technology Jodhpur

MATHEMATICS-II, (12001), Jan-May 2015

Instructor: Prof. Chandramouli V V M Sarma

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**Course contents:**

**Linear Algebra(LA):(Part-1)** System of Linear equations. Vector spaces (over the field of real and complex numbers), subspaces, linear dependence/ independence, basis, dimensions, coordinate with respect to a basis, complementary subspaces. Linear transformations, Range space and rank, Null space and nullity, matrix representation of linear transformation, change of basis and similarity, rank-nullity theorem. Inner product, Norm, Gram-Schmidt orthogonalization process, orthonormal bases. Eigenvalues and eigenvectors, characteristic polynomials, Cayley-Hamilton theorem, properties of eigenvalues and eigenvectors, diagonalization of matrices.

**Ordinary differential equations (ODE): (Part-2)**

Introduction to Differential Equations, First Order ODE,  $y=f(x,y)$ - geometrical interpretation of solution, Picards theorem, Eulers Method, Improved Eulers Method; Separable Eqns, Homogeneous Eqns, Exact Eqns., Integrating Factors, Linear Eqns., Reduction of order, Orthogonal trajectories, Second Order Linear differential eqns: fundamental system of solns. and general soln. of homogeneous eqn, Use of known soln. to find another, Existence and uniqueness of soln. of IVP, Wronskian and general soln of nonhomogeneous eqns. Homogeneous equation with constant coefficients, the method of undetermined coefficients, Method of variation of parameters, Euler-Cauchy Eqn., Operator methods for finding particular solutions, Extensions of the results to higher order linear eqns., Power Series Method - application to Legendre Eqn.. Frobenius Method, Bessel eqn., Sturm Liouville BVP, Orthogonal functions, System of first order linear ODE's and their stability. Basics of Laplace Transform and how to solve ODE using Laplace Transforms.

### **Text for Part-1 (LA)**

- K. Hoffman & R. Kunze, Linear Algebra, 2nd Edition, PHI.

### **References for Part-1**

- Carl D. Meyer, Matrix analysis and Applied Linear Algebra
- Tom Apostol, Calculus, Vol-1 and Vol-2.
- Gilbert Strang, Linear Algebra and its Applications, 4th Edition, Thomson India Edition.
- S. Kumaresan, Linear Algebra A Geometric Approach, PHI.

### **Text for Part-2 (ODE)**

- Simmons G.F., Differential Equations with Applications and Historical Notes.

### **References for Part-2**

- 1• Shepley Ross, Differential Equations
- Boyce and DiPrima, Elementary Differential Equations and Boundary Value Problems
- Tom Apostol, Calculus, Vol-1 and Vol-2.
- Kreyszig, Advanced Engineering Mathematics.

### **Course Objectives**

The main emphasis of the course, Mathematics-II is on

- \* Solution methods with related theory as a tool for clarifying the concepts.
- \* It's a link to the areas : Linear Algebra, Calculus, and Applications of Linear Algebra and Calculus ( Mathematics-I) for solving ODE's.
- \* Stability ( phase space analysis ) : It is important in understanding the steady state behaviour of the physical process .
- \* It's link to applications ( whenever possible ) : we may not able to do justice to this part, but a slight emphasis may motivate the underlying techniques. However, students will able to see more applications in their branches.

### **Lecture and Tutorials**

Every week we have three lectures of about one hour duration. In addition, there will be a tutorial of one hour duration. The mode of lectures will be new to you and puts more responsibility on you. It may not be possible for you to take down notes of each lecture completely but it is advisable to note it down the important points. At the same time, the course will be fast paced. Thus it is extremely important that you remain attentive in the class and do not miss a lecture.

**Lecture Hours:** Please check the current semester time table or course web page

<http://home.iitj.ac.in/~chsarma/>

### **Policy for Attendance**

Attendance in lectures as well as tutorials is compulsory. Students not having 80 % attendance in the above may be awarded F grade. Attendance will be recorded through an attendance sheet that will be circulated in the class. Each student is expected to sign against his/her name only. Cases of Proxy will be severely dealt with. Random check will be performed from time to time.

### **Evaluation Plan**

- There will be surprising quizzes of weightage 10% and announced quizzes of weightage 10%. Day, time and topics for these quizzes will be announced later in the class.
- First Mid-semester examination, schedule to be held during First week of Feb, will be of 20 % weightage. Second Mid-semester examination, schedule to be held during 2<sup>nd</sup> week of March, will be of 20 % weightage. The End-semester examination, scheduled to be held during last week of April, will be of 40 % weightage.
- There are no make-up exams for quizzes and mid exams. However the end exam will be considered after proper documentation.