MF5005 FINITE ELEMENT METHODS FOR MANUFACTURING ENGINEERING

DETAILED SYLLABUS

OBJECTIVE

To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.

UNIT I INTRODUCTION

Fundamentals – Initial, boundary and eigen value problems – weighted residual, Galerkin and Rayleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

UNIT II ONE DIMENSIONAL ANALYSIS

Steps in FEM– Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS

Shape functions for one and two dimensional elements- Three noded triangular and four nodded quadrilateral element Global and natural co-ordinates—Non linear analysis – Isoparametric elements– Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

UNIT IV COMPUTER IMPLEMENTATION

Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation

UNIT V ANALYSIS OF PRODUCTION PROCESSES

FE analysis of metal casting – special considerations, latent heat incorporation, gap element– Time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity and fracture – Solid and flow formulation – small incremental deformation formulation – Fracture criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

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