Date	**Fall 2015-2016**	**Credits**	**3 credits**
Course Title	Advanced Topics in Engineering Mathematics	**Course Number**	**Math 501**
Pre-requisite (s)	**None**	**Co-requisite (s)**	**None**
Hours	**36**	**Out of Class Work Hours**	**90**

Place and Time of Class Meeting

Tuesday 13:00-15:50 @ D304

Name and Contact Information of Instructor

Prof. Dr. Veli Shahmurov
Phone: +90 216 6771630- ext. 2422
E-mail: veli.sahmurov@okan.edu.tr

Book required

1.Veli Shakhmurov and G. Uzgoren, Linear Algebra and applications, Okan University, 2014;
2. Walter Rudin, *Functional Analysis*, 2nd Edition, McGraw Hill, 1991;
3. Marsel B. Finan, A fiğrst course in quasilinear partial differential equations for fhysical and engineering, ArkansesTech University, 2016

Classroom expectations for students

Attendance Policy

Students are liable to attend every course, practical and laboratory work of the program they are enrolled and to take the exams and participate in academic work required for achieving the course. Student attendance to all courses is compulsory. Students who do not attend a minimum 70% of the theoretical courses and 80% of the practical courses will be considered as absent for the related courses. Students who do not meet the mandatory minimum requirement of attendance will fail the course. Students who fail a course for not fulfilling minimum attendance requirement are obliged to meet the attendance requirement when they re-take the course.

Student Tardiness Policy

Students are permitted to arrive to the class in the first 15 minutes after the scheduled start of the course; extension of tardiness time is in instructor's discretion.

Course Description (must correspond exactly to Catalog description)

The purpose of this course is to prepare students fist of all background of functional analysis, i.e. linear spaces and normed spaces, linear operators in normed spaces, linear functional, regular generalized functions, singular generalized functions, Fourier series and Fourier integrals, Fourier transformations, Laplace transformations. Then application of functional analysis to Mathematical Physics equations occur in the engineering problems, i.e. boundary and initial value problems, fundamental solutions of PDE, elliptic equations, parabolic equations, hyperbolic equations, wave equations, schrödinger equations, eigen value problems, nonlinear differential equations

Learning Objectives

At the end of this course the student will be able to:

- To recognize and identify linear spaces, particularly vector spaces and function spaces;
- To study linear operators in linear and normed spaces and properties of differential operators;
- To treat linear functional and its properties, Han-Banach theorem and its applications;
- To study regular generalized functions and its representation with local integrable functions;
- To analyze singular generalized functions and distinguish with regular generalized functions;
- To study Fourier series and Fourier integrals, Fourier transformations applications to differential equations;
- To study Laplace transformations and applications to initial value problems for differential equations;
- To ascertain boundary and initial value problems for ordinary differential equations;
- To study the classification of partial differential equations of the second order;
- Find the fundamental solutions of some partial differential equations;
- fundamental solutions of elliptic equations of the second order;
- fundamental solutions of hyperbolic equations of the second order;
- fundamental solutions of parabolic equations of the second order
- To ascertain the boundary value problems for elliptic equations;
- To ascertain the initial value and mixed value problems for hyperbolic equations;
- To study the initial value and mixed value problems for parabolic equations;
- To study Schrödinger equations in different domains
- To treat Eigen value problems for elliptic equations and its properties;
- To study the nonlinear partial differential equations and its applications in physics and engineering.

Topical Outline and Schedule

DATE	WEEK 1
SPECIFIC OBJECTIVES	• Introduce the course to the students • To show that the set of real and complex numbers are linear spaces • Investigate multivariable functions acting in real and complex domains
TOPIC (S)	• Syllabus • Linear spaces, vector and function spaces • The spaces with dot products and properties • L2 and l2 spaces and its properties • Discuss Course Outline, Instructor to verify completion
LEARNING ACTIVITIES	Discussion of Syllabus Completion of exercises and problems
OUT OF CLASS WORK ASSIGNMENT	Review the Syllabus Homework 1: To read the concept of multivariable analysis
DATE	**WEEK 2**
SPECIFIC OBJECTIVES	To show that the function space Lp and the sequence space lp are linear and normed; To prove that H2 and W2p spaces are normed and Banach spaces
TOPIC (S)	• Normed spaces, Banach spaces and examples • Lp and lp spaces and its properties • Hölder and Sobolev spaces and embedding theorems • •
LEARNING ACTIVITIES	Discussion of MOS transistor
OUT OF CLASS WORK ASSIGNMENT	Homework 2: To show that Sobolev spaces are Banach spaces
DATE	**WEEK 3**
SPECIFIC OBJECTIVES	• To show different examples for linear functional in the class of continuous functions • To show examples for linear operators in the class of differentiable functions • To show examples for linear operators and functional in the space of sequence
TOPIC (S)	• Linear operators in normed spaces and its properties

	• Linear differential operators; • Linear functional in normed spaces and its properties
LEARNING ACTIVITIES	Discussion of single stage amplifier Discussion of common source amplifier
OUT OF CLASS WORK ASSIGNMENT	Homework 3: To prove that different differential operators are linear
DATE	**WEEK 4**
SPECIFIC OBJECTIVES	• To show class of differentiable finite functions • Analyze the class of local integrable functions • Investigate Delta function and its properties • Show examples on regular generalized functions
TOPIC (S)	• Regular generalized functions and its representation with local integrable functions; • Singular generalized functions and distinguish with regular generalized functions
LEARNING ACTIVITIES	Illustrate examples on class of differentiable functions Discussion of singular generalized functions Completion of exercises and problems
OUT OF CLASS WORK ASSIGNMENT	Homework 4: analyze of regular and singular generalized functions in class of continuous differentiable functions
DATE	**WEEK 5**
SPECIFIC OBJECTIVES	• To study Fourier series in Hilbert spaces • To study Fourier integrals in class of periodic functions • Application of Fourier transforms to differential equations;
TOPIC (S)	
LEARNING ACTIVITIES	The Fourier series; The Fourier integrals; The Fourier transforms
OUT OF CLASS WORK ASSIGNMENT	Homework 5: Fourier series of trigonometric systems
DATE	**WEEK 6**
SPECIFIC OBJECTIVES	• To study Laplace transformations and its properties; • Application of the Laplace transform to initial value problems for differential equations •

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TOPIC (S)	• Single ended Operational Amplifiers
LEARNING ACTIVITIES	Laplace transforms and applications
OUT OF CLASS WORK ASSIGNMENT	Homework 6: Application of the Laplace transform to differential equations
DATE	**WEEK 7**
SPECIFIC OBJECTIVES	• Analysis of local and nonlocal boundary value problems for ordinary differential equations of the second order; • Initial value problems for ordinary differential equations
TOPIC (S)	• Boundary value problems for ordinary differential equations • Initial value problems for ordinary differential equations
LEARNING ACTIVITIES	
OUT OF CLASS WORK ASSIGNMENT	• Continue research on boundary and initial value problems for ordinary differential equations Homework 7: Solve problems on boundary and initial value problems for ordinary differential equations
DATE	**WEEK 8**
SPECIFIC OBJECTIVES	• Identify elliptic equations of the second order; • Analyze of hyperbolic equations of the second order; • Study the parabolic equations
TOPIC (S)	• The classification of partial differential equations of the second order
LEARNING ACTIVITIES	Discussion of partial differential equations of second order
OUT OF CLASS WORK ASSIGNMENT	Continue research and work on final project Homework 8: The classification of different partial differential equations of the second order
DATE	**WEEK 9**
SPECIFIC OBJECTIVES	• Evaluate students via midterm exam
TOPIC (S)	• Midterm Exam
LEARNING ACTIVITIES	None
OUT OF CLASS WORK	None

ASSIGNMENT	
DATE	**WEEK 10**
SPECIFIC OBJECTIVES	• Identify the fundamental solutions of elliptic equations of the second order; • Analyze fundamental solutions of hyperbolic equations of the second order; • Find fundamental solutions of parabolic equations of the second order;
TOPIC (S)	• Fundamental solutions of partial differential equations
LEARNING ACTIVITIES	Discussion of partial differential equations
OUT OF CLASS WORK ASSIGNMENT	Homework 10: Funds fundamental solutions of different type partial differential equations
DATE	**WEEK 11**
SPECIFIC OBJECTIVES	• Find eigen value of boundary value problems for Laplace equations • Identify eigen functions of boundary value problems for Laplace equations • Analyze local and nonlocal value of boundary value problems for elliptic equations
TOPIC (S)	• The boundary value problems for elliptic equations; • Local and nonlocal boundary conditions
LEARNING ACTIVITIES	Discussion of local and nonlocal boundary value problems Discussion of eigen value and eigen functions of elliptic operators
OUT OF CLASS WORK ASSIGNMENT	Homework 11: Funds eigen value and eigen functions of local boundary value problems for the Laplace equation
DATE	**WEEK 12**
SPECIFIC OBJECTIVES	• Identify the initial value problems for the wave equations • Analyze the mixed value problems for the wave equations • Finds the solution of the initial value problems for the wave equations • Finds the solution of the mixed value problems for the wave equations
TOPIC (S)	• The initial value and mixed problems for hyperbolic equations
LEARNING ACTIVITIES	Discussion of the initial and mixed value value problems for the wave equations
OUT OF CLASS	Homework 12: Finds the solution of the initial value problems for the different type wave equations

WORK ASSIGNMENT	Doing homework 12
DATE	**WEEK 13**
SPECIFIC OBJECTIVES	• Identify initial value problems for the heat equations; • Analyze mixed value problems for the heat equations; • Find the solution of initial value problems for the heat equations
TOPIC (S)	• The initial value and mixed value problems for parabolic equations
LEARNING ACTIVITIES	Discussion of initial value and mixed value problems for the parabolic equations of second order
OUT OF CLASS WORK ASSIGNMENT	Homework 13: Finds the solution of the initial value problems for the different type parabolic equations
DATE	**WEEK 14**
SPECIFIC OBJECTIVES	• To study Schrödinger equations in all spaces; • Identify Schrödinger equations in half spaces • Analyze Schrödinger equations in bounded domains
TOPIC (S)	• Schrödinger equations in considered on different domains • Eigen value and Eigen spaces of Schrödinger operators
LEARNING ACTIVITIES	• Discussion of Eigen value and Eigen spaces of Schrödinger operators
OUT OF CLASS WORK ASSIGNMENT	Homework 14: Finds the solutions of Schrödinger equations defined on all spaces
DATE	**WEEK 15**
SPECIFIC OBJECTIVES	• To treat boundary value problems for nonlinear elliptic equations; • Analyze initial value problems for nonlinear hyperbolic equations; • To study initial value problems for nonlinear parabolic equations
TOPIC (S)	• The nonlinear partial differential equations and its properties
LEARNING ACTIVITIES	Elliptic equations
OUT OF CLASS WORK ASSIGNMENT	Homework 15: Finds the solutions of nonlinear partial differential equations.

Instructional Methods

In developing methodological strategies, it is best to discuss them between teachers and students in an environment of freedom and mutual agreement in order to ensure that the students make them their own and take responsibility for their execution and for attaining the goals of this course.

The following strategies may be used in this class:
1. A review of the literature.
2. Check of the reading.
3. Analysis of assigned readings.
4. Group discussions.
5. Individual and group discussions.
6. Preparation of reports.
7. Preparation of a didactic plan.
8. Carrying out a micro-class.

Instructional Materials and References

None

Assessment Criteria and Methods of Evaluating Students

Grade	Coefficient
AA	4.00
BA	3.50
BB	3.00
CB	2.50
CC	2.00
DC	1.50
DD	1.00
FF	0.00
VF	0.00

Distribution of Grade Elements		
In-Term Studies	**Quantity**	**Percentage**
Homework	1	30
Midterm	1	30
Total		60
End-Term Studies	**Quantity**	**Percentage**
Final Project	1	40
Total		40
Contribution Of In-Term Studies To Overall Grade		60
End-Term Studies		40
Total		100

Date Syllabus Was Last Reviewed: September 2015