University of Jordan
School of Engineering
Civil Engineering Department

Finite Element Methods (0901932)
Syllabus

Spring 2018/2019

INSTRUCTOR:
Dr. Rabab Allouzi (r.louzi@ju.edu.jo)

OFFICE HOURS:
Sunday, Tuesday and Thursday 3:00 pm – 3:30 pm
Monday and Wednesday: 11 AM-12:30 PM

GRADING SYSTEM:
Mid Exam (40%)
Project (20%)
Final Exam (40%)

REFERENCES:

O.C. Zienkiewicz and R.L. Taylor, The Finite Element Method, Volumes I, II & III, 6th Edition Butterworth & Hinemann publishers.

JN Reddy, An introduction to the Finite Element method, 3rd Edition, McGraw Hill

TJR Hughes, The Finite Element Method, Dover Publication.

KD Hjelmstad, Fundamentals of Structural Mechanics, Springer.

J. Fish and T. Belytschko, A first course in Finite Elements, Wiley & Sons.

R.D. Cook, D.S. Malkus, M.E. Plesha and R.J. Witt, Concepts & Applications of Finite Element Analysis, 4th Edition, Wiley & Sons.

R.D. Cook, Finite Element Modeling for Stress Analysis, Wiley & Sons.

K.J. Bathe, Finite Element Procedures. Prentice Hall.

D. Logan, A first course in Finite Element Method, Fourth Edition, Thomson Publishers.

S. C. Brenner and L. R. Scott. The Mathematical Theory of Finite Element Methods. Springer, 1994.

J. Bonet and R. D. Wood. #onlinear continuum mechanics for finite element analysis. Cambridge University Press, Cambridge, UK, 1997.

PROJECT:
- A case study of reinforced concrete structural member distributed between students to be modeled with a Finite Element oriented software like Abaqus.
- Any solution that does not look professional will not be reviewed and will receive automatically a zero.
- Draw your illustrations neatly.
- Indicate your sign convention, and relevant parameters, labels, and coordinates on your illustrations.
- Your final answers should be identifiable; underline or draw a box around your final answer.
- Provide full solutions. If it is not possible to follow your solution logic easily, you may get zero for your solution even if your "final" answer has the right value or expression.

POLICIES:
- MAKE UP exam policy: for students who cannot attend regular exams due to serious illness, or family emergency (all with written proof approved from the University of Jordan regulations), a makeup exam may be arranged AFTER the regular exam. The instructor must be notified prior to the exam, and no exceptions will be made.
- You are NOT ALLOWED to use CELL PHONE. Close your phone before you get to class unless you are expecting an emergency call then please let your instructor know before class.
- If you have a course-related question, please see the instructor during office hours or set an appointment by email.
- All cheating in the course will be referred to the Office of the Dean of Students
- You are expected to arrive in class and be seated on time and not leave the classroom before the instructor dismisses class. If you will not be arriving on time or have to leave early then let the instructor know beforehand.
- Individuals engaged in any activity that disturbs the attention of the class will be asked to leave the classroom immediately.

CONTENT:

Week	Topics
1	Introduction to problems in Structural Engineering, Finite Element History Structural Analysis Methods; comparison
2-3	Basic Review of Solid/Structural Mechanics / Theory of Elasticity - Concept of Cauchy stress, Equilibrium, Notation: using coordinates; indices; vectors & tensors - Deformation, Strains, Compatibility, Hyper-elasticity
4-7	1D Boundary Value Problem - Governing Differential Equation (Strong Form) - Principle of Virtual Work (Weak form), Method of weighted residuals, Raleigh-Ritz - Energy method, Variational Approach (Alternative Weak form), - Calculus of Variations - Finite Element Discretization (Galerkin Form), Notation - 1D Quadrature, Equation solving, Boundary Conditions - 1-D FE Code structure - Applications
8-12	2D & 3D Problems - Strong Form, Weak form, Integral Theorems, Principle of Virtual Work - Finite Element – CST, Q4, Voight notation, Calculation of edge loads - 2D Quadrature, Area coordinates - Iso-parametric formulation, Jacobian, Element Quality - Boundary conditions & Constraints - Finite Element Families: Lagrange, Serendipity - Locking, Reduced Integration, Non-conforming modes - 3D finite elements - Finite Deformation, Newton-Raphson
13-15	ABAQUS - Learning ABAQUS software and all features that is essential for structural analysis. - Available material constitutive models - Available B.C's and constraints - Analysis Methods; implicit vs. explicit - ABAQUS applications in structural engineering
16	Final Week

LEARNING OUTCOMES

- To be able comparing finite element method with matrix analysis and classical analysis.

- To formulate one-dimension virtual work governing equations.
- To be familiar with calculus of variation and weighted residual
- To be able to formulate strong and weak form of little boundary problem and solve using Ritz method and finite element method
- To be able to solve linear and higher order finite element method
- To be able to use finite element oriented software like Abaqus and use it to model the assigned project.
- To be able to use finite element method to solve 2D triangular, rectangular, and general Q4 elements.