DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING – KFUPM

NUMERICAL & STATISTICAL METHODS IN CIVIL ENGINEERING

CE 318 (2 - 3 - 3)

Course Material:

- **Textbook:** Numerical Methods for Engineers; 6th Edition; *Chapara, S.C. & Canale, R.P. - 2010*
- **Extra Notes:** supplied in class.

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COURSE OUTLINE: 2015-2016 (Academic Term 151)

Dates (Weeks)	Lectures & Subject Matter(s) Textbook sections (Comp-Lab Sessions)	Sub-topics [Additional suggested relevant textbook-sections]
Aug. 23 – 31, 2015 (1; 2)	**1-3** General Introduction & Mathematical Modeling (Programming Fundamentals and Computational Considerations): [1.1; 1.2; 2.4; 3.1-3.4; 4.1]	Analytical *vs.* numerical methods; storage of numbers and characters; use of subscripts; Taylor series and analysis of computational errors; subroutines; flow-charts; computer methods (direct; iterative; logical); aspects of good programming; example-problems. [PT1.1-PT1.3.2; 2.3; 2.5; 2.6]
Aug. 26 & Sept. 02	Lab-Sessions (1 ; 2)	Basics of Programming Tools (e.g.: Excel; FORTRAN; Mathematica); Computing Applications: Machine Epsilon, Errors and Precision.
Sept. 01 – 16 (2; 3; 4)	**4-7** Interpolation and Extrapolation: [18.1; 18.3; 18.6 17.1; 17.2; 21.1; 21.2;22.1; 22.2;22.4; 23.2]	Introduction; interpolation and method of spline functions; the curve fitting using least squares; numerical integration; Newton-Cotes Formulas; Gauss quadrature; Richardson Extrapolation; example-problems. [18.4; 18.5; 23.5; 24.4]
Sep. 09 & Sept. 16	Lab-Sessions (3; 4)	Subtractive Errors; DO-Loops; Cubic Spline Interpolation; Curve Fitting.
Sept. 15 (4)	**8** Series Approximations and Roots of Equations: [4.1; 4.2; 5.1-5.3]	Series solutions; study of convergence; iterative substitutions; Roots of equations. [PT2.1]
Sept. 18 - 28, 2015 Hajj – Eid – Recess		
Sept. 29 – Oct. 07 (5 ; 6)	**9 – 11** Series Approximations and Roots of Equations (cont'd): [6.1; 6.2; 6.6; 7.7]	Roots of equations; interpolation methods (bisection); extrapolation methods (*Newton-Raphson* method); solution of nonlinear equations; acceleration of convergence; example-problems.
Oct.. 07 & Oct.. 21	Lab-Sessions (5; 6)	Numerical Integration; Roots of Equations.
Wednesday, Oct. 14, 2015 - First Major Examination		
Oct. 11 – 14 (6 ; 7)	**12; 13** Solution of Algebraic Equations: [9.1-9.4]	System of linear equations; Matrix notations and operations; *Gaussian* elimination; LU-factorization; *Cholesky's* method; banded equations; iterative methods; example-problems. [PT3.1; PT3.2.2]
Oct.. 28	Lab-Session (7)	Matrix Algebra; Solution of a System of Linear Equations.
Oct. 18 – 21 (8)	**14; 15** Solution of Algebraic Equations (cont'd): [10.1-10.3; 11.1-11.3]	Iterative methods (*Gauss-Seidel* method); pivoting; ill-conditioning; example-problems. [PT3.3; 12.2]
Nov. 04	Lab-Session (8)	Matrix Algebra; Solution of a System of Linear Equations (cont'd).
Oct. 25 – Nov. 04, 2015 (9, 10)	**16-19** Methods of Finite Differences: [23.1; 23.2; 23.5; 27.1; 27.2; 30.1; 30.2]	Introduction; first and second order equations; finite difference discretization in 1D; boundary conditions; solution of time-independent problems; stability analysis of finite differences; example case studies (e.g.: Laplace's equation; Diffusion equation in 1D); example-problems. [27.1.2]
Nov. 11	Lab-Session (9)	Solution a Diffusion Equation.

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Nov. 08 – 25 **11 – 13**	**20-25** **Statistical and Probability Analysis:** [Class Handouts]	Introduction; Basic concepts of probabilities; mathematical background; simple measures of statistical analysis; data distribution; *normal* distribution; *confidence* interval; analysis of variance: [PT5.2.1-PT.5.2.3]
Wednesday Nov. 11, 2015 - Second Major Examination		
Nov. 18 **Nov. 25**	**Lab-Session (10; 11)**	**Statistical analysis (mean; variance); data analysis and normal distribution; analysis of variance (ANOVA); Hypothesis-testing & decision-making.**
Nov.29 – Dec. 02 **14**	**26; 27** **Methods of Design Optimization:** [15.1-15.2]	General introduction; types of problems; linear programming; the *Simplex* Method; applications to civil engineering design problems; example-problems. [PT4.1-PT4.3; 16.2]
Dec. 02	**Lab-Session (12)**	**Linear Programming Using Excel.**
Dec. 06 – 09 **14, 15**	**28; 29** **Design Applications (Case-studies):** [15.3]	Computer applications to typical problems selected from one of the four specialties of civil engineering (depending on a student's interest).
Dec. 09	**Lab-Session (13)**	**Engineering Analysis; Design Optimization.**
Dec. 13, 2015 **15 (cont'd)**	**30** **Over-all Review & Presentations of Projects**	Over-all Review & Presentations of Projects.
-	-	**Presentations of Term Projects.**

Grading Policy for the Course$:

1.	Attendance^	04%
2.	Homework & Lab. Assignments	15%
3.	Exam 1 [Wednesday, Oct. 14, 2015]*	15%
4.	Exam 2 [Wednesday, Nov. 11, 2015]	20%
5.	Lab. Project [TO BE ASSIGNED]@	10%
6.	Final Exam [TO BE SCHEDULED]	30%
	TOTAL	**100 %**

$ Notes:

^ Due to critical importance of timely class-attendance, the regulations set by KFUPM are enforced and it will affect other grade segments [*for*: Class lectures & Comp. Lab. sessions].

* Major exams are conducted within the computer-laboratory session.

@ Each student should arrange for a meeting to select the project for the course.