

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:

- *Advanced Engineering Mathematics*, by Erwin Kreyszig, Herbert Kreyszig, and Edward J. Norminton; Hoboken, NJ: John Wiley, 10th Edition (December 8, 2010).
- *Schaum's Outline of Differential Equations*, by Richard Bronson and Gabriel Costa; McGraw Hill Professional, ISBN-13: 978-0071824859, ISBN-10: 0071824855, 4th Edition (Mar 2014).

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