MAT332 - PARTIAL DIFFERANTIAL EQUATIONS II - Fen Edebiyat Fakültesi - Matematik Bölümü

General Info

Objectives of the Course

Giving basic information about partial differential equations that the student will need during undergraduate and graduate education. And to figure out how to go about solving problems.

Course Contents

Second order linear equation with constant coefficients, Generalization of equation with constant coefficients, Non-reducible equations, Euler equation, Second order almost linear equations, Reduction to kanoic form, Second order linear equations with variable coefficients, Order reduction of second order linear equation, Wave equation, A fixed string vibration motion of the ends, Solutions of Laplace equations

Recommended or Required Reading

Kısmi Türevli Denklemler-Prof. Dr. Kerim Koca

Planned Learning Activities and Teaching Methods

The course will involve theoretical lectures, example problem-solving sessions, in-class discussions, homework assignments, and project work. Active student participation will be encouraged during lectures to enhance understanding of the topics. Applied problem-solving using software tools (e.g., Mathematica) will also be demonstrated.

Recommended Optional Programme Components

Regular attendance is crucial for successful completion of the course. Students are encouraged to study independently outside class hours to reinforce the material covered. A strong mathematical background, particularly in differential equations and linear algebra, is essential for success in this course.

Instructor's Assistants

There is no instructor's assistants teaching the course.

Presentation Of Course

The course will be delivered face-to-face (in-person instruction). Alongside theoretical content, practical examples will be included during lectures. Students will be encouraged to actively participate. Online materials may be provided as supplementary resources when necessary.

Dersi Veren Öğretim Elemanları

Assoc. Prof. Dr. Mehmet Şenol

Program Outcomes

1. Can classify second-order linear PDEs with constant coefficients and apply fundamental solution methods.
2. Can analyze generalized forms of constant coefficient equations and adapt solution techniques accordingly.
3. Can identify non-reducible PDEs and evaluate appropriate approaches for their solution.
4. Can recognize Euler-type differential equations and solve them using appropriate transformation techniques.
5. EN: Can analyze nearly linear second-order equations and apply solution methods.
6. Can apply canonical form reduction techniques to partial differential equations.
7. Can interpret second-order linear PDEs with variable coefficients and solve them using suitable methods.
8. Can apply order reduction techniques in second-order linear differential equations.
9. Can obtain the one-dimensional solution of the homogeneous wave equation using the method of separation of variables.
10. Can solve the two-dimensional wave equation in a rectangular domain.
11. Can obtain separable solutions of the one-dimensional heat equation and apply them to heat conduction problems.
12. Can solve the Laplace equation under various boundary conditions.

Weekly Contents

Order	PreparationInfo	Laboratory	TeachingMethods	Theoretical	Practise
1	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Classification of second order linear partial differential equations with constant coefficients.	Classification of second order linear partial differential equations with constant coefficients.

Order	PreparationInfo	Laboratory	TeachingMethods	Theoretical	Practise
2	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution methods for equations with constant coefficients.	Solution methods for equations with constant coefficients.
3	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution methods of irreducible partial differential equations.	Solution methods of irreducible partial differential equations.
4	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution method of partial differential equations of Euler type.	Solution method of partial differential equations of Euler type.
5	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution methods of almost linear partial differential equations of the second order.	Solution methods of almost linear partial differential equations of the second order.

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6	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Reduction of partial differential equations to canonical form.	Reduction of partial differential equations to canonical form.
7	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution methods of second order linear partial differential equations with variable coefficients.	Solution methods of second order linear partial differential equations with variable coefficients.
8	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.		
9	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution of homogeneous wave equations by separation of variables.	Solution of homogeneous wave equations by separation of variables.

Order	PreparationInfo	Laboratory	TeachingMethods	Theoretical	Practise
10	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution of homogeneous wave equations by separation of variables.	Solution of non-homogeneous wave equations by separation of variables.
11	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution of the two-dimensional wave equation in a rectangular domain.	Solution of the two-dimensional wave equation in a rectangular domain.
12	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution of the two-dimensional wave equation in a rectangular domain.	Solution of the two-dimensional wave equation in a rectangular domain.
13	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution methods of one dimensional heat equation.	Solution methods of one dimensional heat equation.

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14	Basic knowledge of ordinary differential equations (especially first- and second-order ODEs) Understanding of linear algebra (matrix operations, eigenvalues and eigenvectors) Knowledge of partial derivatives and multivariable calculus (Calculus II/III) Basic understanding of Fourier analysis (Fourier series, trigonometric transforms) Successful completion of Partial Differential Equations I course.		Lecture (Theoretical Course): Basic concepts and vector-matrix definitions in MATLAB are explained in detail with subject explanations. Practical Demonstration: Vector and matrix operations are demonstrated step by step on the MATLAB screen. Computer-Aided Applications: Students practice on their own computers with examples and exercises. Question-Answer: Intermediate questions are used to ensure active participation of students. Problem Solving: Vector/matrix problems are solved in the context of real-life problems or engineering applications. Quiz and Feedback: Instant evaluation is done with short exercises and tests at the end of the subject.	Solution methods of one dimensional heat equation.	Solution methods of one dimensional heat equation.
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Workload

Activities	Number	PLEASE SELECT TWO DISTINCT LANGUAGES
Derse Katılım	14	4,00
Vize	1	1,00
Ödev	4	3,00
Ders Öncesi Bireysel Çalışma	14	1,00
Ders Sonrası Bireysel Çalışma	14	1,00
Ara Sınav Hazırlık	1	1,00

Assesments

Activities	Weight (%)
Ara Sınav	40,00
Final	60,00

	P.O. 1	P.O. 2	P.O. 3	P.O. 4	P.O. 5	P.O. 6	P.O. 7	P.O. 8	P.O. 9	P.O. 10	P.O. 11
L.O. 1											
L.O. 2											
L.O. 3											
L.O. 4											
L.O. 5											
L.O. 6											
L.O. 7											
L.O. 8											
L.O. 9											
L.O. 10											
L.O. 11											
L.O. 12											

Table :

P.O. 1 : Matematiğin temel alanlarından Analiz, Geometri ve Cebirin temel kavramlarını bilimsel yöntem ve teknikler yardımıyla tanımlar.

P.O. 2 : Matematiksel verileri yorumlar, çözümler, güvenirliliğini ve geçerliliğini değerlendirir.

P.O. 3 : Günlük hayattaki bazı problemlerin Matematiksel modellerini tanımlar, eleştirel bir açı ile değerlendirir, teorik ve uygulamalı bilgilerle analiz eder.

P.O. 4 : Öğrenme süreçlerinde disiplinler arası yaklaşımı analitik olarak kullanır.

P.O. 5 : Matematik alanındaki bir konuya uygun materyal geliştirir; bilgi ve tecrübe kazanımlarını farklı yöntemlerle kullanır.

P.O. 6 : Kendini bir birey olarak tanır; yaratıcı ve güçlü yönlerini kullanır, kişisel ve kurumsal iletişim ve etkileşim kurar.

P.O. 7 : Alanıyla ilgili öğrenme ihtiyaçlarını belirler. Alanının gerektirdiği düzeyde bilgisayar yazılımı ile birlikte bilişim ve iletişim teknolojilerini ileri düzeyde etkileşimli olarak kullanır.

P.O. 8 : Yaşam boyu öğrenme ve kalite yönetim süreçlerini öğrenir ve uygular; alanındaki sosyal, kültürel ve sanatsal etkinliklere katılır.

P.O. 9 : Toplumsal sorumluluk bilinciyle mesleki proje ve etkinlikler planlar ve uygular.

P.O. 10 : Matematik temel alanının gerektirdiği yabancı dili Avrupa Dil Portföyü B1 Genel düzeyinde kullanarak sözlü ve yazılı iletişim kurar.

P.O. 11 : Kazanacağı bilgi birikimi ile sorumluluğu altında çalışanların öğrenme gereksinimlerini belirler, lisansüstü eğitimin gereklerini yerine getirir.

L.O. 1 : İkinci basamaktan sabit katsayılı lineer kısmi diferansiyel denklemleri sınıflandırabilir ve temel çözüm yöntemlerini uygulayabilir.

L.O. 2 : Sabit katsayılı denklemlerin genelleştirilmiş formlarını analiz ederek çözüm tekniklerini uygun şekilde uyarlayabilir.

L.O. 3 : İndirgenemeyen (non-reducible) kısmi diferansiyel denklemleri tanımlayabilir ve bu tür denklemlere uygun yaklaşım yollarını değerlendirebilir.

L.O. 4 : Euler tipi diferansiyel denklemleri tanıyabilir ve uygun dönüşüm teknikleriyle çözümleyebilir.

L.O. 5 : İkinci basamaktan hemen hemen lineer denklemleri analiz edebilir ve çözüm yöntemlerini uygulayabilir.

L.O. 6 : Kısmi diferansiyel denklemleri kanonik forma indirgeme tekniklerini uygulayabilir.

L.O. 7 : Değişken katsayılı ikinci basamak lineer kısmi diferansiyel denklemleri çözüm yöntemleriyle birlikte yorumlayabilir.

L.O. 8 : İkinci basamaktan lineer denklemlerde basamak (order) indirgeme yöntemini uygulayabilir.

L.O. 9 : Homojen dalga denkleminin bir boyutlu çözümünü değişkenlerine ayırma yöntemiyle elde edebilir.

L.O. 10 : Dikdörtgensel bölgede iki boyutlu dalga denklemini çözebilir.

L.O. 11 : Bir boyutlu ısı denklemini ayrılabilir çözümlerle elde edebilir ve ısı iletimi problemlerinde uygulayabilir.

L.O. 12 : Laplace denkleminin çözümünü çeşitli sınır koşulları altında gerçekleştirebilir.