



SECOND SEMESTER 2015-16

Course Handout (Part-II)

13.01.2016

In addition to part I (General handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No: CE F244 (3L 1P 4U)

Course Title: **Highway Engineering**

Instructor-in-charge: Dr. Amit Goel

Other Instructors : Dr. Prasanta Sahu (T), Dr. Muthu kumar(Lab), Vidhi Vyas (T, Lab), Dewal Mishra(Lab), Makrand Waghle(Lab)

- 1. Course Description:** This course mainly covers the topics viz. basics of transportation systems, design of geometric standards, pavement materials and testing, design of highway pavements: flexible and rigid highways: IRC method; overlays; traffic engineering: traffic characteristics; traffic studies; signals; parking; intersections and traffic accidents.
- 2. Scope and Objective of the Course:** The growth of a country is measured by its transportation facilities through which economic, social, political and strategic developments take place. The objective of this course is to introduce the students to the basic concepts of roadways (or Highways), with specific focus on the planning and various aspects of design of highways, as well as an understanding of the vehicular traffic.
- 3. Text Book(s):**

T1. Kadiyali L.R. and Lal N B, (2011) Principles and Practices of Highway Engineering, Fourth Edition; Khanna Publishers, New Delhi 110006

Reference Books:

R1. Khanna, S.K. and Justo A, and Veeraragavan, A. (2014): Highway Engineering, Nem Chand and Bros. Roorkee (U.P.)

R2. Garber, N.J. and Hoel, L.A. (2010) Traffic and Highway Engineering, Fourth Edition; Cengage Learning, Stamford, CT, USA

R3. Papacoastas, C. S. and Prevedouros (2008) Transportation Engineering and Planning, Third Edition; Pearson Education.

R4. Khisty C J and Lall B Kent; 2002; Transportation Engineering: An Introduction, Third Edition; Prentice Hall of India Private Limited, New Delhi,

R5. Kadiyali L R; Traffic Engineering and Transportation Planning; Khanna Publishers, New Delhi; 2003

R6. Partha chakroborty and Animesh Das, (2013) Principles of Transportation Engineering, PHI

R7. Rajib B. Mallick and Tahar El-Korchi, (2014) Pavement engineering Principles and Practice Second Edition, CRC Press.





R8. Yang H. Huang, (2008) Pavement Analysis and Design, Pearson Education, New Delhi, Second Edition (LPE).

R9. Relevant codes and manuals

C1. IRC: 37-2012 Guidelines for the Design of Flexible Pavements

C2. IRC: 58-2011 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways

C3. IRC: 81-1997 Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique

Relevant **Handouts** (softcopy/hardcopy) will be shared in class, time to time, as required.

Journals that may be referred:

1. Transportation Research Record, TRB
2. Journal of Transportation Engg., ASCE
3. International Journal of Pavement Engg., Taylor & Francis
4. Journal of the Indian Roads Congress, IRC
5. Indian Highways, IRC
6. NDT&E International, Elsevier

4. Course plan (tentative)

Lectures	Topic	Learning Objective	Ref. To Text Book Chapter
2	Introduction to Transportation Engineering	Definition of transportation engineering and what does it cover.	T1: Chapter-1
2	Highway Development and Planning	Introduction, History and Importance of Highways, Highway Development in India	T1: Chapter-2
7	Pavement Materials	Characteristics of Subgrade Soil, Soil strength, Tests on aggregates and bitumen, Introduction to Modified Bitumen, Bituminous Concrete Mix Design by Marshal Method	T1: Chapters - 19 & 20
1	Geometric Design-1	Introduction to Highway Geometric Design	T1: Chapter-6
1	Geometric Design-2 Cross-sectional elements	Width of Pavement, Formation and Land, Cross Slopes etc.	T1: Chapter-6
2	Geometric Design-3 Sight Distances	Stopping Sight Distance, Overtaking Sight Distance	T1: Chapter-6





5	Geometric Design-4 Horizontal Alignment	Horizontal Curves, Superelevation, Widening of Pavement	T1: Chapter-6
3	Geometric Design-5 Vertical Alignment	Gradient, Compensation in Gradient, Summit Curves, Valley Curves	T1: Chapter-6
3	Traffic Characteristics, Highway Capacity and Level of Service	Basic traffic characteristics - Speed, volume and concentration. Relationship between Flow, Speed and Concentration, Basic definitions of capacity; Level of service concept; Factors affecting capacity and level of service	R1: Chapter 5
4	Traffic Measurement and Analysis	Volume & Spot Speed Studies, Methods, Interpretations & Analysis	R2: Chapter 4
5	Design of Flexible Pavements	Design Factors, IRC Method	T1: Chapter-16 and C1
3	Design of Rigid Pavements	General Design Considerations, Critical Load Positions, Wheel Load Stresses, Temperature Stresses, IRC Method of Rigid Pavement Design	T1: Chapter-22 and C2
3	Intersections	Types, Design of Isolated Traffic Signal by Webster method, Warrants for signalization	R2: Chapter 5
1	Parking & Accident Studies and Analysis	Types of Parking Facilities – On-street and off street Parking facilities; Introduction to Parking & accident studies and analysis.	R2: Chapter 4

5. Laboratory tests:

S. No	Name of the Experiment
1	Determination of Abrasion of aggregates
2	Determination of Flakiness and Elongation Index of aggregates





3	Determination of impact value and crushing value of aggregates
4	Specific Gravity, Angularity no and Stripping value of the aggregates
5	Penetration and Ductility of bitumen
6	Flash & Fire Point and Softening Point of Bitumen
7	Viscosity test on Bitumen
8	Bituminous Mix Design - Marshal method
9	Dynamic Cone Penetration Test
10	Benkelman Beam Deflectometer/ LWD
11	Traffic Volume Counts and Spot Speed Studies
12	Turning Movement Studies at Intersections

References:

- 1) Khanna, S.K. and Justo, C.E.G., Veeraragavan, A., (2010), Highway Material Testing Laboratory Manual, Nem Chand & Bros, Roorkee.
- 2) Relevant Indian Standards and Indian Roads Congress Codes of Practice
- 3) BITS Transportation Laboratory Manual

6. Evaluation Scheme:

EC No.	Evaluation component	Duration (minutes)	Weightage (%)	Schedule	Nature of component
1	Mid-Semester exam.	90	25	15/3 9:00 - 10:30 AM	OB/CB
2	Comprehensive Examination	180	35	5/5 FN	OB/CB
3	Project*/ Assignment		5-10	Continuous	OB
4	Tutorials/ Surprise Quiz		15-20	Continuous	OB/CB
5	Laboratory		15	Continuous	OB

*During the semester each student will work in a team on a project dealing with various aspects of highway engineering. These projects will deal with latest research available at national and





international levels. The projects typically can be of interdisciplinary nature which can deal with concepts of structural engineering, geotechnical engineering, transportation engineering and applications of various tools available. Each group will make two oral presentations (at the end of five and ten weeks) of their results to the class and submit a final report.

The purposes of the term project are:

1. To enable you to explore in-depth knowledge of the subject.
2. To provide a teamwork experience, dealing with the interdisciplinary nature of the subject.
3. To provide experience in the formulation, execution and presentation of an engineering investigation in the area.

Steps in Carrying out the Project

The steps in carrying out the project are:

1. Prepare a proposal in MS Word and email it to the instructor-in-charge at amit.goel@pilani.bits-pilani.ac.in specifying the objective of your project and outlining how you plan to go about executing it.
2. Present an oral report in class on the date posted on the class web page (NALANDA)/communicated to you in class.
3. Send a written report (in MS Word) to the instructor by the last date announced in the class to the instructor-in-charge at amit.goel@pilani.bits-pilani.ac.in.

Before beginning your project, you need to prepare a project proposal and submit it to the instructor-in-charge for approval and feedback. This proposal should be about one page in length. The instructor-in-charge will review the proposals and provide comments for the student to revise the proposal for final submittal and approval. The proposal should contain:

- Definition of the problem including relevant background.
- Discussion (preliminary) of the proposed methods of solution of the problem.
- Anticipated data needs.
- Anticipated problems in carrying out the project.
- Team members.
- Assignment of tasks to team members.
- A minimum of **eight** bibliographic citations from reputed international journals relevant to your proposed project.
- The registered student must submit duly filled above outline after verification from undersigned latest by **26.01.2016**.

7. **Chamber Consultation Hour:** Thursday 9th Hour at 6021-L (Dr. Amit Goel)

Notices: All notices concerning the course will be displayed on *Nalanda (intranet website)* and/or Civil Engineering Group Notice Board.

Make-up Policy:

1. Make-up will be granted only on genuine reasons. However, prior permission is must.





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2. For medical cases, a certificate from the concerned physician of the Medical Centre must be produced.
 3. Please also refer item no. 6 on page 2 of Part I of course handout mentioned in the Timetable for 2015-16 for more details.

Academic honesty and academic integrity Policy:

Academic honesty and academic integrity are to be maintained by all of the students throughout the Semester and no type of academic dishonesty is acceptable. Students are encouraged to *use anti-plagiarism software* to check reports before submission.

Instructor-in-charge

CE F244





SECOND SEMESTER 2015-2016

(Outline of the course: To be filled in consultation with the I/C)

Course No.: CE F244

Course Title: Highway Engineering

Date of Submission of Outline:

Name of the student(s):

ID No.:

Topic of the study:

Aim and Scope of the Study:

Background of the Study:

Plan of Work:

References:

Student's Signature

Approved/Disapproved

Date:

Signature of the instructor

*The registered student must submit duly filled above outline after verification from the Instructor-in-charge of the course, Dr. Amit Goel latest by 26.01.2016

