SECOND SEMESTER 2013-2014
Course Handout (Part II)

Date: 13-01-2016

In addition to Part I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : MATH F341
Course Title : INTRODUCTION TO FUNCTIONAL ANALYSIS
Instructor-in-Charge: **BALRAM DUBEY**

1. Scope and Objective of the Course:

Objective of the course is to present basic facts of Functional Analysis in a form suitable for Engineers Scientist & applied Mathematicians. Ideas are not always generated by logical process an engineer may have a feeling for a problem which may lead him in a method of solution but justifying part of that needs Analysis. Several concepts of Functional Analysis were invented as there was need from Integral & differential equations. Functional Analysis is needed in Numerical Analysis & differential equations. Modern theory of partial differential equations relies heavily on functional analysis. Theoretical study of numerical solution of partial differential equations is heavily based on functional Analysis.

2. Course Description:

Normed linear spaces, Banach Spaces; Continuous Linear transformations, open mapping theorem ;Closed graph theorem, Uniform boundedness Principle, Hahn Banach theorem, Hilbert Space theory; Dual space, Direct sum and orthogonal compliment in Hilbert spaces, Function spaces, Symmetric and self adjoint linear mapping in Hilbert spaces , Finite Rank & Compact transformations, Unbounded linear transformation, spectral theory, Differential equations and linear transformations

3 Text-book: Kreyzig. E., Introductory Functional Analysis with Applications, John Wiley

4. **Reference Books:**

I. C. Colin : Numerical Functional Analysis, Oxford University Press, 1982
II. BV Limaye : Functional Analysis, New Age International Ltd, 1996.
III. Arch W Naylor and Geprge R Sell : Linear operator theory in Engineering & Science: Applied Mathematical Sciences, Springer- Verlag, 1982.

Lecture no.	Learners objective	Subject matter	Ref.
1	Recollect some concept of linear Algebra and real Analysis	Vector spaces, dimension, infinite dimensional vector spaces, Metric spaces, space of Continuous functions	Chapter1 & Chapter 2 1st Article
2-4	Every normed linear space is a metric space	Normed Linear Spaces; Banach spaces	Chapter 2 Article 2
5-7	Study of certain normed linear spaces & their properties	l_p, C, C_0, C[a,c] & properties of normed linear spaces	Chapter 2 Article 3
8-9	All norms are equivalent on a finite dimensional normed linear space	Finite-Dimensional normed linear spaces and compact sets	Chapter 2 Article 4-5
10-13	A linear transformation is continuous iff bounded	Continuous linear transformations, examples of linear functionals, dual space , reflexive spaces	Chapter 2 Article 6-10
14-20	How concept of dot product has generalization to vector spaces,	Inner Product Spaces, Hilbert spaces, Orthogonal sets, direct sum, Bessel's inequality , Continuous linear functionals on Hilbert space	Chapter 3 Article 1-7
21-23	Dual of a Hilbert space, How transpose of a matrix has generalization to continuous linear transformations in Hilbert spaces	Riesz Representation Theorem, Symmetric and self adjoint Transformations	Chapter 3 Article 8-10
24	How a continuous linear functional defined on a subspace can be extended to whole space	Hahn-Banach Theorem	Chapter 4 Article 2
25-30	when a family of Continuous linear transformations uniformly bounded, When is a continuous linear map a homeomorphism ,closed linear maps need not be bounded	Category Theorem ,Uniform boundedness principle, Open Mapping Theorem, Closed Graph Theorem	Chapter 4 Article 7-13
31 - 35	Are there finite rank transformations defined on infinite dimensional spaces	finite rank transformations & Compact linear Transformations in normed linear spaces	Chapter 8

36-40	Generalization of concept of eigen values of matrices to bounded linear transformations	Spectral theory of bounded linear transformations	Chapter 7 & 9

Evaluation Scheme :

Components	Durations	Weightage %	Date & Time	Remarks
Mid Sem Exam	90 min.	35	17/3 2:00 -3:30 PM	Closed Book
Quizzes/assignments		20	Regular (may be conducted during regular class or common hour)	
Comprehensive Exam	3 hrs.	45	11/5 FN	Open/Closed Book

7. Chamber consultation hour: To be announced in class.

8. Notices: All notices regarding this course will be displayed on the Math NB only. Normally information will be conveyed in the class.

10. **Make up :** Prior permission is needed for makeup.

INSTRUCTOR-IN-CHARGE
MATH F341