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.

Textbook(s) 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
CHAPTER 2 Second-Order Linear ODEs	2.1 Homogeneous Linear ODEs of Second Order 2.2 Homogeneous Linear ODEs with Constant Coefficients 2.3 Differential Operators. 2.4 Modeling of Free Oscillations of a Mass–Spring System 2.5 Euler–Cauchy Equations 2.6 Existence and Uniqueness of Solutions. 2.7 Nonhomogeneous ODEs 2.8 Modeling: Forced Oscillations. Resonance 2.9 Modeling: Electric Circuits 2.10 Solution by Variation of Parameters
CHAPTER 4 Systems of ODEs	4.1 Systems of ODEs as Models in Engineering Applications 4.4 Criteria for Critical Points. Stability
CHAPTER 11 Fourier Analysis	11.1 Fourier Series 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 Transforms
CHAPTER 6 Laplace Transforms	6.1 Laplace Transform. Linearity. First Shifting Theorem (*s*-Shifting) 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: *Dr. Rami Al-Jarrah* **Date:** *10th October 2020*