# GUJARAT TECHNOLOGICAL UNIVERSITY

**BRANCH NAME: Applied Mechanics**
**SUBJECT NAME: Theory and applications of cement composites**
**SUBJECT CODE: 3712014**
**1st Semester**

**Type of course: Program Elective – I**

**Prerequisite: Material Science, Concrete Technology, Mechanics of Structures**

**Rationale:** Concrete as one of the conventional composite material is invariably one of the most robust and versatile material. It performs extremely well under compression, however high strength concrete tends to be brittle.Concrete these days is modified in order to enhance its capacity for long term performance under harsh environmental & structural loads. Cement and concrete composites have made this possible. These composites comprise of binder or a matrix that binds together different types of fibers or fragments as per the requirements. The final product in form of composite is light, strong, flexible and more efficient in comparison to conventional composite i.e. concrete.

**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) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 30 | 20 | 150 |

**Content:**

| Sr. No. | Content | Total Hrs | % Weightage |
|---|---|---|---|
| 1 | **Introduction:**<br>• Genesis of composites, Classification and Characteristics of Composite Materials,Constituent materials and their properties<br>• Stress-strain relations, Orthotropic & Anisotropic materials,Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina<br>• Advantages over conventional materials<br>• Manufacturing process of composites | 13 | 30 |
| 2 | **Cement composites:**<br>Advanced Cement Composites: Fiber-reinforced cementitious composites, high-strength cementitious composites, Polymers in concrete, shrinkage-compensating concrete, engineered cementitious composites | 10 | 25 |
| 3 | **Mechanical Properties**:<br>Behaviour of cement composites in tension, compression, flexure, bond, post-cracking behavior, Fatigue, Impact, Durability & corrosion, Factors affecting mechanical properties | 13 | 30 |

| | | | |
|---|---|---|---|
| 4 | **Application of cement composites:** Fiber Reinforced Concrete, Ferrocement, Housing, Water storage, Boats & Miscellaneous structures | 6 | 15 |

**Reference Books:**


- Mechanics of Composite Materials, Jones R. M,, 2nd Ed., Taylor and Francis,BSP Books, 1998.
- Advanced Concrete Technology –Zongjin Li
- Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
- New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman & Hall, 1983.
- Isaac M. Daniel and OriIshai - Engineering Mechanics of Composite Materials, OxfordUniversity Press, Second Edition, New Delhi.
- Michael W. Hyer - Stress Analysis of Fiber-Reinforced Composite Materials,WCB/McGraw-Hill,Singapore.
- Roman Solecki and R Jay Conant – Advanced Mechanics of Materials, Oxford UniversityPress,New York, Special Edition for sale in India.


**Course Outcome:**

After learning the course the students should be able to:

1. Formulate constitutive behaviour of composite materials –Ferrocement & FiberReinforced Concrete - by understanding their strain- stress behaviour.
2. Classify the materials as per orthotropic and anisotropic behaviour.
3. Estimate strain constants using theories applicable to composite materials.
4. Analyse and design structural elements made of cement composites.

**List of Experiments:**

5. Study the changes in the mechanical properties of Fiber reinforced concrete by varying % content of fibers
6. Investigation of the change in the mechanical properties of the Fiber reinforced concrete due to variation in geometry of fibers
7. Experimental study of Effect of size and aspect ratio of fibers on properties of concrete
8. Experimental investigation to study tensile properties of Normal and Fiber reinforced concrete
9. Experimental study on effect of addition of fibers on Pull-Off strength of concrete
10. Study of cracking pattern of reinforced beams made up of (i) Normal Concrete (ii) Fiber reinforced concrete (iii) Ferrocement wrap under bending.

**Major Equipment: Compression Testing Machine**

**List of Open Source Software/learning website:**