Marwadi University

Syllabus for Masters of Technology

Subject Code: 01CA0106

Subject Name: Advance stress analysis

M.Tech. (I Year) Semester-I: CAD/CAM

Type of course: Program Elective

Prerequisite: Mechanics of solid

Rationale: 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.

Teaching and examination scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks			Practical Marks		
L	T	P	C	ESE	IA	CSE	VIVA	TW	
4	--	2	5	50	30	20	25	25	150

Sr. No.	CONTENTS	TOTAL HOURS	WEIGHTAGE %
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	8
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	10	25

	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.		
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	20
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. centre, bending of circular plates of variable thickness, circular plate with circular hole at centre symmetrically loaded and load distributed along inner and outer edges	10	20
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	15
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	12

R Level	U Level	A Level	N Level	E Level
15	30	25	15	15

Reference Books:

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

2. Advanced Mechanics of Materials and Applied Elasticity, A C Ugural and A K Fenster, Pearson.
3. Theory of Elasticity, Timoshenko and Goodier, McGraw Hill.
4. Advanced Strength of Materials, Vol. 1, 2, Timoshenko, CBS.
5. Experimental Stress Analysis, J W Dally & W F Riley, Mc Graw Hill.
6. K. Ramesh, e-Book on Experimental Stress Analysis, IIT Madras, 2009.

URL: http://apm.iitm.ac.in/smlab/kramesh/book_5.htm
7. Theory of Plates and Shells, Timoshenko McGraw Hill
8. The Mathematical Theory of Plasticity - R. Hill, Oxford University Press.

Course Outcome:

After learning the course the students should be able to:
1. Analyze stresses in components subjected to various loading.
2. Apply concepts of theory of elasticity and plasticity.
3. Analyze structures idealized as plates.
4. Analyze contact stresses in components forced against each other.
5. Learn experimental techniques for stress analysis

LIST OF EXPERIMENTS

1. Strain gauge Wheatstone bridge circuit
2. To measure the strain in a loaded steel cantilever using strain gauges
3. Study of Polaris cope and its components
4. Photo elastic stress measurements and fringe constant determination
5. Determination of crack depth using crack depth meter
6. Determination of SIF using Photo elasticity
7. Problems on theory of elasticity
8. Problems on plate bending
9. Problems on contact stresses

Major Equipment:
1. Strain measurement kit
2. Digital Polari scope
3. Crack depth meter

List of Open Source Software/learning website:
1. http://www.ni.com/white-paper/3642/en/
2. http://nptel.ac.in/downloads/112106068