

The Hashemite University Faculty of Engineering Course Syllabus

Department of Mechanical Engineering

Course Title:	Engineering Analysis (3,0,0)	Course Number:	120402701
Designation:	Graduate Course	Prerequisite(s):	
Instructor:	Dr. Rami Al-Jarrah	E-mail:	ramia@hu.edu.jo
LECTURE TIME AND LOCATION: ONLINE LECTURES USING MICROSOFT TEAMS			

Course Description:

❖ This course is to discuss some of the concepts of Engineering Analysis. It provides a comprehensive, thorough, and up-to-date treatment of *Engineering Mathematics*. It is intended to introduce graduated students of Mechanical Engineering to areas of *Applied Mathematics* that are most relevant for solving practical problems.

<u>Textbook(s)</u> and/or Other Supplementary Materials:

❖ Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, JOHN WILEY & SONS, INC., **2011.**

Major Topics Covered:

Chapter	Section		
CHAPTER 1 First-Order ODEs	1.1 Basic Concepts. Modeling 1.2 Geometric		
	1.3 Separable ODEs. Modeling 1.4 Exact ODEs. Integrating Factors		
	1.5 Linear ODEs. Bernoulli Equation. Population Dynamics 1.6 Orthogonal Trajectories.		
	1.7 Existence and Uniqueness of Solutions for Initial Value Problems		
	2.1 Homogeneous Linear ODEs of Second Order2.2 Homogeneous Linear ODEs with Constant Coefficients		
	2.3 Differential Operators.2.4 Modeling of Free Oscillations of a Mass–Spring System		
CHAPTER 2	2.5 Euler–Cauchy Equations		
Second-Order Linear ODEs	2.0 Emberies and originals		
Linear ODLs	2.8 Modeling: Forced Oscillations. Resonance		
	2.9 Modeling: Electric Circuits2.10 Solution by Variation of Parameters		
CHAPTER 4	4.1 Systems of ODEs as Models in Engineering Applications 4.4 Criteria for Critical Points. Stability		
Systems of ODEs	11.1 Fourier Series		
CHAPTER 11 Fourier Analysis	11.2 Arbitrary Period. Even and Odd Functions. Half-Range Expansions 11.3 Forced Oscillations 11.4 Approximation by Trigonometric Polynomials 11.5 Sturm–Liouville Problems. Orthogonal Functions 11.6 Orthogonal Series. Generalized Fourier Series 11.7 Fourier Integral 11.8 Fourier Cosine and Sine Transforms		
	11.9 Fourier Transform. Discrete and Fast Fourier Transforms6.1 Laplace Transform. Linearity. First Shifting Theorem (s-Shifting)		
CHAPTER 6 Laplace Transforms	 6.2 Transforms of Derivatives and Integrals. ODEs 6.3 Unit Step Function (Heaviside Function). Second Shifting Theorem (t-Shifting) 6.4 Short Impulses. Dirac's Delta Function. Partial Fractions 6.5 Convolution. Integral Equations 6.6 Differentiation and Integration of Transforms. ODEs with Variable Coefficients 6.7 Systems of ODEs 6.8 Laplace Transform: General Formulas 6.9 Table of Laplace Transforms 		
	12.1 Basic Concepts of PDEs 12.2 Modeling: Vibrating String, Wave Equation		

CHAPTER 12 Partial Differential Equations (PDEs)	12.3 Solution by Separating Variables. Use of Fourier Series 12.4 D'Alembert's Solution of the Wave Equation. Characteristics 12.5 Modeling: Heat Flow from a Body in Space. Heat Equation 12.6 Heat Equation: Solution by Fourier Series. Steady Two-Dimensional Heat Problems. 12.7 Heat Equation: Modeling Very Long Bars. Solution by Fourier Integrals and Transforms 12.8 Modeling: Membrane, Two-Dimensional Wave Equation 12.9 Rectangular Membrane. Double Fourier Series 12.10 Laplacian in Polar Coordinates. Circular Membrane. Fourier—Bessel Series 12.11 Laplace's Equation in Cylindrical and Spherical Coordinates. Potential 12.12 Solution of PDEs by Laplace Transforms	
CHAPTER 7 Linear Algebra: Matrices, Vectors, Determinants.	7.1 Matrices, Vectors: Addition and Scalar Multiplication 7.2 Matrix Multiplication 7.3 Linear Systems of Equations. Gauss Elimination 7.4 Linear Independence. Rank of a Matrix. Vector Space 7.5 Solutions of Linear Systems: Existence, Uniqueness 7.6 For Reference: Second- and Third-Order Determinants 7.7 Determinants. Cramer's Rule 7.8 Inverse of a Matrix. Gauss–Jordan Elimination	
CHAPTER 9 Vector Differential Calculus	 9.1 Vectors in 2-Space and 3-Space 9.2 Inner Product (Dot Product) 9.3 Vector Product (Cross Product) 9.4 Vector and Scalar Functions and Their Fields. Vector Calculus: Derivatives 9.5 Curves. Arc Length. Curvature. Torsion 9.6 Calculus Review: Functions of Several Variables. 9.7 Gradient of a Scalar Field. Directional Derivative 9.8 Divergence of a Vector Field 9.9 Curl of a Vector Field 	
CHAPTER 5 Series Solutions of ODEs.	5.1 Power Series Method 5.4 Bessel's Equation. Bessel Functions 5.5 Bessel Functions. General Solution	
CHAPTER 15 Power Series, Taylor Series	15.1 Sequences, Series, Convergence Tests 15.2 Power Series 15.3 Functions Given by Power Series 15.4 Taylor and Maclaurin Series	
CHAPTER 17 Conformal Mapping	17.1 Geometry of Analytic Functions: Conformal Mapping 17.2 Linear Fractional Transformations 17.3 Special Linear Fractional Transformations 17.4 Conformal Mapping by Other Functions	

Grading Plan:

Mid Exam 30 Points
Others 20-30 Points

Final exam 40-50 Points

Prepared by: Sr. Rami Al-Jarrah Date: 10th October 2020