



FIRST SEMESTER 2016-2017

Course Handout Part II

In addition to Part-I (General Handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course No : CE G562
Course Title : Advanced Concrete Technology
Instructor-in-charge : Dr.Bahurudeen A

Objective of the course and Course Description

This course aims to provide comprehensive scientific insight of concrete ingredients and their influence on hydration kinetics. At the end of this course, the students will be able to apply their knowledge in modern concrete practices. The course will provide in-depth analysis into the composition and relevant chemistry of concrete constituents. This course will elucidate the functional role and inherent chemistry of ingredients of concrete through stoichiometry, hydration reactions and application of microanalysis techniques. Furthermore, the course elaborates on the fundamental knowledge of fresh and hardened properties of concrete, through the effect on concrete composition and the relevant chemistry. The course will describe the degradation mechanism of concrete against different aggressive exposure conditions and design of durable concrete. Additionally, this course will demonstrate techniques of Non-Destructive Evaluations (NDE) of concrete structures. Moreover, it will describe utilization of waste materials as novel materials for use in concrete and subsequently, the outlines for designing a concrete mix which fulfills the required properties for fresh and hardened Portland cement concrete.

Text Books:

- T1:** Mehta, P. K., and Monteiro, P. J. M., "Concrete: Microstructure, Properties, and Materials", 4th Ed., 2013, McGraw-Hill Education, USA.
T2: Neville, A.M, "Properties of Concrete", 4th Edition 1996, Addison Wesley Longman Limited, Harlow, UK.

Reference Books:

- R1:** Taylor, H. F. W., "Cement Chemistry", 2nd Ed., 1997, Thomas Telford Publishing, London, UK.
R2: Mindess, S., Young, J. F., and Darwin, D., "Concrete", Second Ed., 2002, Pearson Edu, New Jersey, USA.
R3: Malhotra, V. M., and Carino, N. J., "Handbook on Nondestructive Testing of Concrete", Second Ed., 2004, CRC Press, ASTM International, PA, USA.
R4: ASTM Standards, ACI Codes, IS Codes as necessary, and as referred in TB and RB (1 – 4).
R5: Kett, I., "Engineered Concrete: Mix Design and Test Methods", 2nd Ed. 2010, CRC Press, T & F, FL, USA.
R6: Newman, J. and Choo, B.S., "Advanced Concrete Technology", Vol. 1 - 4, 2003, Butterworth – Heinemann (ELSEVIER), MA, USA.
R7: Ramachandran and Beaudoin. Handbook of analytical techniques in concrete science and technology. 2002.





Course Plan

Learning Objective	Topics Covered	Lect	References
Components of Concrete – Chemical properties of cement and cementitious paste	Introduction: constituents; Cement: raw materials, manufacturing process; Dry and wet process; Precalciner and rotary kiln; Ternary diagrams; Composition and types, hydration, C-S-H models; Tests of cement, paste and mortar; microstructure of cementitious paste; heat of hydration; calorimetry; tests on cement, paste and mortar; microstructure of cementitious paste.	7	Ch 1 – 4 (T 1), Ch 6 (T 1), Ch 1, 3, 4, 5, 7 (R 1); Ch 1 – 4 (R 2)
Components of Concrete – Properties of Aggregates	Properties of aggregates; petrography techniques to determine aggregate properties. high performance concrete using aggregate Skelton method and analytical tools	2	Ch 7 (T 1)
Chemistry of Admixtures: Mineral	Supplementary cementitious materials (SCM): fly ash, slag, silica fume, metakaolin, rice husk ash; volume stoichiometry of chemical reactions; difference between pozzolanic and hydraulic SCM; Influence of SCMs on fresh and hardened properties of blended concrete.	5	Ch 5 (T 1), Ch 9(R 1)
Chemistry of Admixtures: Chemical	Types of chemical admixtures- Super plasticizers; VMA; Set controlling chemicals, Air entraining admixtures; Shrinkage reducing admixtures; Corrosion inhibitors. chemical compositions of admixtures; Mechanism of chemical admixtures; effect of chemical admixtures on concrete characteristics	5	Ch 8 (T 1)
Characterization techniques	X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), nuclear magnetic resonance (NMR), atomic absorption spectroscopy (AAS), Differential scanning calorimetry (DSC), Thermogravimetric analysis (TGA). Non-Destructive Techniques for concrete evaluation.	6	R7- Ch 1-8
Effect of concrete composition on Properties of Fresh Concrete	Effect of concrete composition on properties of fresh concrete; effect of concrete composition and curing on workability, setting times, segregation, and bleeding of fresh concrete. rheology of concrete, Marsh cone, mini slump and rheometers	4	Ch 9, 11, 12 (T 1)
Effect of concrete composition on Properties of Hardened Concrete	Effect of concrete composition on properties of hardened concrete; shrinkage and creep; correlation between micro- and specimen level properties, interfacial transition zone.	3	Ch 13, 14, 16 (TB 1)





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Durability of concrete	Alkali silica reaction, freeze-thaw effect, salt attack, acid attack, sulfate attack, corrosion of embedded steel rebar, carbonation of concrete, delayed ettringite formation; durability tests; Prediction of concrete service life	5	R6- Ch 8
Alkali activated binders	Preparation of green concrete using additives such as metakaolin, rice husk ash, microsilica, alccofine; concrete with alkali activated binders (AAB); geopolymer terminologies; anomalies in nomenclature; chemistry of alkali-activated binders; difference between alkali – activated binders and blended cements.	3	R6- Ch 2

Total 40 Lectures (Tentative)

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Remarks
Mid Semester Test	90 minutes	25	<TEST_1>	Closed Book
Term Project and Seminar	-	10	-	Open book
Literature Review & Take Home Assignments	-	30	Continuous	Open Book
Comprehensive Exam	3 hours	35	<TEST_C>	Closed book

Chamber Consultation Hour: Thursday; 5:00-6:00 pm

Notices: Notices concerning the course will be displayed on the Civil Engineering Dept. Notice Board only.

Make-up Policy: Take prior permission from I/C. Make-up will be granted with prior permission, on a case to case basis, only on genuine extraordinary reasons. For medical cases, a **certificate** from the concerned doctor of the Medical Centre must be produced.

Instructor-in-charge **CE G562**



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