KING ABDULAZIZ UNIVERSITY
DEPARTMENT OF MATHEMATICS
Syllabus For Ph.D. Entrance Exam
(1434/2013)

Real Analysis

Supremum and infimum of a set in R. Metric spaces, Cauchy and convergent sequences in metric spaces, completeness in metric spaces. Limit of a function, continuity and uniform continuity. Differentiation, Rolle's theorem; intermediate value theorem; mean-value theorem, L'Hospital's rule.

References:

1. R.G. Bartle, D.R. Sherbert, Introduction to Real Analysis, 3rd Edition, 2011.
2. W. Rudin, Principles of Mathematical Analysis, 3rd Edition 1976.

Functional Analysis:

Metric spaces, complete metric spaces, normed and Banach spaces, sequences and series in Banach spaces, quotients and products of normed spaces, bounded linear functionals and operators, dual spaces, reflexive spaces, inner product and Hilbert spaces, projection theorem, Riesz representation theorem, Hahn Banach Extension theorem, strong and weak convergence.

References:

1. J. R. Giles**,** Introduction to the Analysis of Normed Linear Spaces, 2000.
2. E. Kreyszig, Introductory Functional Analysis with Applications, 1989.
3. T. J. Morrison**,** Functional Analysis: An Introduction to Banach Space Theory, 2001.

Algebra:

Free abelian groups, Sylow theorems with applications to the groups of small orders, normal and subnormal series, solvable groups, Jordan-Holder Theorem.

Rings and ideals, factor rings, homomorphisms, isomorphism theorems of rings, maximal and prime ideals. Noncommutative examples of rings, polynomials, factorization of polynomials over fields.

Modules, submodules, factor modules, homomorphisms between modules, isomorphism theorems, direct sums and products, free modules.

References

1. C.C. Pinter, A Book of Abstract Algebra, Dover, 2nd Edition 2012.
2. D.S. Dummit, R.M.Foote, Abstract Algebra, 3rd Edition 2003.
3. J. J. Rotman, Advanced Modern Algebra (Graduate Studies in Mathematics) 2010.

Topology:

Topology and topological spaces, open and closed sets, closure and interior of sets, dense sets and separable spaces. Bases and local bases, first and second countable spaces. Separation Axioms: Continuous functions and homeomorphisms, homeomorphic spaces.

Reference:

1. C. Patty, Foundations of Topology, 1993.
2. James Munkers, Topology, 2nd Edition, 2000.

Differential Equations

ODEs: Basic concepts of the existence-uniqueness theory of ODEs. Methods of solution for solving IVPs/BVPs involving linear homogeneous/nonhomogeneous ODEs. Solving system of ODES.

Sturm-Liouville problems. Introduction to stability theory.

PDEs: Occurrence of PDEs (geometrical and physical ideas). Existence of solutions. Lagrange method of solutions for quasilinear PDEs. Methods of solution for solving second order PDEs. Cauchy Problem.

References:

1. Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th Edition, 2006. (Free Download).
2. Ian N. Sneddon, Elements of Partial Differential Equations, 2006.
3. Richard Haberman, Applied Partial Differential Equations, 4th Edition (Free Download).

Numerical Analysis

Numerical solution of linear systems: direct methods (Gauss Elimination), iterative methods (Jacobi and Gauss Seidel method). Numerical solution of initial value problems: Euler method, Runge Kutta method of order 4, systems of differential equations. Numerical solution of Boundary value problems: Finite difference method (second order only). Numerical solution of nonlinear systems: fixed point and Newton's method. Numerical solution of partial differential equation: explicit method and Crank Nicolson for parabolic equations in one dimension.

References:

1. R. Burden and J. D. Faris, Numerical Analysis, 8th Edition, 2004.
2. V. A. Patel, Numerical Analysis, 1994.