

**FIRST SEMESTER 2019-2020**

# Course Handout Part II

Date: 02-08-2019 In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.* : *CE G619*

*Course Title* : Finite Element Analysis

*Instructor-in-Charge* : P N Rao

**Scope and Objective of the Course:**

Finite element method is one of the most powerful numerical methods widely used for solving problems in different branches of engineering specially Civil Engineering. This method can be used to solve even complex and difficult problems such as nonhomogeneous material, complex loading and complicated boundary conditions, material and geometric nonlinear problems, dynamics including earthquake analysis. The course is aimed to enable students to understand the advanced concept of finite element method and its application to Civil Engineering.

**Textbook:**

1. R. D. Cook, D.S. Malkus, M.E. Plesha and R.J. Witt, Concepts and Applications of Finite Element Analysis, John Wiley India Pvt. Ltd., Fourth Edition, 2010.

**Reference books**

1. J. N. Reddy, An introduction to the finite element method, Third edition, Mc Graw Hill, 2015.
2. C.S. Krishnamurthy, Finite Element Analysis: Theory and programming, Second edition, McGraw Hill, 2017.
3. D.V. Hutton, Fundamentals of Finite Element Analysis, McGraw Hill,2014.
4. D.L. Logan, A first Course in the Finite Element Method, Fifth edition, Cengage,2015.
5. O. C. Zienkiewicz, R.L. Taylor and J.Z. Jhu, The Finite Element Method-Its Basis and Fundamentals,6th edition, Elsevier, 2012.

**Course Plan:**

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| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text**  **Book** |
| 1-5 | Fundamentals of Finite element method | Introduction of FEA, Modeling,  Discretization, Interpolation, Elements, Nodes and DOF, Example applications | T1 – Ch-1 |
| 6-12 | Basic formulations of  FEM | Formulation techniques: variational methods, Galerkin and weighted residual methods | T1 – Ch-4,5 & Class Notes |
| 13-16 | Assembly of elements, solution techniques | Introduction to bar elements, beam elements, Numerical examples | T1 – Ch-2, 5 & Class Notes |
| 17-23 | 2D and 3D Problems | Area Coordinate system, Plane stress and Plane strain Problems, Volume Coordinate system and axisymmetric problems | T1 – Ch-3,  6, 7 &  Class Notes |
| 24-28 | Review of the Isoparametric elements | Isoparametric bar element, plane bilinear element, quadratic plane element,  triangular element, hexahedral element, numerical integration. | T1 – Ch-6, 7 & Class Notes |
| 29-30 | Thin and thick plate elements | Plate Bending Theory, Plate Elements. | T1 – Ch-15 & Class Notes |
| 31-32 | Introduction to shell formulations. | Shell Theory and shell elements. | T1 – Ch-16 & Class Notes |
| 33-34 | Use of newly developed elements | Newly developed elements. | Research papers &  Material |
| 35-37 | Mixed finite element method | Mixed Finite elements. | Research papers &  Material |
| 38-40 | Material and geometric nonlinear  problems | Solution methods, small-strain plasticity relation, elastic-plastic analysis procedure, nonlinear dynamic, problems, geometric nonlinear problems. | T1 – Ch-17 & Class Notes |
| 41-43 | Application of FEM to Civil Engineering problems, programming FEM | Structural and Civil Engineering, Fluid flow problems, Modeling and Programming in FEM | Class Notes |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of**  **Component** |
| Mid Semester Test | 90 Min | 25% | 30/9; 9.00 to 10.30 pm | CB |
| Comprehensive Exam | 180 Min | 35% | 4/12 FN | CB |
| Assignments | - | 15% | - | OB |
| Project | - | 25% | - | OB |

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** Notices concerning this course will be displayed on CMS/Notice Board ofCivil Engg. Department.

**Make-up Policy:** Make-up would be granted only for genuine cases with prior permission.

**Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**INSTRUCTOR-IN-CHARGE**

**CE G619**