

COURSE PROFILE

Course Name	Code	Semester	Term	Theory +PS+Lab. (hour/week)	Local Credits	ECTS
Methods of Applied Mathematics I	MATH 324	Spring	6	3+0+0	3	7

Prerequisites	None
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Course Language	English
Course Type	Elective
Course Lecturer	Assoc. Prof. Nalan Antar
Course Assistant	-
Course Objectives	The aim of this course is to study various methods used for solving boundary value problems.
Course Learning Outcomes	<p>By the end of the course the students should be able to:</p> <ul style="list-style-type: none"> • derive a two-point boundary value problem starting from the heat conduction equation and understanding the physical meaning of this derivation, • classify a Sturm-Liouville problem as regular or singular • know the basic properties of eigenvalues and eigenfunctions of a regular Sturm-Liouville problem • find the coefficients in the eigenfunction expansion of a given function • know the notion of mean convergence • solve the nonhomogeneous Sturm-Liouville problems • solve a sample problem of singular Sturm-Liouville problems (Chebyshev polynomials) • derive the Bessel differential equation starting from the problem of the vibrations of a circular elastic membrane • know integral forms and orthogonality properties of Bessel functions • know the Gamma function • derive the Legendre differential equation starting from the Dirichlet problem in a ball • know orthogonality properties of Legendre polynomials, know associated Legendre polynomials • know the definition of the Fourier transform and understand convolution • compute and apply Fourier transforms and use them to solve partial differential equations • understand the concept of a Green's function • construct Green functions for nonordinary differential equations • construct Green's function for Laplace's equation

Course Content	Application of special functions, orthogonal series, boundary-value problems in mechanics and engineering, introduction to Sturm-Liouville systems. Solution techniques for boundary-value problems in curvilinear coordinates, integral transforms; Green's functions, potentials, applications.
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COURSE CONTENT

Week	Subjects	Related Preparation
1	Two-point boundary value problems, Regular Sturm-Liouville problems	Ref II: Chapter 6.1
2	Self-adjoint problems, Inner products and orthogonality of functions	Ref I: Chapter 1, 2.3
3	Eigenvalues and eigenfunctions	Ref I: Chapter 2.4.1
4	Eigenfunction expansions and mean convergence	Ref I: Chapter 2.4.1
5	Completeness and Parseval's Equality	Ref I: Chapter 2.4.2
6	Nonhomogeneous Sturm-Liouville problems, Singular Sturm-Liouville problems	Ref I: Chapter 2.4.3
7	Vibrations of a circular elastic membrane, Bessel's differential equation and Bessel functions	Ref II: Chapter 8.13, 8.1, 8.2, 8.3, 8.4 Ref I: Chapter 5
8	Some properties of Bessel functions	Ref II: Chapter 8.5, 8.6, 8.7, 8.8, 8.9
9	Fourier-Bessel series	Ref II: Chapter 8.10
10	Dirichlet problem in a ball, Legendre's differential equation and Legendre polynomials	Ref II: Chapter 9.1, 9.2
11	Some properties of Legendre polynomials	Ref II: Chapter 9.7, 9.3, 9.4
12	Fourier-Legendre series, Associated Legendre functions	Ref II: Chapter 9.5
13	Distributions, Fourier transforms, Properties of the Fourier transform, Convolution	Ref I: Chapter 6
14	Source functions, Green's function for ordinary differential equations, Modified Green's function, Green's function for Laplace's equation	Ref III: Chapter 2.2.4 Ref II: Chapter 10.6

Course Textbooks	<p>Ref. I: "Sturm-Liouville Theory and its Applications", by M.A. Al-Gwaiz, Published by Springer, 2008.</p> <p>Ref. II: "Fourier Series and Boundary Value Problems", by J.W. Brown and R.V. Churchill, Published by McGraw-Hill Companies, Inc., 2001.</p> <p>Ref. III: "Partial Differential Equations- An Introduction" W.A. Strauss, Published by John Wiley Sons, Inc, 1992.</p>
Recommended References	<ul style="list-style-type: none"> • "Elementary Differential Equations and Boundary Value Problems" (Chapter 11), by W.E. Boyce and R.C. DiPrima, Published by John Wiley & Sons, Inc., 1992. • "First Course in Partial Differential Equations with Complex Variables and

	Transform Methods" (Chapters 5,7,10), by H.F. Weinberger, Published by Dover Publications, Inc., 1995. • "Partial Differential Equations-An Introduction" (Chapters 7,10,12), by W.A. Strauss, Published by John Wiley & Sons, Inc., 1992.
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Semester Requirements	Number	Percentage of Grade
Attendance/Participation	1	10
Laboratory	-	-
Application	-	-
Special Course Internship (Work Placement)	-	-
Quizzes/Studio Critics	-	-
Homework Assignments	5	-
Presentation	-	-
Project	-	-
Seminar/Workshop	-	-
Midterms/Oral Exams	5	50
Final/Resit Exam	1	40
Total	12	100

PERCENTAGE OF SEMESTER WORK	11	60
PERCENTAGE OF FINAL WORK	1	40
Total	12	100

Course Category		
Core Courses		X
Major Area Courses		
Supportive Courses		
Media and Management Skills Courses		
Transferable Skill Courses		

COURSE'S CONTRIBUTION TO PROGRAM

#	Program Qualifications / Outcomes	* Level of Contribution				
		1	2	3	4	5
1	To have a grasp of basic mathematics, applied mathematics and theories and applications of statistics.					X
2	To be able to use theoretical and applied knowledge acquired in the advanced fields of mathematics and statistics,					X
3	To be able to define and analyze problems and to find solutions based on scientific methods,					X
4	To be able to apply mathematics and statistics in real life with interdisciplinary approach and to discover their potentials,					X
5	To be able to acquire necessary information and to make modeling in any field that mathematics is used and to improve herself/himself,					X
6	To be able to criticize and renew her/his own models and solutions,					X
7	To be able to tell theoretical and technical information easily to both experts in detail and nonexperts in basic and comprehensible way,				X	
8	To be able to use international resources in English and in a second foreign language from the European Language Portfolio (at the level of B1) effectively and to keep knowledge up-to-date, to communicate comfortably with colleagues from Turkey and other countries, to follow periodic literature,				X	
9	To be familiar with computer programs used in the fields of mathematics and statistics and to be able to use at least one of them effectively at the European Computer Driving Licence Advanced Level,					
10	To be able to behave in accordance with social, scientific and ethical values in each step of the projects involved and to be able to introduce and apply projects in terms of civic engagement,					
11	To be able to evaluate all processes effectively and to have enough awareness about quality management by being conscious and having intellectual background in the universal sense,					
12	By having a way of abstract thinking, to be able to connect concrete events and to transfer solutions, to be able to design experiments, collect data, and analyze results by scientific methods and to interfere,					X
13	To be able to continue lifelong learning by renewing the knowledge, the abilities and the competencies which have been developed during the program, and being conscious about lifelong learning,					

14	To be able to adapt and transfer the knowledge gained in the areas of mathematics and statistics to the level of secondary school,				X	
15	To be able to conduct a research either as an individual or as a team member, and to be effective in each related step of the project, to take role in the decision process, to plan and manage the project by using time effectively.					

*1 Lowest, 2 Low, 3 Average, 4 High, 5 Highest

ECTS ALLOCATED BASED ON STUDENT WORKLOAD BY THE COURSE DESCRIPTION

Activities	Number	Duration (Hours)	Total Workload
Course Hours (Including Exams)	14	3	42
Tutorials	-	-	-
Laboratory	-	-	-
Application	-	-	-
Special Course Internship (Work Placement)	-	-	-
Field Work	-	-	-
Study Hours Out of Class	14	2	28
Presentations / Seminar	-	-	-
Project	-	-	-
Preparatory reading	13	2	26
Homework Assignments	5	2	10
Quizzes	-	-	-
Midterm Exams	5	11	55
Final / Resit Exam	1	14	14
		Total Workload	175

COURSE CATEGORY

ISCED GENERAL AREA CODES	GENERAL AREAS	ISCED BASIC AREA CODES	BASIC EDUCATIONAL AREAS	
1	Education	14	Teacher Training and Educational Sciences	0

2	Humanities and Art	21	Art	0
2	Humanities and Art	22	Humanities	0
3	Social Sciences, Management and Law	31	Social and Behavioral Sciences	0
3	Social Sciences, Management and Law	32	Journalism and Informatics	0
3	Social Sciences, Management and Law	38	Law	0
4	Science	42	Life Sciences	0
4	Science	44	Natural Sciences	0
4	Science	46	Mathematics and Statistics	100
4	Science	48	Computer	0
5	Engineering, Manufacturing and Civil	52	Engineering	0
5	Engineering, Manufacturing and Civil	54	Manufacturing and Processing	0
5	Engineering, Manufacturing and Civil	58	Architecture and Structure	0
6	Agriculture	62	Agriculture, Forestry, Livestock, Fishery	0
6	Agriculture	64	Veterinary	0
7	Medicine and Welfare	72	Medical	0
7	Medicine and Welfare	76	Social Services	0
8	Service	81	Personal Services	0
8	Service	84	Transport Services	0
8	Service	85	Environment Protection	0
8	Service	86	Security Services	0