I YEAR M. TECH (MACHINE DESIGN) FIRST SEMESTER

17MEMD1T5B CONTINUUM MECHANICS & TENSOR ANALYSIS Credits 4

Lecture: 4 periods/week **Internal assessment: 40 marks**

Tutorial: - - **Semester end examination: 60 marks**

COURSE OBJECTIVES:

- Demonstrate knowledge of the physical meanings, principles and mathematics of continuous media represented as solids, liquids and gases.
- Formulate and solve simplified problems using the language and methods of Continuum mechanics.
- Set up and discuss solvability of complicated continuum boundary value problems
- Articulated basic principles and equations applicable to all constitutive models.

COURSE OUTCOMES:

At the end of the course student can be able to

1. Understand the stress tensor and derive it for ideal, Newtonian and viscous fluids
2. Explain the models of linear elasticity and, linear viscoelasticity
3. Explain central terms as material volume, particle and deformation tensor
4. Distinguish Eulerian and Lagrangian definition of the equations of motion
5. Derive conservation laws for mass, momentum and energy on local and global form

UNIT-I

TENSOR ANALYSIS - I:

Multi linear forms, Definition of Tensor over including vector spaces, Alternating tensors, determinants, orientation, tensor products.

UNIT-II

TENSOR ANALYSIS – II:

Rotation of tensors, calculations of tensors, internal calculations of tensors and Integral identities,

TENSOR CALCULUS: Tensor calculus.

UNIT-III

CONTINUUM MECHANICS

Eulerian and Lagrangian description of a continuous, discrete systems, continua, physical quantities and their derivatives. Rigid body motion, Relation between continuum models and real materials

CONSERVATION LAWS IN A CONTINUUM:

Mass conservation in Lagrangian and Eulerian frames, Conservation of momentum in Lagrangian and Eulerian frames.

UNIT-IV

CONSERVATION LAWS OF ENERGY:

Conservation in angular momentum in Lagrangian form. Conservation of energy in Lagrangian and Eulerian frames. Strain and decomposition. Finite deformation, infinitesimal displacements

CONSTITUTIVE RELATIONS - I:

Material frame indifference, Elastic Materials

CONSTITUTIVE RELATIONS - II:

Viscous fluids, linear viscoelasticity

Learning Resources

Text Book

1. Continuous mechanics by George Backus, Samizdat Press, 1997

References:

1. Mechanics of Continua by A.C. Eringan, 1962
2. Continuous Physics by A.C. Eringan Vol. 1, Academic press 17, 1967,
3. Introduction to Continuous Mechanics by B.L.N. Kennett
4. Quick introduction to Tensor analysis by R.Sharipov, 2004, Samizdat Press.
5. Non-linear continuum mech-win, SEACAS theory manuals part II by T.A. Laursen, S.W.Attaway and R.I.Zadoks