# CE5025 - LATTICE STRUCTURES

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

**Course Type:** Theory

**Description:** To impart the knowledge of basic mathematical tools that can be used to analyze and design lattice structures. To convey the potential usefulness of lattice structural-material and meta-material systems for engineering applications and to motivate/inspire further research.

**Course Content:** Introduction: Lattice theory, mechanics of lattice structures, periodicity constraints, deformations, Analysis methods: Elastostatics, homogenization, theory of composites, Bloch wave analysis, elastic band structure, wave directionality, elastic bandgaps**,** Lattice metamaterials: Mechanical metamaterials, honeycomb lattices, origami lattices, geometric mechanics, pentamode lattices, programmability & tunability, Atomic lattices: Atomistic models, governing equations, mathematical similarities between quantum and continuum systems, 2D lattices like Graphene, Design of lattice structures: Structural optimization approaches, topology optimization, mathematical formulations and numerical calculations, Additional topics: Stability of lattice systems, dynamics including damping and nonlinearity, manufacturing of lattice structures.

**Text Books:** Phani, A. S., and Hussein, M. I., eds. Dynamics of lattice materials. John Wiley, 2017.

**Reference Books:**


- Gibson, L. J., and Ashby, M. F. Cellular solids: structure and properties. Cambridge University Press, 1999.
- Brillouin, L. Wave propagation in periodic structures: electric filters and crystal lattices. Dover Publications, 1953.
- Milton, G. W. The theory of composites. Cambridge University Press, 2002.
- Christensen, P. W., and Klarbring, A. An introduction to structural optimization. Vol. 153. Springer Science & Business Media, 2008.
- Lang, R. J. Twists, tilings, and tessellations: mathematical methods for geometric origami. AK Peters/CRC Press, 2017.


**Prerequisite:** NIL