GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Mechanical Engineering
SUBJECT NAME: Applied Mechanics of Solids
SUBJECT CODE: 2171916
B.E. 7thSEMESTER

Type of course: Undergraduate

Prerequisite: Mechanics of Solids.

Rationale: The course is aimed give insight of techniques that can be used to predict the behavior of a solid that is subjected to mechanical loading.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	State of stress: body and surface forces, traction vector and stress tensor, stress transformations, principle stresses, spherical and deviatoric stresses, equilibrium relations, Mohr's circle, Experimental techniques*	**9**	20 %
2	State of strain: general deformation, geometric construction of small deformation theory, strain transformations, principle strains, spherical and deviatoric strains, strain compatibility, Mohr's circle.	**7**	15 %
3	Stress function formulation: plane stress, plane strain, generalized plane stress, Airy stress function in Cartesian and polar coordinates.	**7**	15 %
4	Yield and failure criteria: yield criteria independent of hydrostatic pressure, failure criteria for pressure dependent materials.	**3**	5 %
5	Elastic stress strain relations: linear and nonlinear elastic isotropic stress strain relations, principle of virtual work, Drucker's stability postulate, Normality, convexity and uniqueness for an elastic solid, incremental stress strain relation.	**7**	15%
6	Stress strain relation for perfectly plastic materials: plastic potential and flow rule, flow rules associated with von Mises, Tresca and Mohr-Coulomb yield function, convexity, normality and uniqueness for elastic perfectly plastic materials, incremental stress strain relations, Prandti-	**5**	15 %

	Reuss and Drucker Prager material model,		
7	Stress strain relation for work hardening materials: deformation theory of plasticity, loading surface and hardening rules, Flow rule and Drucker's stability postulate, effective stress and effective strain	**5**	15

***Topics should be covered in only laboratory hours**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	**30**	**15**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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. Elasticity, M. H. Sadd, Elsvier
7. Plasticity for Structural Engineers, W-F Chen and D-J Han, Cengage Learning
8. Advanced Mechanics of Solids, L S Srinath, Mc Graw Hill

Course Outcome:

After learning the course the students should be able to do the complete stress analysis on the basis of elastic and plastic limit of the material and these concepts can be directly apply to solve the industrial based design problem in detail.

List of Experiments:

1. Find the constitutive properties in elastic and plastic region for ductile soild using simple tension test.
2. Develop the code for measuring the stress concentration around a circular hole in a plate subjected to uniaxial loading using Airy's stress function approach.
3. Develop the code to predict the stress distribution in a wedge when subjected to various kind of loadings.
4. Study of strain gauge technique used for stress analysis.
5. Study of the photoelasticity approach.
6. Study of Coherent Gradient Sensing approach.
7. Study of digital image correlation technique.

Design based Problems (DP)/Open Ended Problem:

1. Stress analysis of circular disc under compression load using Airy stress function approach and compare the results using finite element analysis.
2. Design of thick vessel using plasticity concept.

Major Equipment:

1. Universal Testing Machine/Tensometer
2. Extensometer

List of Open Source Software/learning website:

1. Scilab and NPTEL lecture notes

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.