İTÜ
DERS KATALOG FORMU
(COURSE CATALOGUE FORM)

Dersin Adı	**Course Name**
Bilgisayar Mühendisliği'nde Sayısal Yöntemler	Numerical Methods in Computer Engineering

Kodu (Code)	**Yarıyılı (Semester)**	**Kredisi (Local Credits)**	**AKTS Kredisi (ECTS Credits)**	**Ders Uygulaması, Saat/Hafta (Course Implementation, Hours/Week)**		
				Ders (Theoretical)	**Uygulama (Tutorial)**	**Laboratuar (Laboratory)**
BLG 202E	4	3	5	3	-	-

Bölüm / Program (Department/Program)	Bilgisayar Mühendisliği, Computer Engineering		
Dersin Türü (Course Type)	Zorunlu Compulsory	**Dersin Dili (Course Language)**	İngilizce English
Dersin Önkoşulları (Course Prerequisites)	MAT 102/MAT 102E veya (or) MAT 104 / MAT 104E		

Dersin mesleki bileşene katkısı, % (Course Category by Content, %)	**Temel Bilim (Basic Sciences)**	**Temel Mühendislik (Engineering Science)**	**Mühendislik Tasarım (Engineering Design)**	**İnsan ve Toplum Bilim (General Education)**
	50	50	-	-

Dersin İçeriği **(Course Description)**	Sayısal yöntemler ve temel uygulamalarının bilgisayar mühendisliği bakış açısıyla tanımlanması. Sayısal yöntemlerde hata analizi ve sayısal çözümlemeleri. Doğrusal ve doğrusal olmayan sistemlerin sayısal yöntemlerle modellenmesi ve çözümlenmesi. Yaklaşıklık çözümleri ve yazılımsal uygulamaları, interpolasyon, doğrusal ve doğrusal olmayan regresyon modellerinin bilgisayar mühendisliğine özgü uygulamaları, MATLAB uygulamaları, lineer programlama, Monte-Carlo simülasyonları ve bilgisayar mühendisliğinden uygulanması.
	Description of Numerical Methods (NM) and application of them particularly in Computer Engineering. Error analyses in numerical methods, Analytical solutions, numerical methods for the solution of systems (lineer and non linear), approximation methods and software implementation, interpolation, linear regression, non-linear regression for specific CE applications, numerical integration in MATLAB, linear programming, Monte-Carlo Simulation.
Dersin Amacı **(Course Objectives)**	1.Bilgisayar bilimleri ve mühendisliğinde temel olarak kullanılan sayısal yöntemlere giriş kavramlarının yapılması ve öğrenilmesi 2.Sayısal yöntemlerin bilgisayar mühendisliği,nin sıkca kullanıldığı bilim ve endüstriyel uygulamalarının kullanılmasının öğrenilmesi
	1.An introduction to the language, logic, and math of numerical methods as used in computer engineering and in the computer science. 2.An opportunity to learn how numerical analyses can be applied to a wide range of problems of importance in the sciences, industry, and society.
Dersin Öğrenme Çıktıları **(Course Learning Outcomes)**	1.Bilgisayar mühendisliği'den temel olarak kullanılan sayısal yöntemlerin temel bilgisini edinilmesi, 2.Yazılımsal ve donanımsal tabanlı bilgisayar mühendisliği problemlerinin sayısal yöntemler yardımıyla modellenmesi, 3. Sayısal yöntemler kullanılarak bilgisayar destekli doğru çözüm üretilmesi, 4.Bilgisayar destekli çözümlere ve modellere analitik bir bakış açısı getirilmesi .
	Student, who passed the course satisfactorily can: 1. The fundamental knowledge of numerical methods for its specific usage in Computer Engineering, 2. The ability to model Computer Engineering based software and hardware based problems using numerical methods 3. The ability to choose the right solution method and algorithm for a particular challenge in a computer-based environment, 4. The ability to embed an analytical perspective into the computer-aided solutions.

Ders Kitabı (Textbook)	W.Cheney and D. Kincaid, "Numerical Mathematics and Computing", 6th Edition. Thomson Brooks & Cole, 2008.		
Diğer Kaynaklar (Other References)	-S.R. Otto and J.P. Denier, " An Introduction to Programming and Numerical Methods in MATLAB", Springer, 2005. -C. Moler, " Numerical Computing with MATLAB", Mathworks, 2004. -U. M. Ascher and C. Greif, " A first Course on Numerical Methods", SIAM, 2011. -I. uzun, "Nümerik Analiz", Beta Yayınları, 2004. ISBN:9754869529. -S. Chaapra, S. and R.P, Canale, "Mühendisler için Sayisal Yöntemler", Literatür Kitabevi, 2003. ISBN:0130126411.		
Ödevler ve Projeler	2 tane MATLAB yardımıyla modellenecek ve çözülecek proje		
(Homework & Projects	2 Projects be given to solve specific Computer Engineering based problems using Numerical Methods and Implementation to the used method in MATLAB.		
Laboratuar Uygulamaları	-		
(Laboratory Work)	-		
Bilgisayar Kullanımı	Projeler MATLAB ortamında gerçeklenecektir ve tüm raporlar bilgisayar ortamında yazılıp toplanacaktır.		
(Computer Use)	All the projects should be implemented in MATLAB and reports should be prepared using a word processor.		
Diğer Uygulamalar	-		
(Other Activities)	-		
Başarı Değerlendirme Sistemi	**Faaliyetler (Activities)**	**Adedi (Quantity)**	**Değerlendirmedeki Katkısı, % (Effects on Grading, %)**
	Yıl İçi Sınavları (Midterm Exams)	**2**	**2X20= 40**
(Assessment Criteria)	**Kısa Sınavlar (Quizzes)**	**0**	
	Ödevler (Homework)	**0**	
	Projeler (Projects)	**2**	**2X10= 20**
	Dönem Ödevi/Projesi (Term Paper/Project)	**0**	
	Laboratuar Uygulaması (Laboratory Work)	**0**	
	Diğer Uygulamalar (Other Activities)	**0**	
	Final Sınavı (Final Exam)	**1**	**40**

DERS PLANI

Hafta	Konular	Dersin Çıktıları
1	Sayısal Yöntemlere giriş. Bilgisayar Mühendisliğinde kullanılan örnekler.	1
2	Hata analizi, Hatanın bilgisayar ortamında kodlanması.	1-2
3	Bilgisayar müh.de doğrusal sistemlerin sayısal yöntemlerle modellenmesi,çözülme yöntemleri ve kodlanması. Gauss Eliminasyon ve LU parçalama yöntemlerinin algoritmalarının analizi.	1-2-3
4	Bilgisayar müh.de doğrusal olmayan sistemlerin sayısal yöntemlerle modellenmesi,çözülme yöntemleri ve kodlanması. Bisection, Newton-Rapson and Secant algoritmalarının analizi.	2-3
5	Bilgisayar mühendisliği uygulamalarında interpolasyon ve eğri uydurma algoritmaları ve analitik incelenmesi	2-3
6	MATLAB üzerinde uygulamalar.	2-3
7	Spline fonksiyonları, n. dereceden Spline modellemesi, analitik ve yazılımsal incelenmesi	2-3
8	Doğrusal Regresyon, küçük kareler yöntemleri, analitik ve yazılımsal incelenmesi.	2-3
9	Korelasyon katsayısı kavramı, doğrusal olmayan regresyon modelleri, analitik ve yazılımsal incelenmesi.	2-3
10	Doğrusallaştırma ve dönüştürme yöntemleriyle bir sistemin modellenmesi, yazılımsal incelenmesi	2-3
11	İntegrasyon algoritmaları, analitik ve yazılımsal incelenmesi.	1-2-3
12	MATLAB üzerinde uygulamalar.	2-3
13	Doğrusal programlama ve doğrusal eniyileme.	1-2-3
14	Monte-Carlo simulasyonun analitik ve yazılımsan incelenmesi	1-2-3

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Introduction to NM. Specific usage examples of NM in CE. Error in numerical analysis.	1
2	Error analysis of generic and radical functions. Floating-Point Arithmetic and Floating Number representations in IEEE. Computer-Caused Loss of Significance.	1-2
3	Methods to solve linear equations. Linear system modeling and usage in CE applications. Gauss Elimination and LU Decomposition algorithms.	1-2-3
4	Methods to solve non-linear equations. Non-linear system modeling and usage in CE applications. Bisection, Newton-Rapson and Secant algorithms.	2-3
5	Interpolation and Curve fitting in CE applications. Direct Method, Lagrange and Newton algorithms.	2-3
6	MATLAB-based demo Session.	2-3
7	Spline functions and algorithm. First-second degree splines. Approximation by Splines. Smoothing of Data. Spline usage examples in CE-based applications.	2-3
8	Linear Regression Modeling and Analysis. Linear behavior models and estimations using linear regression. Least-Square approach and its algorithm.	2-3
9	Correlation Coefficient, linear correlation and coefficient of determination for linear estimations. Non-Linear Regression Modeling and Analysis. Non-linear behavior models and estimations using linear regression.	2-3
10	Transformation and Linearization of nonlinear data.	2-3
11	Integration, Algorithms to solve numerical integration. Trapezoidal, Gaussian Quadrature and Simpson 1/3 rules.	1-2-3
12	MATLAB-based demo Session.	2-3
13	Linear Programming and Linear Optimization. Graphical solutions. Simplex algorithm.	1-2-3
14	Monte-Carlo simulations and specific applications using Monte-Carlo simulations	1-2-3

Relationship between the Course and Computer Engineering Curriculum

(1: "Little", 2: "Partial", 3: "Full", Leave blank if your answer is "None")

Computer Engineering Department Program Outcomes and Performance Criteria				Level of Contribution		
				1	2	3
a	**an ability to apply knowledge of mathematics, science, and engineering to the field of computer engineering**			X		
	a1	**Acquiring knowledge of mathematics, science and engineering**		X		
		PC.a1	answers questions on mathematics	X		
		PC.a2	answers questions on science and engineering	X		
	a2	**Applying knowledge of mathematics**		X		
		PC.a3	applies mathematical principles to obtain analytical or numerical solutions to computer engineering problems	X		
		PC.a4	chooses appropriate mathematical methods/approaches for a given problem	X		
	a3	**Applying knowledge of science and engineering fundamentals**		X		
		PC.a5	applies science and engineering principles to model and solve computer engineering problems			
b	**an ability to design and conduct experiments, as well as to analyze and interpret data**					
	b1	**Designing experiments**			X	
		PC.b1	selects variables, appropriate equipment, test apparatus, model, etc		X	
		PC.b2	chooses the effective measure(s) by which the outcome or the alternative will be evaluated		X	
	b2	**Conducting experiments**			X	
		PC.b3	uses appropriate measurement techniques to collect data		X	
		PC.b4	documents collection procedures so that the experiment may be repeated		X	
	b3	**Analyzing data**		X		
		PC.b5	selects and uses appropriate tools (i.e., statistical and graphical) to analyze data	X		
	b4	**Interpreting data**		X		
		PC.b6	interprets results with respect to the original hypothesis	X		
c	**an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability**				X	
	c1	**Identifying stated needs and determining functional requirements and limitations**			X	
		PC.c1	describes scope of the problem and specifies the requirements based on the desired needs		X	
		PC.c2	selects appropriate methods satisfying the constraints and the requirements		X	
	c2	**Developing a design**			X	
		PC.c3	applies appropriate design methods		X	
		PC.c4	designs a software system, component or process			X
		PC.c5	designs a hardware system, component or process			X
		PC.c6	presents the complete design with appropriate tools		X	
	c3	**Implementing the design**		X		
		PC.c7	develops a solution/prototype based on the design	X		
	c4	**Testing and validating the developed solution**			X	
		PC.c8	describes test cases and strategies		X	
		PC.c9	debugs the developed solution and corrects detected errors		X	
d	**an ability to observe and examine an existing structure or system in a criticizing attitude and finally correct or enhance it**				X	
		PC.d1	observes an existing hardware/software system to analyze its functionality			X
		PC.d2	analyzes outputs given certain well-chosen inputs that cover different possible cases			X
		PC.d3	finds and corrects defects of a system			X
		PC.d4	enhances a system according to the requirements		X	
e	**an ability to function on multi-disciplinary teams**					X

		PC.e1	participates effectively as a team member in a long-term group/multi-disciplinary project team			X
		PC.e2	takes and fulfills responsibilities in the team			X
		PC.e3	participates in the development of ideas			X
		PC.e4	incorporates feedback from others into revisions/improvements			X
f	**an ability to identify, formulate, and solve engineering problems**			X		
		PC.f1	identifies a computer engineering problem	X		
		PC.f2	formally describes constituents of a computer engineering problem	X		
		PC.f3	develops a solution for a computer engineering problem	X		
g	**an understanding of professional and ethical responsibility**			X		
		PC.g1	is aware of the code of ethics that guide the professional practice of engineering	X		
		PC.g2	identifies and defines ethical issues concerning a decision	X		
		PC.g3	evaluates and judges a situation in practice, using facts and a professional code of ethics	X		
h	**an ability to communicate effectively**				X	
	h1	**Written communication of information, concepts, and ideas effectively**		X		
		PC.h1	writes a document using an appropriate format and grammar and uses discipline-specific conventions including citations	X		
	h2	**Orally communicating information, concepts, and ideas effectively**				X
		PC.h2	plans, prepares, and delivers a well-organized, logical oral presentation; explains when questioned			X
	h3	**Graphically communicating information, concepts, and ideas**		X		
		PC.h3	uses professional graphics on written and oral presentations	X		
i	**the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context**					X
		PC.i1	lists several types of impacts an engineering solution might have			X
		PC.i2	defines key terms associated with understanding of a societal context including society, culture, and global society			X
		PC.i3	recognizes the engineering aspects of a global problem			X
j	**a recognition of the need for, and an ability to engage in life-long learning**				X	
	j1	**Demonstrating an awareness of what needs to be learned**			X	
		PC.j1	determines what needs to be learned in an actual project		X	
	j2	**Ability to engage in life-long learning**			X	
		PC.j2	applies the learning plan to an actual research project and/or independent learning opportunity		X	
		PC.j3	attends seminars and training activities		X	
k	**a knowledge of contemporary issues**					X
		PC.k1	identifies engineering problems with potential environmental impact issues			X
		PC.k2	lists and describes major socio-economic issues			X
		PC.k3	lists and describes major political issues at national or international levels			X
l	**an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice**			X		
		PC.l1	uses engineering techniques, skills, and tools to monitor performance of an engineering system and/or create an engineering design	X		
		PC.l2	uses engineering techniques, skills, and tools to acquire information needed for decision-making	X		
		PC.l3	selects appropriate techniques and tools for a specific engineering task	X		
m	**an ability to adapt to changing conditions**					X
		PC.m1	adapts to new tools and approaches			X
		PC.m2	practices different team roles in a working group			X
		PC.m3	is aware of emerging fields and adapts to them			X

Prepared by	***Date***	***Signature***
	12.05.2014	