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|  | | | **National Institute of Technology Meghalaya**  An Institute of National Importance | | | | | | | | | | **CURRICULUM** | | |
| Programme | | | **Doctor of Philosophy** | | | | | Year of Regulation | | | | | **2018** | | |
| Department | | | **Civil Engineering** | | | | | Semester | | | | | **I** | | |
| Course Code | | Course Name | | Pre-requisite | | Credit Structure | | | | Marks Distribution | | | | | |
| L | T | P | C | INT | | MID | END | | Total |
| **CE 701** | | **FINITE ELEMENT METHOD** | | **NIL** | | **3** | **0** | **0** | **3** | **50** | | **50** | **100** | | **200** |
| Course Objectives | | **To develop the student’s knowledge on understanding of ordinary and partial differential equations.** | | | Course Outcomes | | CO1 | Student will be able to have a solid foundation on the theoretical basis of the weighted residual Finite Element Method. | | | | | | | |
| CO2 | Be able to use the commercial Finite Element packages to build Finite Element models and solve a selected range of engineering problems. | | | | | | | |
| **To provide some knowledge on mathematical concepts of the Finite Element Method for obtaining an approximate solution of ordinary and partial differential equations.** | | |
| CO3 | Be able to use these solutions to guide and validate a Finite Element model using a range of techniques. | | | | | | | |
| CO4 | Be able to communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained. | | | | | | | |
| CO5 | Be able to discuss the accuracy of the Finite Element solutions | | | | | | | |
| SYLLABUS | | | | | | | | | | | | | | | |
| No. | Content | | | | | | | | | | Hours | | | COs | |
| I | **Introduction:** Introduction; Basic Concepts of Finite Element Analysis; Introduction to Elasticity; Steps in Finite Element Analysis | | | | | | | | | | 06 | | | CO1 | |
| II | **Finite Element Formulation Techniques:** Virtual Work and Variational Principle; Galerkin Method; Finite Element Method: Displacement Approach; Stiffness Matrix and Boundary Conditions. | | | | | | | | | | 06 | | | CO2 | |
| III | **Element Properties:** Natural Coordinates; Triangular Elements; Rectangular Elements; Lagrange and Serendipity Elements; Solid Elements; Isoparametric Formulation; Stiffness Matrix of Isoparametric Elements; Numerical Integration: One Dimensional; Numerical Integration: Two and Three Dimensional | | | | | | | | | | 06 | | | CO3 | |
| IV | **Analysis of Frame Structures:** Stiffness of Truss Members; Analysis of Truss; Stiffness of Beam Members; Finite Element Analysis of Continuous Beam; Plane Frame Analysis | | | | | | | | | | 06 | | | CO4 | |
| V | **FEM for Two and Three Dimensional Solids:** Constant Strain Triangle; Linear Strain Triangle; Rectangular Elements; Numerical Evaluation of Element Stiffness; Computation of Stresses, Geometric Nonlinearity and Static Condensation; Axisymmetric Element; Finite Element Formulation of Axisymmetric Element; Finite Element Formulation for 3 Dimensional Elements | | | | | | | | | | 06 | | | CO5 | |
| VI | **FEM for Plates and Shells:** Introduction to Plate Bending Problems; Finite Element Analysis of Thin Plate; Finite Element Analysis of Thick Plate; Finite Element Analysis of Skew Plate; Introduction to Finite Strip Method; Finite Element Analysis of Shell. | | | | | | | | | | 06 | | | CO1, CO3 | |
| Total Hours | | | | | | | | | | | 36 | | |  | |
| **Essential Readings** | | | | | | | | | | | | | | | |
| 1. Reddy, J. N., “*An Introduction to the Finite Element Method*”, Tata McGraw Hill, 2nd Ed, 2003 | | | | | | | | | | | | | | | |
| 2. Krishnamoorthy, C. S., “*Finite Elements Analysis: Theory and Programming*”, Tata McGraw Hill, 2nd Ed, 1994 | | | | | | | | | | | | | | | |
| **Supplementary Readings** | | | | | | | | | | | | | | | |
| 1. Cook, R. D., Malkus, D. S., and Plesha, M. E., “*Concepts and Applications of Finite Element Analysis*”, John Wiley & Sons, 4th Ed, 2002. | | | | | | | | | | | | | | | |
| 2. Zienkiewicz, O. C., Taylor, R. L., and Zhu, J. Z., “*Finite Element Method Its Basis and Fundamentals*”, Elsevier, 6th Ed, 2005. | | | | | | | | | | | | | | | |