FIRST SEMESTER 2015-2016
Course Handout Part II

Date: 02/01/2016

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 G534**
Course Title	:	**Pavement Material Characterization**
Instructor-in-charge	:	**Bahurudeen A**

Scope and Objective of the course

The present course deals with all the materials available for highway/runway pavement construction. Scope includes detailed discussion on soils, aggregate, cement, concrete, bitumen, emulsions, and cutbacks along with both Bituminous and cement concrete mix designs. Moreover, fly ash, modified bitumen and locally available materials will be discussed as the current emphasis is in the course. Additionally, laboratory component is included to achieve in-depth understanding of characterization test methods. Emphasis will be given on thorough understanding and interpretation of relevant IRC and IS codes.

Text Book:
T1. Atkins, H. N., *Highway Materials, Soils and Concretes*, Fourth Ed., Prentice-Hall, 2002.
T2. Yoder E. J. and Witczak, M.W., *Principles of Pavement Design*, 2nd Ed., John Wiley & Sons, 1975.

Reference Books:
R1: Huang,Y.H., *Pavement Analysis and Design*, Pearson, 2004.
R2: Kerbs Robert D. and Richard D. Walker, *Highway Materials*, McGraw-Hill, 1971.
R3: *Geotechnical Aspects of pavements*, FHWA NHI-05-037, 2006
R4. Relevant IRC, MoRTH and IS Codes of Practices (Separate List will be given).
R5. Papagiannakis AT and Masad EA. Pavement design and materials. John Wiley & Sons, 2008.
R6. Ramachandran and Beaudoin. Handbook of analytical techniques inconcrete science and technology. 2002.

Course Plan

L	Learning Objective	Topics to be covered	Reference
2	Introduction	Basics of material characteristics. Types of pavements, components, Pavement materials and types.	T1- ch1, ch4, ch5, ch6; R1-ch1; R5-ch10, ch13, MoRTH manual
4	Modern Characterization techniques	X-ray florescence spectroscopy (XRF), Thermogravimetric analysis (TGA/DSC), Ion chromatography, Fourier Transform-Infra red spectroscopy (FT-IR), NMR spectroscopy, UV spectroscopy, Scanning electron microscopy (SEM), X-ray diffractometer (XRD), Tomography and Mercury intrusion porosimetry	R6- Ch 1-8

3	Stone and Aggregates	Origin, Classification, Types of aggregates, Properties of aggregates, Importance of aggregate gradation, Superpave gradation, Tests on the aggregates	T1-ch4; R4-IS383, IRC-15-2011
2	Bituminous materials	Origin, Preparation of bitumen materials, properties of paving bitumen, important tests on bituminous materials	T1-ch6 and T2-ch8, ch12
4	Bituminous mix design	Requirements of bitumen mixes, Marshalls mix design, Introduction to super pave mix design procedure	T1-ch6 and T2-ch12
2	Mechanical properties of bituminous mixes	Elastic modulus, dynamic modulus, visco-elastic and fatigue properties, creep test, stiffness modulus of bitumen mixes using shell nomographs	T2-ch8, R1-ch7
2	Soil Classification	Soil Classification based on origin, IS classification, Suitability of different type of soil for the construction of highway embankments and pavement layers etc.	R4- IS1498; T1-ch1
2	Laboratory testing of Soils	Lab. tests for various engineering and index properties, lab compaction, shrinkage, swelling and CBR test, triaxial testing and resilient modulus.	R4, T2-ch7, ch8, ch9, R1-ch7
3	Field testing – I	Evaluating design soil parameters from conventional field tests using SPT, DCPT, CPT, CBR, Plate Load test- subgrade modulus, determination of resilient modulus and other field tests.	T1- ch1, ch2, ch3 and T2-ch7, ch8, ch9; R3-Ch4; R1-ch7
2	Field testing - II	Geophysical and Dynamic tests for roads and highways, FWD, LWD, Geogauge, dynamic cone penetrometer	T1- ch2, ch3 and T2-ch7, ch8, ch9; R3-Ch4; R1-ch7
2	Characteristics and control of improved soil	Testing and quality control for field compaction, stabilization and ground improvement	ch10, T2, IS and IRC codes
2	Field testing - III	Latest advances in NDT&E of pavements	R5- ch14
1	Bituminous emulsions and cutbacks	Preparation, Characteristics, Uses of emulsions and cutbacks, tests on emulsions	T1-ch6
2	Modified bitumen	Introduction to modified bitumen, Tests for qualifying the modified bitumen with case studies	IRC-53-2010
3	Fly ash, natural fibers, and other innovative materials	Various locally available materials used for pavement construction, Properties, tests, characterization of flyash and other locally available materials	IRC:88-1984, IRC-SP-58-2001, 89-2010, IRC-SP-72-2007
3	Cement, concrete pavement materials	Type of cements and properties, quality tests on the cement, admixtures, workability, tests on cement concrete, concrete construction, curing.	T1-ch7 IRC-15-2011 IRC44-2008
2	Cement concrete mix design	Mix design process and examples for pavement	T1-ch7 and IRC, IS codes
1	Joint fillers and sealers	Discussion on fillers and sealers	Relevant IRC

Total 42 Lectures (Tentative)

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Remarks
Mid Semester Test	90 minutes	25	18/3 4:00- 5:30 PM	Closed Book
Presentations and Term Project	-	10	-	Open book
Tutorials, Review papers & Take Home Assignments	-	30	Continuous	Open Book
Comprehensive Exam	3 hours	35	13/5 AN	Closed book

Chamber Consultation Hour: Wednesday; 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 G534**