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|  | **National Institute of Technology Meghalaya**An Institute of National Importance | **CURRICULUM** |
| Programme | **Master of Technology (Structural Engineering)** | Year of Regulation | **2018** |
| Department | **Civil Engineering** | Semester | **I** |
| Course Code | Course Name | Pre-requisite | Credit Structure | Marks Distribution |
| L | T | P | C | INT | MID | END | Total |
| **CE 501** | **Advanced Solid Mechanics** | **NIL** | **3** | **0** | **0** | **3** | **50** | **50** | **100** | **200** |
| Course Objectives | To develop the student’s knowledge on understanding response of solids to applied forces will be developed and will be used to study simple boundary value problems. | Course Outcomes | CO1 | Student will be able to have a solid foundation on advanced stress/strain correlations. |
| To provide some knowledge on the concepts of 3D elasticity solutions to boundary value problems and simplified solutions and use of available tools to analyze a structure and to elucidate the simplifying assumptions made to make the structure analyzable.  | CO2 | Student will be gaining the physical intuition to obtain simple mathematical and physical relationships between mechanics and materials, Model the plastic behaviour, as well as the fatigue, fracture and creep response, of common engineering materials |
| To provide an understanding on a number of problems that will be solved to illustrate how the learnt concepts help solve problems of interest. | CO3 | Student will be able to possess and establish links between theoretical and practical applications; identify problems and formulate solution strategies. |
| CO4 | Student will be able to use these solutions to guide a analytical and cognitive skills through learning experiences in a diverse range of solid mechanics topics. |
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| SYLLABUS |
| No. | Content | Hours | COs |
| I | **Introduction:** Review of basic concepts and equations in mechanics, Classification of materials, Outline of general techniques to solve boundary value problems. | 3 | CO1 |
| II | **Mathematical Preliminaries:** Indicial notation, Introduction to tensors, Representation of tensors, Gradient and related operators, Divergence theorem. | 3 | CO2 |
| III | **Kinematics:** Motion field, Displacement field, Deformation gradient, Transformation of curves, surfaces and volumes, strain measures, linearized strain measures, Principal strains and principal directions, Transformation of strain components with changes in coordinate basis, Compatibility conditions for linearized strain. | 3 | CO3 |
| IV | **Traction and stresses:** Concept of traction, Cauchy's stress theorem, Postulate of Cauchy stress tensor, Traction on arbitrary planes, Extreme normal and shear traction, Octahedral shear stress, Other stress measure – Engineering stress | 3 | CO3 |
| V |  **Equilibrium equations:** Equilibrium equations in Cartesian and cylindrical polar coordinates | 3 | CO3 |
| VI |  **Constitutive relations:** Restrictions on constitutive relations, General relationship between Cauchy stress and Cauchy Green strain for isotropic materials, General Hooke's law and its reduction for isotropic and orthotropic materials. | 4 | CO3 |
| VII | **Boundary value problems: Formulation :**Displacement method, Stress method, Airy's stress functions for plane stress and strain problems, Uniaxial Tension, Thick-walled annular cylinder subjected to uniform boundary pressure, Infinite medium with a stress free hole under far field tension loading. | 4 | CO3 |
| VIII | **Bending of prismatic straight beams:** Pure bending, bending due to uniform transverse loading and bending due to transverse sinusoidal loading of a beam, Asymmetrical bending of straight beams, Shear center, and Shear stresses in thin walled open sections. | 4 | CO4 |
| IX |  **End torsion of prismatic beams:** Formulation of the BVP for torsion of beams with solid cross section - warping function and Prandtl stress function approach, Torsion of circular, elliptic, rectangular and triangular cross sections, Membrane analogy, Torsion of thin walled tubes, thin rectangular sections, rolled sections and multiply connected sections. | 3 | CO4 |
| X |  **Bending of curved beams:** Winkler-Bach Formula, Elasticity solution for: pure bending of curved beams, curved cantilever under end loading. | 3 | CO4 |
| XI |  **Beam on elastic foundation:** Derivation of the basic governing equation, Solution to beam on an elastic foundation subjected to a point load at the center, moment at the center, uniformly distributed load over some length 'a' symmetrically about the center. | 3 | CO4 |
| **Total Hours** | **36** |  |
| **Essential Readings** |
|  1. Srinath, L. S., “*Advanced Mechanics of Solids*”, Tata McGraw Hill, 2nd Ed, New Delhi, 2003. |
|  2. Timoshenko, S. P. and Goodier, J. N., Zienkiewicz, “*Theory of Elasticity*”, McGraw Hill, 2nd Ed, New Delhi, 1970. |
|  3. Budynas, R. G., “*Advanced Strength and Applied Stress Analysis*”, McGraw Hill, 2nd Ed, New Delhi, 1999. |
| **Supplementary Readings** |
|  1. Singh, A. K., “*Mechanics of solids*”, PHI Pvt. Ltd., 1st Ed, 2007. |
|  2. Boresi, A. P. and Schmidt, R. J., “*Advanced Mechanics of Materials*”, John Willey and Sons Inc, 5th Ed, 1993. |
|  3. Chandrasekharaiah, D. S. and Debnath, L., “Continuum Mechanics”, Prism Books Pvt. Ltd., Bangalore, 1994. |