

Approval: 9th Senate Meeting

Course Number: CE 507

Course Name: Advanced Concrete Science

Credits: 3-0-0-3

Prerequisites: CE 552 - Concrete Technology

Intended for: UG/PG

Distribution: - Discipline Elective

Semester: Odd/Even

Preamble: Concrete is the most widely used building material of modern era. Despite of its wide application, a wide gap continues to prevail in rationally comprehending its performance characteristics. The lacuna invariably leads to a prescriptive application of the material in practice. This course intends to cover the science of concrete from a materials perspective. The course provides a basis for research in the domain of concrete technology.

Course Outline: The course covers the topics of mix design for desired performance, factors governing the characteristics of concrete in fresh and hardened states, the transport process which lead to its degradation and the mechanisms of common degradation processes. A chapter has been devoted to the problem of reinforcement corrosion, known to be the most widespread cause of premature deterioration of concrete elements. The course concludes with deliberations on the aspect of design for durable performance.

Modules:

1. Mix design methods for ordinary and high performance concretes. **(6 contact hours)**
2. Performance in fresh and hardened states – Rheology, Stress-Strain characteristics, Creep and Shrinkage. **(6 contact hours)**
3. Pore structure of cement based materials: Types and genesis of pores, Methods of measurement. **(6 contact hours)**
4. Transport processes in concrete: Mechanisms of Water, Gas and Salt transport; Transport models; Tests for the assessment of transport characteristics. **(6 contact hours)**
5. Degradation mechanisms: Carbonation, Sulphate attack, Freeze-Thaw, Alkali-Silica reaction. **(6 contact hours)**
6. Reinforcement corrosion: Mechanisms of initiation and propagation, Electrochemical aspects, Monitoring, controlling and prevention, service-life prediction. **(6 contact hours)**
7. Design for Durability: Service-life, Prescriptive, Performance and Model-based approaches. **(6 contact hours)**

Text Books:

- a) Aligizaki, K. K., 'Pore structure of cement-based materials: testing, interpretation and requirements', Taylor & Francis, New York, 2005.
- b) Richardson, M., 'Fundamentals of durable reinforced concrete', Spon Press, London and New York, 2003.
- c) Hall, C. and Hoff, W.D., 'Water transport in brick, stone and concrete', CRC Press, Florida, 2011.

Reference Books:

- a) Sarja, A. and Vesikari, E., 'Durability design of concrete structures-Report of RILEM technical committee 130-CSL', E&FN Spon, London, 2004.
- b) Cerny, R. and Rovnanikova, P., 'Transport processes in concrete', Spon Press, USA and Canada, 2002.
- c) Claisse, P.A., 'Transport properties of concrete: measurement and applications', Woodhead Publishing, UK, 2014.
- d) Bertolini, L., Elsener, B., Pedferri, P., Redaelli, E. and Polder, R.B., 'Corrosion of steel in concrete: prevention, diagnosis, repair', Wiley-VCH Verlag GmbH & Co. KGaA, Germany, 2013.