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ME~~5XX~~ **Finite Element Methods in Mechanical Design**

Introduction- structural element and system- assembly and analysis of a structure- boundary conditions- general pattern- standard discrete system- transformation of coordinates- examples – direct physical approach to problems in elasticity- direct formulation- displacement approach – minimization of total potential- convergence criteria – discretization error- nonconforming elements and patch test- solution process- numerical examples

Boundary value problems – integral or weak statements- weighted residual methods- Galerkin method- virtual work as weak form of equations in solid mechanics- variational principles

Elements types: triangular, rectangular, quadrilateral, sector, curved, isoparametric elements - shape functions- completeness of polynomials - Lagrange family- Serendipity family- global and local finite element approximation- mapped elements- coordinate transformations- numerical integration –example problems.

Application to structural mechanics problems: plane stress and plane strains, Axisymmetric stress analysis, three dimensional stress analysis, bending of plates.

Dynamic equations- stiffness, mass and damping matrices- consistent and diagonal mass matrices- Extraction of natural frequencies and modes

Computer procedures for Finite element analysis

REFERENCES:

1. CHANDRUPATLA T R AND BELEGUNDU A D, *Introduction to Finite Elements in Engineering*, Pearson Education, New Delhi, 2002.
2. Logan D L, "A First Course in the Finite Element Method", Third Edition, Thomson Learning, 2002.
3. RAO S S, *The Finite element Method in Engineering*, Pergammon Press, New York, 1989.
4. REDDY J N, An Introduction to Finite Element Method", McGraw-Hill International Student Edition, New York, 1985
5. Cook R D, Malkus D S and Plesha M E, "Concepts and Applications of Finite Element Analysis", Fourth Edition, John Wiley and Sons, New Delhi, 2003

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