HOWARD UNIVERSITY
DEPARTMENT OF MATHEMATICS
SENIOR COMPREHENSIVE EXAM SYLLABUS

The Senior Comprehensive Exam in Mathematics covers Calculus I, Calculus II and Calculus III (Math 156 , Math 157, and Math 158), Introduction to Linear Algebra (Math 180) and Introduction to Analysis I (Math 195).

According to the current syllabi, these courses cover the following topics:

1 Calculus:

1.1 Calculus I - Math 156

Limits (Precise definition of Limit, One-Sided limits, Limits involving Infinity etc.), Continuous functions, Intermediate Value Theorem, Derivative (definition of derivative, Tangent Line, Differentiation Rules, Chain Rule, Implicit Differentiation, Related Rates, Linearization, etc), Application of Derivatives (Extreme Values of Functions, Rolle's Theorem, Mean value Theorem, Monotonic Functions, Concavity, L'Hopitals Rule, Optimization Problems), Integration (Riemann Sums, Definition of Definite Integral, Fundamental Theorems of Calculus, Area between curves).

1.2 Calculus II - Math 157

Applications of Definite Integrals (Volume, Arc Length, Areas, etc.), Techniques of Integration (Substitution, integration by parts, Trigonometric Integrals and Trigonometric Substitution, Partial Fractions Method, Numerical Integration), Improper Integrals, Definition of Convergence of Sequences, Infinite Series, Tests for Convergence (Integrals Test, Comparison Test, Ratio Test, etc.) , Alternating Series, Power Series, Taylor and Maclaurin Series.

1.3 Calculus III - Math 158

Vectors (Vector Products, Parametric representations), Calculus of Vector Valued Functions, Calculus of Functions of Several Variables (Limits and Continuity, Partial Derivatives, Chain Rule in Several Variables, Gradient, Tangent Planes, Extreme Values of functions of two Variables etc.), Multiple Integrals (Double Integrals, Surface areas, Volumes, Triple Integration, Applications of Triple Integral, Change of Variables, Cylindrical and Spherical Coordinates), Vector Calculus (Line Integrals, Green's Theorem, Surface Integrals, Divergence and Stokes Theorem).

2 Introduction to Linear Algebra - Math 180

Solving Systems of Linear Equations, Vectors, Linearly independent and Linearly dependent vectors, Linear Transformations and their matrices, Inverse of a Matrix, Dimension and Rank of Matrix, Determinant, Vector Spaces, Null Space, Columns Space, Dimension and Rank of a Vector Space, Bases of Vector Spaces, Eigen Values and Eigen Vectors.

3 Introduction to Analysis - Math 195

Proof by induction, Compact Sets, Limits, Limit Theorems, Sequences of real numbers (Convergence, boundedness, Subsequences, Cauchy Sequences), Heine-Borel Theorem, Bolzano - Weirestrass Theorem, Continuous Functions, Unifrom Continuity.