MAT548 - MATHEMATICAL PROGRAMMING II - Fen Bilimleri Enstitüsü - Matematik Ana Bilim Dalı

General Info

Objectives of the Course

The aim of this course is to enable students to learn and apply mathematical concepts using the Mathematica software. Students will acquire skills in defining functions, plotting graphs, performing calculus, linear algebra, and differential equations, as well as implementing basic programming. The course is designed to enhance students' ability to integrate mathematical reasoning and problem-solving with computational tools.

Course Contents

(1) Fundamental features of Mathematica: numbers, variables, functions, and symbolic operations (2) Numerical approaches, graphics and visualization tools, interactive manipulations, and programming (3) Creating lists, operations with list elements, and applying functions to lists (4) Graphical and analytical investigation of single and multivariable functions (5) Calculus topics: limits, derivatives, integrals, and series (6) Linear algebra applications: vector operations, matrix operations, systems of equations, and matrix factorizations (7) Differential equations and their solutions in Mathematica (8) Mathematica's core language, functional and procedural programming, flow control, and program examples

Recommended or Required Reading

Matematik ve İstatistik Uygulamalarıyla Mathematica Enis Sınıksaran, Aylin Aktükün TÜRKMEN KİTABEVİ

Planned Learning Activities and Teaching Methods

(1) Theoretical lectures (2) Applied computer laboratory sessions (3) In-class discussions and question–answer (4) Problem-solving and sample applications (5) Individual assignments and project work (6) Interactive practices using software

Recommended Optional Programme Components

(1) Students are advised to attend classes regularly and participate actively in laboratory sessions. (2) It is recommended that they install and practice Mathematica on their own computers outside class hours. (3) Reviewing mathematical topics from previous courses (Analysis, Linear Algebra, Differential Equations) is beneficial. (4) Following supplementary resources and guidelines provided during the course is encouraged.

Instructor's Assistants

There is no instructor's assistants teaching the course.

Presentation Of Course

The course is delivered face-to-face in the computer laboratory. Students actively work on Mathematica during each session, where theoretical knowledge is immediately reinforced through practical applications in the software environment. In this way, both theoretical and applied learning proceed together, providing students with hands-on experience and direct practice opportunities.

Dersi Veren Öğretim Elemanları

Assoc. Prof. Dr. Mehmet Şenol

Program Outcomes

1. Explain the basic features, commands, and applications of Mathematica.
2. Apply function definitions, list operations, and symbolic/numerical computations.
3. Plot graphs of single and multivariable functions and use visualization tools.
4. Perform calculus operations such as limits, derivatives, integrals, and series in Mathematica.
5. Carry out vector and matrix operations, solve systems of linear equations, and perform matrix factorizations.
6. Solve differential equations using Mathematica and interpret the results.
7. Develop algorithms using Mathematica's functional and procedural programming structures.
8. Acquire the ability to model and solve mathematical problems with computer assistance.

Weekly Contents

Order	PreparationInfo	Laboratory	TeachingMethods	Theoretical	Practise
1	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Introduction to Mathematica, interface, and basic features	Introduction to Mathematica, interface, and basic features

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2	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Numbers, variables, function definitions, basic commands	Numbers, variables, function definitions, basic commands
3	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Symbolic operations and numerical computations	Symbolic operations and numerical computations
4	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Plotting: two- and three-dimensional graphs, visualization tools	Plotting: two- and three-dimensional graphs, visualization tools
5	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Lists and list operations, applying functions to lists	Lists and list operations, applying functions to lists
6	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Analysis of single-variable functions and their plots	Analysis of single-variable functions and their plots
7	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Analysis of multivariable functions and their plots	Analysis of multivariable functions and their plots

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8	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Calculus applications I: limits and derivatives	Calculus applications I: limits and derivatives
9	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Calculus applications II: integrals and series	Linear algebra applications I: vector operations, matrix operations
10	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Linear algebra applications I: vector operations, matrix operations	Linear algebra applications I: vector operations, matrix operations
11	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Linear algebra applications II: systems of equations, matrix factorizations	Linear algebra applications II: systems of equations, matrix factorizations
12	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Differential equations: basic solutions and graphical interpretation	Differential equations: basic solutions and graphical interpretation
13	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Programming in Mathematica: functional and procedural approaches, flow control	Programming in Mathematica: functional and procedural approaches, flow control

Order	PreparationInfo	Laboratory	TeachingMethods	Theoretical	Practise
14	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	Programming in Mathematica: functional and procedural approaches, flow control	Programming in Mathematica: functional and procedural approaches, flow control
15	For this course, students are expected to have a fundamental background in Analysis I–II, Linear Algebra, and Differential Equations. Familiarity with topics such as functions, differentiation and integration, matrix operations, and solutions of differential equations is essential. Basic computer literacy is also recommended to facilitate participation in laboratory applications.		The course is conducted through a combination of theoretical lectures and applied computer laboratory sessions. Students first learn the fundamental concepts from the instructor and then reinforce their understanding by directly applying them in Mathematica. Active participation is encouraged through problem-solving, sample applications, in-class discussions, assignments, and small projects.	General review, sample projects, and applications	General review, sample projects, and applications

Workload

Activities	Number	PLEASE SELECT TWO DISTINCT LANGUAGES
Vize	1	1,00
Derse Katılım	14	4,00
Ödev	4	3,00
Ders Öncesi Bireysel Çalışma	14	2,00
Ders Sonrası Bireysel Çalışma	14	2,00
Ara Sınav Hazırlık	2	4,00
Final Sınavı Hazırlık	1	1,00
Teorik Ders Anlatım	4	4,00
Problem Çözme	4	4,00

Assesments

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

Matematik Ana Bilim Dalı / MATEMATİK (YÜKSEK LİSANS - TEZLİ) X Learning Outcome Relation

	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	P.O. 12	P.O. 13	P.O. 14	P.O. 15	P.O. 16	P.O. 17	P.O. 18
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L.O. 2																		
L.O. 3																		
L.O. 4																		
L.O. 5																		
L.O. 6																		
L.O. 7																		
L.O. 8																		

Table :

P.O. 1 : Analiz, Uygulamalı matematiğin, Geometri ve Cebirin bazı alt toerileri hakkındaki temel teoremleri yeni problemlere uygulayabilir.

P.O. 2 : programcıktısı 2

P.O. 3 : Matematik, fen bilimleri ve kendi dalları ile ilgili konularda yeterli alt yapıya sahiptir ve bu alanlardaki teorik ve uygulamalı bilgileri jmatematik problemlerin çözümleri için kullanır.

P.O. 4 : Bilimsel, matematiksel düşünme yeteneği kazanabilme ve ilgili alanlarda bu bilgiyi kullanabilme.

P.O. 5 : Bilimsel, matematiksel düşünme yeteneği kazanabilme ve ilgili alanlarda bu bilgiyi kullanabilme.

P.O. 6 : Temel matematiksel beceriler (problem çözme, akıl yürütme, ilişkilendirme, genelleme) ve bu becerilere dayalı yetenekler edinebilme. (Rasyonel düşünme tekniği kazandırabilme)

P.O. 7 : Bilim ve teknolojideki gelişmeleri izleme ve kendini sürekli yenileme becerisi kazanabilme.

P.O. 8 : Bilgiye erişebilme ve bu amaçla kaynak araştırması yapabilme, veri tabanlarını ve diğer bilgi kaynaklarını kullanabilme becerisine sahip olabilme.

P.O. 9 : Çalışma hayatında etik sorumlulukların gereklerini yerine getirebilme.

P.O. 10 : Bilim tarihi ve bilimsel bilginin üretimiyle ilgili bilgi edinebilme.

P.O. 11 : Eleştirel ve yaratıcı düşünmenin ve problem çözme becerilerinin gelişimi için uygun yöntem ve tekniklerle etkinlikler düzenleyebilme.

P.O. 12 : Çalışma hayatı ve sosyal yaşam ile ilgili konularda bireysel ve takım çalışmaları yapabilme.

P.O. 13 : Alanı ile ilgili konularda düşüncelerini ve konulara ilişkin çözüm önerilerini yazılı ve sözlü olarak aktarabilme.

P.O. 14 : Matematiksel bilgi birikimlerini teknolojide kullanabilme.

P.O. 15 : Alanındaki bilgileri izleyebilecek ve meslektaşları ile iletişim kurabilecek düzeyde bir yabancı dili geliştirebilme.

P.O. 16 : Gerçek dünya problemlerinde Matematiksel prensipleri uygulayabilme.

P.O. 17 : Farklı disiplinlerin yaklaşım ve bilgilerini Matematikte kullanabilme.

P.O. 18 : Matematik alanındaki bir problemi, bağımsız olarak kurgulayabilme, çözüm yöntemi geliştirebilme, çözebilme, sonuçları değerlendirebilme ve gerektiğinde uygulayabilme.

L.O. 1 : Mathematica'nın temel özelliklerini, komutlarını ve kullanım alanlarını açıklar.

L.O. 2 : Fonksiyon tanımlama, liste işlemleri ve sembolik/nümerik hesaplamaları uygular.

L.O. 3 : Tek ve çok değişkenli fonksiyonların grafiklerini çizer ve görselleştirme araçlarını kullanır.

L.O. 4 : Limit, türev, integral ve seriler gibi kalkülüs işlemlerini Mathematica ortamında gerçekleştirir.

L.O. 5 : Vektör ve matrislerle işlemleri yapar, lineer denklem sistemlerini ve matris ayrışımlarını çözer.

L.O. 6 : Diferansiyel denklemleri Mathematica kullanarak çözer ve elde edilen sonuçları yorumlar.

L.O. 7 : Mathematica'nın programlama yapısını (fonksiyonel ve prosedürel) kullanarak algoritmalar geliştirir.

L.O. 8 : Matematiksel problemleri bilgisayar destekli olarak modelleme ve çözme becerisi kazanır.