

## CE-840 Nano Secrets in Concrete

Code	Credit Hours	Category
CE-840	3 Credit Hours	Elective

### Course Description:

This course provides an in-depth understanding of nanotechnology applications in concrete to enhance its properties. It covers the fundamentals of nanomaterials and their interactions with concrete components, leading to advancements in strength, durability, and sustainability of concrete structures.

### Text Book:

- J. G. Sanjayan, K. M. Nazari (2015), "Nano and Biotech Based Materials for Energy Building Efficiency," Springer.
- A. M. Brandt (2009), "Cement-Based Composites: Materials, Mechanical Properties and Performance," CRC Press.
- *Handbook of nanotechnology*. Authors: B. Bhushan, Springer

### Reference Books:

- Sobolev, Konstantin, and Surendra P. Shah. "Nanotechnology in Construction." Springer, 2008.
- T. Wang (2014), "Nanotechnology in Civil Infrastructure: A Paradigm Shift," Springer.
- *Nanotechnology: Next big idea*. Authors: M. Ratner, Prentice-Hall, Inc., 2003.
- *Nano systems*. Authors: K. Eric Drexler, Willey, 1992.
- *Concrete Nano-science and Nanotechnology: Definitions and Applications*. Author: E. J. Garboczi.
- *Advanced Research on Nanotechnology for Civil Engineering Applications*. Authors: Anwar Khitab and Waqar Anwar. IGI Global
- *Nanostructured Cement and Concrete*. Authors: Henning Zoz, Reinhard Trettin.

### Prerequisites:

BE (Civil, Architecture, Construction Engineering & Management).

### Assessment System

Component	Weightage	Frequency
Quizzes	10-15%	2-3
Assignments	10-20%	2-3
Mid Terms	30-35%	1

ESE	40-50%	1
Project (optional)	10-15%	1

### Teaching Plan:

Week	Topics
1	Introduction/Overview
2	Nanotechnology
3-4	Nano scale behavior of construction materials
5-6	Trends in nano-scropy in materials research: Nano scale microscopic characterization of cement
7-8	Nano sensing technology
9	<b>Mid Term Exam/ OHT, (As per NUST Exam Policy)</b>
10-11	Role of nanotechnology in green construction
12-13	Structural rehabilitation/maintenance using nano-intrusion techniques
14-15	Risks and preventive measures of nanotechnology
16	Presentations for Term-project
17-18	<i>ESE</i>

### Software Tools

MATLAB, VCCTL Software, Concrete Optimization Software Tool