

شماره‌ی درس: 33133209	نام درس: روش اجزاء محدود
رشته و مقطع تحصیلی: رشته مهندسی مکانیک - کارشناسی ارشد و دکتری	نام استاد، نشانی الکترونیکی و وب سایت: محمد حسین ابوالبشری abolbash@um.ac.ir http://abolbash.profcms.um.ac.ir
دروس پیش نیاز: هم نیاز با ریاضی مهندسی پیشرفته	نیمسال تحصیلی:
ساعت درس: طبق برنامه	شماره کلاس:
ساعت مشاوره: طبق برنامه اعلام شده	اتاق کار: 211
کلاس حل تمرین: -	زمان برگزاری آزمون پایانی: روز سوم ساعت 8

➤ تعریف اصلی درس:

To provide an understanding of the principles of the Finite Element Method (FEM), its formulation and application to solid mechanics and other problems.

➤ سرفصل درس:

1. Introduction
 - 1-1 Classification of the physical problems
 - 1-2 Some mathematical concepts
 - 1-3 Analytical solutions
 - 1-4 Numerical methods
 - 1-5 Approximations of the solution of P.D.E.
 - 1-6 Approximate solutions
 - 1-7 Finite element and other methods
 - 1-8 Finite element methods for CAD
 - 1-9 F.E.M. programs
 - 1-10 Finite difference
 - 1-11 Boundary element
 - 1-12 Basis of Finite element methods
2. Four approximate solutions using methods of weighted residuals
 - 2-1 The Collocation method
 - 2-2 The subdomain method
 - 2-3 The least-squares method

2-4 The Galerkin method

امتحان میان ترم

2-5 Inverse problem

2-6 Nonlinear equation

3. Boundary element method as a weighted residual technique
4. The statement of the model problem
 - 4-1 Variational statement of the problem
 - 4-2 Finite element interpolation
 - 4-3 Various measures of errors
5. One dimensional problems
 - 5-1 Variational formulation of two-point Boundary-Value problem
 - 5-2 Galerkin approximations
 - 5-3 Hierarchical shape function
6. 2-D interpolation
7. Discretization of the domain
8. Linear interpolation polynomials
9. Interpolating polynomials for a discretized region
10. A finite element formulation for some Boundary value-problems
11. Fundamentals of finite element techniques for structural engineers
12. Basis principles
13. Displacement and force methods for member systems
14. The F.E. displacement method- General procedure
15. Using one or two F.E. Programs (Upon availability of them and time)

➤ نحوه‌ی ارزشیابی دانشجو :

1- Assignments	%10
2- Midterm Exam	%30
(Closed book- Questions in English)	
3- Term Paper	%20
4- Final Exam	%40
(Closed book- Questions in English)	

Term paper is evaluated as follows

Everybody should consult with a finite element text or theoretical/verification manual of one of the commercial finite element packages such as ANSYS, ABAQUS, CATIA, NASTRAN, etc. and find his/her own problem of interest. The problem should have an exact solution and must be solved at least with two commercial finite element packages. A detailed description of the problem and investigation of the solution and comparison of the results should be carried out thoroughly. Also a discussion for the reason of the element type selection should be provided. Furthermore, if there is any alternative element type, a new solution for the problem should be provided. The effect of increasing the number of elements on the solution should be discussed as well. Procedure for writing a term paper is posted in the course site (<http://vu.um.ac.ir>). The due time for submitting the term paper is the second last week of the class.

- 1- A handout entitled: Semi notes on FEM
- 2- Boundary elements an introductory course, C.A. Brebbia and J. Dominguez, McGraw-Hill, 1989. TA347.B64B73
- 3- Finite element procedures in engineering analysis, K.J. Bathe, Prentice-Hall, 1982. TA347.F5B36
- 4- Finite element a second course, V.2, E.B. Becker, G.F. Carey, J. T. Oden, Prentice –Hall, Englewood Cliffs, N.J., 1981. TA347.F5B4
- 5.1 An introduction to the finite element method, J.N. Reddy, McGraw-Hill, New York, 1993. TA 347.F5R4
- 5.2 Finite elements, Mathematical aspects V.IV, J. T. Oden, G.F. Carey,, Prentice –Hall, Englewood Cliffs, N.J., 1983. TA347.F5B4
- 6- Finite elements an introduction, V.I, E.B. Becker, G.F. Carey, J. T. Oden, Prentice Hall, 1981. TA347.F5B4
- 7- Applied functional Analysis and variational methods in engineering, J.N. Reddy, McGraw-Hill, 1986. TA330.R44
- 8- Finite element computational aspects, V. III, G.F. Carey, J. T. Oden, Prentice Hall, 1981. TA347.F5B4
- 9- Applied finite element analysis for engineers, F.L. Stasa, Holt, Rinehart and Winston, New York, 1985. TA347.F5S72
- 10- The finite element Method, Fourth Edition, V. 1, Basic formulation and linear problems, O.C. Zienkiewicz, FRS and R.T. Taylor, McGraw-Hill (UK), 1989. TA640.2.Z5
- 11- Fundamentals of finite element techniques: for structural Engineers, C.A. Brebbia, J.J. Connor, Butterworth and Co. Publisher Ltd, 1973. TA640.2.B73
- 12- The Method of weighted residual and variational principles with application in fluid mechanics, Heat and Mass transfer, B.A. Finlayson, Academic Press, New York, 1972. QA371.53
- 13- Engineering Analysis, A survey of numerical Procedures, S.H. Crandall, McGraw-Hill, New York, 1956. TA347.F5D3
- 14- Computer Aided Design, J. Encarnacao, E.G. Schlechtendahl, Springer-Verlag, 1983.
- 15- Boundary element techniques in engineering, , C.A. Brebbia and M.A Walker,. London, Newnes, Butterworth, 1980. TA347.B69B74
- 16- Finite element s for structural analysis, W. Jr. Weaver, and P.R. Johnston, Prentice-Hall, 1984. TA347.F5W4
- 17- Concepts and applications of finite element analysis, second Edition, R.D. Cook, John Wiley and Sons, 1981. TA646.C66
- 18- Applied finite element analysis, L.J. Segerlind, John Wiley and Sons, Inc., New York, 1984. TA347.F5S43
- 19- Finite element analysis from concepts to applications, D.S. Burnett, Addison-Weseley Pub. Com., 1987. TA347.F5B87
- 20- Introduction to perturbation techniques, A.H. Nayfeh, John Wiley and Sons, Inc., 1980. QA 371.N32
- 21- Applied numerical Methods, B. Carnahan, H.A. Luther and J.O. Wilke, John Wiley and Sons, Inc., 1969. QA 297.C34
- 22- Schaum’s outlines- Theory and problems: Finite element analysis, Buchanan, G.R., McGraw-Hill, New York, 1995. TA347.F5B83
- 23- Energy and finite element methods in structural mechanics, Shames, Irving Herman, Dym, Clive L., Washington, Hemisphere Pub. Corp., 1985. TA645.S4794
- 24- The Finite element Method in Engineering, Forth Edition, S.S. Rao, Elsevier Butterworth-Heinemann, MA 01803, USA, 2005. TA347.F5R36
- 25- Fundamentals of Finite Element Analysis, D.V. Hutton, McGraw Hill Inc., NY, USA, 2004. TA347.F5H88

جدول زمان بندی درس دادن

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Finite element and other methods Finite element methods for CAD	هفته‌ی چهارم
F.E.M. programs Finite difference	هفته‌ی پنجم
Boundary element Basis of Finite element methods	هفته‌ی ششم
Four approximate solutions using methods of weighted residuals The Collocation method The subdomain method	هفته‌ی هفتم
The least-squares method The Galerkin method امتحان میان‌ترم	هفته‌ی هشتم
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Interpolating polynomials for a discretized region A finite element formulation for some Boundary value-problems	هفته‌ی چهاردهم
Fundamentals of finite element techniques for structural engineers Basis principles	هفته‌ی پانزدهم
Displacement and force methods for member system The F.E. displacement method- General procedure	هفته‌ی شانزدهم
Using one or two F.E. Programs (Upon availability of them and time)	هفته‌ی هفدهم