Syllabus for the Mathematics Qualifying Exam

The mathematics examination is based on contents from the course: MEGR 7174/8184, Engineering Analysis I. Students must obtain 70% or above on the exam to pass.

The topics for the Math Qualifying Exam can be found on next two pages.

Suggested textbooks to study:

Topics for the Math Qualifying Exam  
(January, 2021)

Part I Ordinary Differential Equations

1 Ordinary Differential Equations in Applications
  1.1 Physical Processes Modeling using ODEs
  1.2 Examples

2 First-Order Ordinary Differential Equations
  2.1 Direction Fields
  2.2 Type 1: Direct Integration
  2.3 Type 2: Separation of Variables
  2.4 Type 3: Exact Equations
  2.5 Type 4: Integrating Factors
  2.6 Type 5: Homogeneous Differential Equations
  2.7 Type 6: Bernoulli Equations
  2.8 Miscellaneous
  2.9 Existence and Uniqueness Conditions

3 Second and Higher Order Ordinary Differential Equations
  3.1 General Theory
     3.1.1 Homogeneous and Nonhomogeneous Parts of an $n$th-order Equation
     3.1.2 Normal Differential Equation
     3.1.3 An Existence and Uniqueness Theorem for Normal Equations
     3.1.4 Families of Solutions, Linear Dependence and Independence
     3.1.5 Wronskian of Particular Solutions of a Second-Order ODE
  3.2 Methods to Obtain Solutions to ODEs
     3.2.1 Variation of Parameters
3.2.2 Reduction of Order
3.2.3 Constant Coefficient ODEs
3.2.4 Method of Undetermined Coefficients
3.2.5 The Euler-Cauchy Differential Equation
3.2.6 Boundary Value Problems
3.3 Power Series Methods to Obtain Solutions to ODEs
3.3.1 Power Series
3.3.2 Regular and Singular Points of an ODE
3.3.3 Power Series Solutions to ODEs about an ordinary point
3.3.4 Power Series Solutions to ODEs about a regular singular point

Part II Partial Differential Equations

4 Second Order Partial Differential Equations
4.1 Introduction to Partial Differential Equations
4.1.1 Classification of PDEs
4.1.2 Examples of Parabolic, Hyperbolic and Elliptic PDEs
4.2 Fourier Series
4.2.1 Periodic Functions
4.2.2 Fourier Representation of a Function
4.2.3 Even and Odd Functions
4.2.4 Fourier Cosine and Sine Series
4.2.5 Convergence of a Fourier Series
4.2.6 Half-Range Expansions
4.3 Separation of Variables for PDEs with Homogeneous Boundary Conditions
4.3.1 One-Dimensional Wave Equation
4.3.2 One-Dimensional Heat Equation
4.3.3 Laplace’s Equation in Two-Dimensions
4.3.4 Sturm-Liouville Eigenvalue Problems
4.4 Separation of Variables for PDEs with Inhomogeneous Boundary Conditions and Source Terms
4.5 Separation of Variables for PDEs in Cylindrical Coordinates
4.5.1 An Example Problem
4.5.2 Bessel Functions
4.5.3 Applications