The University of Jordan
School of Engineering
Electrical Engineering Department

2nd Semester – A.Y. 2023/2024

Course: **Engineering Analysis (II) – 0903202 (3 Cr. – Required Course)**

Instructor: Dr. Yanal Faouri
Office: E314, Telephone: 06/5355000 Ext. 22843, Email: y.faouri@ju.edu.jo
Office Hours: UTR: 11:30 AM – 12:30 PM.

Course website: **https://elearning.ju.edu.jo/moodle10/course/view.php?id=24676**

Catalog Description: Vector differential calculus. The gradient of a scalar field. Divergence and Curl of a vector field. Vector integral calculus. Line and surface integrals. Green's theorem. Divergence theorem of Gauss. Stokes' theorem. Partial differential equations (PDE). Solution of PDE by separating variables. Solution of PDE by Fourier series. Solution of PDE by Fourier integrals and transforms. Linear algebra. Matrices, determinants, and systems of linear equations. Gauss elimination. Cramer's rule. Linear dependence. The inverse of a matrix. Vector spaces and subspaces. Rank and nullity. Inner product spaces. Orthonormal bases. Eigenvalues and eigenvectors. Linear transformations. Linear algebra applications.

Prerequisites by course: **EE 0903201** Engineering Analysis (I) (pre-requisite) **EE 0953221** Signal Analysis & Systems (pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Calculus (functions, limits, differentiation and integration, partial derivatives).
- Ordinary differential equations.
- Fourier series and Fourier transform.

Textbook: **Advanced Engineering Mathematics by Dennis G. Zill, Jones & Bartlett Learning, 7th Edition, 2020.**

References:
1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley, 10th Edition, 2011.
2. Advanced Engineering Mathematics by Peter V. O'Neil, Cengage Learning, 8th Edition, 2017.
3. Advanced Engineering Mathematics by K.A. Stroud and Dexter Booth, Red Globe Press, 6th Edition, 2020.
4. Schaum's Outline of Differential Equations by Richard Bronson and Gabriel Costa, McGraw-Hill Education, 4th edition, 2014.
5. Schaum's Outline of Advanced Mathematics for Engineers and Scientists by Murray Spiegel, McGraw-Hill Education, 1st Edition, 2009.
6. Elementary Linear Algebra by Ron Larson, Cengage Learning, 8th Edition, 2016.
7. Linear Algebra Done Right by Sheldon Axler, Springer, 3rd Edition, 2015.
8. Schaum's Outline of Linear Algebra, by Seymour Lipschutz and Marc Lipson, McGraw-Hill Education, 6th Edition, 2017.

Schedule: 16 Weeks, 42 lectures (50 minutes each) including exams.

Course goals: The overall objective is to introduce the student to the fundamentals of vector differential calculus, line and surface integrals, partial differential equations and their solution techniques, and linear algebra.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will: **[SO]**

1. Be able to calculate the gradient of a scalar function and the divergence and curl of a vector field. **[1]**
2. Be able to evaluate line integrals, apply Green's theorem to transform between double and line integrals, apply the divergence theorem of Gauss to transform between triple and surface integrals, and apply Stokes's theorem to transform between surface and line integrals. **[1]**
3. Be able to solve partial differential equations using the separation of variables technique. **[1]**
4. Be able to solve partial differential equations using Fourier series, integrals, and transforms. **[1]**
5. Be able to perform computations involving linear systems, matrices, vector spaces, and linear transformations. **[1]**
6. Be able to evaluate the eigenvalues and eigenvectors of a matrix. **[1]**
7. Be able to use linear algebra and/or partial differential equations to model a given engineering system. **[1]**

Course topics:

		Hrs
1.	Review of vectors in 2-space and 3-space. Review of vector dot product and cross product. Review of lines, curves, and planes: circle, ellipse, straight line, helix, plane curves. Tangent to a curve. Vector spaces and subspaces. Orthonormal bases.	**8**
2.	Linear algebra. Systems of linear equations. Matrices. Matrix operations. Rank and nullity. Determinants. Matrix inverse and using it to solve systems of equations. Linear dependence. Gauss elimination. Cramer's rule. Powers of matrices. Orthogonal matrices.	**6**
3.	Eigenvalues and eigenvectors. Diagonalization. LU-Factorization. Linear transformations.	**4**
4.	Practical linear algebra applications (such as error-correcting codes, cryptography, etc.). Project.	**2**
5.	The gradient of a scalar field. Divergence and curl of a vector field. Line integrals. Independence of the path for line integrals. Double integrals. Green's theorem. Surfaces and surface integrals. Stokes's theorem. Triple integrals. Divergence theorem of Gauss. Change of variables in multiple integrals.	**14**
6.	Partial Differential Equations (PDEs) and boundary-value problems. Boundary-value problems in rectangular coordinates. Using PDEs to model a vibrating string and electromagnetic waves (wave equation). Solving PDEs by separation of variables. Use of Fourier series. Characteristics of the wave equation solution. Heat Equation: Solution by Fourier series. Heat Equation: Solution by Fourier integrals and transforms. Laplace's equation.	**6**
7.	Boundary-value problems in other coordinate systems. Laplace equation for electrostatic potentials in polar coordinates.	**2**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken at every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed books. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

First Exam	25%
Midterm Exam	25%
Final Exam	50%
Total	**100%**

Last Revised: February 2024

Important Notes:

Attendance:

- Class attendance will be taken and the University policy on absence shall be applied.
- According to the university regulations, any student who exceeds 15% (5 for MW and 8 for UTR lectures) of the scheduled class meeting without an official excuse will receive a grade of F in the course. (محروم)
- According to the university regulations, any student that exceeds 15% (5 for MW and 8 for UTR lectures) of the scheduled class meeting with an official excuse will be considered dropped from the course. (منسحب)
- Official excuses: All official excuses related to the exams must be submitted to the instructor no later than one week before the exam date. The instructor may not accept a late excuse.
- Attendances will be uploaded to the Grades system after every lecture.