COURSE TITLE	**ADVANCED STRESS ANALYSIS**
COURSE CODE	**01CA1113**
COURSE CREDITS	**3**

Objective:

1 The course is intended to strengthen fundamentals of applied mechanics of solids and build understanding of design and analysis of machine components under dynamic loading.

2 The course introduces design and analysis of machine components at elevated temperature.

3 The course also includes fundamentals and application of fracture mechanics and surface failures in machine component design

Course Outcomes: After completion of this course, student will be able to:

1 Analyze stress distribution in components subjected to various loading conditions.

2 Apply principles of elasticity and plasticity to solve engineering problems involving material behavior.

3 Analyze structural behavior of components idealized as plates under different loading conditions.

4 Analyze contact stress distribution in components subjected to interacting or forced contact conditions.

5 Apply experimental techniques for stress analysis and analyze the obtained results.

Pre-requisite of course: Mechanics of solids

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	**Stress** Surface forces and body forces, Cartesian components of stress on small cubic element, Stress at a point, Stress equations of equilibrium, Principal stresses, Maximum shear stress,, Two dimensional state of stress, Special cases: Pure shear stress, Hydrostatic state of stress, Strain equations of transformations,, Principal strain, Energy method for analysis of stress, strain and deflection , three theorem's -theorem of virtual work, theorem of least work, Castiglione's theorem, Rayleigh Ritz method, Galekin's method,	4

Contents : Unit	Topics	Contact Hours
2	**Theory of Elasticity** Elasticity problems in two dimensions - stress strain relationship for brittle materials, ductile materials. Compatibility equations in two and three dimensions, Airy's stress function, Polar component of stress in terms of stress function free body diagram of complicated structures and stress calculations, stress functions in rectangular and cylindrical coordinate systems, evaluation of stresses in flat rectangular plates with different clamp and load conditions , evaluation of the stresses in the flat and circular plate with center hole/holes using stress function.	10
3	**Theory of Plasticity** Different criterions for three-dimensional stress analysis using plasticity, evaluation of stress concentration factors in different geometries using plasticity theorem,, practical problems on stress analysis for plasticity,, stress in the sharp groove of the shaft, stress in the L shaped bracket under cantilever load, strain rate effects on highly deformable materials and stress calculations	10
4	**Plate Bending** Bending of plate to cylindrical surface, bending of a long uniformly loaded rectangular plate,, pure bending in two perpendicular directions, bending of circular plates loaded symmetrically w. r. t. center, bending of circular plates of variable thickness, circular plate with circular hole at center symmetrically loaded and load distributed along inner and outer edges	10
5	**Contact Stress** Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact,, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area, gear contacts, contacts between cam and follower, ball bearing contacts	8
6	**Experimental stress analysis** Dimensional analysis, analysis techniques, strain gauges, types of strain gauges, materials, configuration, instrumentation, characteristics of strain gauge measurement,, theory of photo elasticity, elements of polar scope, simple and circular polar scope, fringes in dark and white field, isoclinic and isochromatic fringe patterns, evaluation of stresses from these fringe patterns	10
Total Hours		**52**

Textbook :

1 Advanced Mechanics of Materials and Applied Elasticity, A C Ugural and A K Fenster, Pearson, 2011

2 Theory of Plates and Shells, Timoshenko , McGraw Hill, 1959

References:

1 Theory of Elasticity, Theory of Elasticity, Timoshenko and Goodier, McGraw Hill, 1934

References:

2 Advanced Strength of Materials, Vol. 1, 2, Advanced Strength of Materials, Vol. 1, 2, Timoshenko , CBS, 2004

3 Advanced Strength and Applied Stress Analysis, Advanced Strength and Applied Stress Analysis, Richard G. Budynas , McGraw Hill. , 1977

4 Advanced Mechanics of Materials and Applied Elasticity , Advanced Mechanics of Materials and Applied Elasticity , A C Ugural and A K Fenster , Pearson, 2011

5 Experimental Stress Analysis, Experimental Stress Analysis, K. Ramesh, IIT Madras, 2009

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
10.00	20.00	20.00	20.00	20.00	10.00

Instructional Method:

1 The course is intended to strengthen fundamentals of applied mechanics of solids and build understanding of design and analysis of machine components under dynamic loading. The course introduces design and analysis of machine components at elevated temperature. The course also includes fundamentals and application of fracture mechanics and surface failures in machine component design

Supplementary Resources:

1 http://www.ni.com/white-paper/3642/en/

2 http://nptel.ac.in/downloads/112106068