Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

ID7200 – Design of frp composite structures

Credit Distribution: C: 9 L: 3 T: 0 P: 0 E: 0 O: 6 TH: 0

Course Type: Theory

Description: To understand the concepts in the design of Fibre Reinforce Polymer (FRP) composites. 2. To design FRP composite structural elements and structures.

Course Content: 1 Principles of Design: Definition, design values and constraints, uncertainties in design, use of decision theory, design acceptance and optimization criteria. Product design variables, Design methodologies, Design algorithm, and procedure of routine, innovative and inventive designs. Product synthesis techniques. 2.Material Considerations in Composite Product Design: Review of structure property relations of composite materials. Material selection and microstructure design. Effect of material on the choice of other design variables. 3. Design for Function: Material design of thermal, optical, acoustic, electrical and electromagnetic radiation design requirements. 4. Design for Safety under Mechanical Loads: Deterministic, probabilistic, semi-probabilistic and damage tolerant design approaches ,determination of factor of safety / probability of failure, Design limit states and design acceptance criteria for each limit state. Failure criteria under uniaxial and multi-axial loading. 5. Analysis of FRP Composites: Micromechanical and fracture mechanical analysis and prediction of mechanical properties and fracture behavior of composites. Single and multiple fracture. Visco-elastic behavior. Anisotropy of composites, Anisotropic elastic constants, Transformation of elastic constants, Elastic constants of multilayered plates and sandwich composites. Failure criteria under multiaxial loading. Interlaminar failure mechanisms, Material properties under time dependent loads, fatigue, impact and vibratory loads. 6. Design of Simple Structural Elements and Joints: Tension bars, Columns, beams, rings, arches, plates and shells. Detailed design of joints and critically stressed regions of products: Bolted and adhesive joints, Nozzles and opening, supports, lugs and fittings. 7. Design of FRP Composite Structures: Design of chemical storage tanks and plants, pipes, pressure vessels, roofs, transport containers, bus body, fishing boats and machine elements.

Text Books:

- Eckold, G., Design and Manufacture of Composite Structures, Woodhead Publishing Ltd., 1994.
- Herakovich, C.T. and Tarnopolskii, Y.M., Handbookof Composites, Vols. 1 and 2, North-Holland Publishing Co., 1989.

Reference Books:

- Jones, R.M., Mechanics of Composite Materials, Taylor and Francis, 1999.
- Peters, S.T., Handbook of Composites, Chapman and Hall, 1998.

Prerequisite: Nil