

Module Code: MATH-311  
Module Title: **Functional Analysis - I**  
Module Rating: 3 Cr. Hours

### **Metric Space**

- Review of metric spaces
- Convergence in metric spaces
- Complete metric spaces
- Completeness proofs
- Dense sets and separable spaces
- No-where dense sets
- Baire category theorem

### **Normed Spaces**

- Normed linear spaces
- Banach spaces
- Convex sets
- Quotient spaces
- Equivalent norms
- Linear operators
- Linear functionals
- Finite dimensional normed spaces
- Continuous or bounded linear operators
- Dual spaces

### **Inner Product Spaces**

- Definition and examples
- Orthonormal sets and bases
- Annihilators, projections
- Hilbert space
- Linear functionals on Hilbert spaces
- Reflexivity of Hilbert spaces

### **Recommended Books**

1. E. Kreyszig, *Introduction to Functional Analysis with Applications*, (John Wiley and Sons, 2004)
2. A. L. Brown and A. Page, *Elements of Functional Analysis*, (Van Nostrand Reinhold London, 1970)
3. G. Bachman and L. Narici, *Functional Analysis*, (Academic Press, New York, 1966)
4. F. Riesz and B. Sz. Nagay, *Functional Analysis*, (Dover Publications, Inc., New York, Ungar, 1965)
5. A. E. Taylor, *Functional Analysis*, (John Wiley and Sons, Toppan, 1958)



**CHAIRMAN**  
Department of Mathematics  
University of the Punjab  
Lahore-Pakistan