CONCRETE TECHNOLOGY

ENCE 205

Lecture : 2 **Year : II**
Tutorial : 0 **Part : I**
Practical : 2

Course Objectives:

The objective of this course is to build the basic understanding of students on concrete ingredients and their properties, properties of fresh and hardened concrete, quality assurance and quality control in concreting works, concrete grade and concrete mix design, and special concrete. After completing this course, students should be able to develop competency in understanding on behavior of concrete, concreting operation, tests on concrete, and mix design.

1 Concrete and Constituents of Concrete (6 hours)

1.1 Introduction to concrete and use of concrete in structures
1.2 Constituents of concrete
  1.2.1 Aggregates (Properties and their gradation)
  1.2.2 Cement: Compound composition of cement (Bogue's compound) and their properties, hydration of cement, strength of cement
  1.2.3 Water (Quality/requirements of water for concrete)
  1.2.4 Admixtures: Chemical admixtures and mineral admixtures, use of chemical admixtures (Plasticizers, Super-plasticizers, accelerator, retarder, air entraining agents, water proofer), properties, use and different types of mineral admixtures (Fly ash, blast furnace slag, silica fume, rice husk ash, meta-kaolin)
1.3 Structure of concrete: Concrete as three phase system (aggregate, hydrated cement paste and transition zone phases)

2 Properties of Fresh Concrete and Concreting Operations (4 hours)

2.1 Water-cement ratio
2.2 Workability and its tests (Slump test, compaction factor test, Vee-Bee consistency test, flow table test)
2.3 Segregation, bleeding and their effects
2.4 Concreting operations (Batching, mixing, handling, placing, compaction, finishing, curing and formwork removal)
2.5 Concreting in extreme temperatures and its mitigation
2.6 Mass concreting issues and their mitigation

3 Mix Design of Concrete (6 hours)

3.1 Compressive strength of concrete and grade designation
3.2 Variability of concrete strength, characteristic strength and grade of concrete
3.3 Introduction to nominal Mix
3.4 Mix design (IS code, British code, ACI methods)

4 Properties of Hardened Concrete (6 hours)

4.1 Load-deformation behavior of hardened concrete, moduli of elasticity
4.2 Shrinkage and creep
4.3 Impact, cyclic loading and fatigue
4.4 Effect of water cement ratio (Abram's law, effect of porosity and aggregate size)
4.5 Effect of gel/space ratio
4.6 Concrete maturity
4.7 Durability of concrete: Physical and chemical cause of deterioration, effect of water and permeability, sulphate attack, attack by sea water, alkali silica reaction (AAR/ASR), chloride ion penetration, carbonation, corrosion of steel in concrete

5 Testing of Concrete, Quality Assurance and Quality Control (5 hours)

5.1 Strength of concrete (Tensile, compressive, shear and bond strength)
5.2 Compressive strength test
5.3 Tensile strength test (Direct, splitting and flexural)
5.4 Acceptance criteria
5.5 Non-destructive tests (Schmidt rebound hammer test, ultrasonic pulse velocity test, and resistivity test)
5.6 Quality assurance and quality control; Testing and monitoring

6 Special Types of Concretes (3 hours)

6.1 Light weight concrete (Aerated concrete, cellular concrete, no fines concrete)
6.2 High density/heavy weight concrete (Self compacting concrete, ferro-cement concrete)
6.3 Fiber reinforced concrete (Steel fibers, glass fibers, carbon fibers, organic fibers)
6.4 Self-healing concrete
6.5 High performance concrete (High strength concrete, abrasion resistant concrete)
6.6 Emerging concrete technologies

Practical (30 hours)

1. Gradation and properties of aggregates
2. Nominal mix (IS code provision)

3. Concrete mix design: IS code method, British code method, ACI method
4. Workability tests: Slump test, compaction factor test, Vee-Bee time test
5. Testing of concrete cubes, cylinders, and prisms etc.
6. Non-destructive testing (Schmidt rebound hammer test and ultrasonic pulse velocity test)

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	6	6
2	4	4
3	6	6
4	6	6
5	5	5
6	3	3
Total	**30**	**30**

* There may be minor deviation in marks distribution.

References

1. Neville, A.M. (2016). Properties of Concrete, (5th edition). Pearson Education.
2. Shetty, M. S. (2006). Concrete Technology. S. Chand & Co.
3. M. L. Gambhir, (2017). Concrete Technology. Tata Mc Graw Hill Publishers.
4. Mehta P. K., Monteiro J. M. (2014). Concrete: Micro structure, Properties and Materials. McGraw Hill Publishers
5. IS 383:2016 Coarse and Fine Aggregate Specification for Concrete Specification
6. IS 456:2000 Plain and Reinforced Concrete – Code of Practice
7. IS 10262:2019 Concrete Mix Proportioning Guidelines
8. IS 2386 (Part 1, 3, 4) Methods of Test for Aggregates for Concrete
9. IS 516 (2021) Methods of Tests for Strength of Concrete
10. IS 1199 Methods of Sampling and Analysis of Concrete
11. IS 5816 Splitting Tensile Strength of Concrete – Method of Test
12. ACI 211.1-91: Standard Practice for Selecting Proportions for Normal, Heavy weight, and Mass Concrete.
13. BS 5328: Part 2: 1997, Concrete-Part 2: Methods for Specifying Concrete Mixes.