**15-01-2022**

**SECOND SEMESTER 2021-2022**

# Course Handout Part II

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

## Course Title : Highway Engineering

## Instructor-in-Charge : Bandhan Bandhu Majumdar

Co-instructor : Prof. Sridhar Raju

Instructor : Vuthipalli Harshitha

1. **SCOPE AND OBJECTIVES OF THE COURSE:**

The growth of any country is measured by its transportation facilities through which economic, social, political and strategic developments take place. This course aims at providing a comprehensive insight of various elements of Highway transportation engineering. Topics related to the highway development, characterisation of different materials needed for highway construction, structural and geometric design of highway pavements along with the challenges and possible solutions to the traffic related issues will be covered as a part of this course.

**2. Course Outcomes:**

At the end of this course, the students will be able to:

CO1: Evaluate horizontal and vertical elements related to highway design.

CO2: Design flexible and rigid pavement as per latest Indian codes of practices

CO3: Estimate basic characteristics of traffic stream and conduct basic on-field traffic studies.

CO3: Conduct physical tests on aggregate, and bitumen, bitumen rheology and mix design using standard and advanced laboratory set-up.

Student Learning Outcomes (SLOs) assessed in this course – (a), (b), (c), (e), (f), (g), (h), (j), and (k).

**3. Textbooks:**

**T1**. Khanna, S.K, Justo, A and Veeraragavan, A, ‘Highway Engineering’, Nem Chand & Bros. Revised Tenth Edition, 2018 (Reprint)

**T2.** Khanna, S.K, Justo, A and Veeraragavan, A, ‘Highway Materials and Pavement Testing’, Nem Chand & Bros., Fifth Edition, 2013

**Reference books**

**R1.** Kadiyali L R; Traffic Engineering and Transportation Planning; Khanna Publishers, New Delhi; 2003.

**R2.** Partha chakroborty and Animesh Das, Principles of Transportation Engineering, PHI, 2013

**R3.** Design Codes: Latest codes of IRC 37, IRC 58, IRC 81, MS 2 manual and other IS, MoRT&H Codes

**R4.** Kandhal, Prithvi Singh, [Bituminous Road Construction in India, 2016, by PHI, **ISBN:** 978-81-203-5258-2](https://phindia.com/bookdetails/bituminous-road-construction-in-india-kandhal-prithvi-singh-isbn-OTc4LTgxLTIwMy01MjU4LTI=)**R5.** Shell Bitumen Handbook. Sixth Edition

**R6.** Indo HCM 2017. Central Road Research Institute, New Delhi, India

**4. Tentative Lecture Plan**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Lecture No.** | **Topics to be covered** | **Learning Objectives** | **Chapter in the Text Book** | **SLO\*** |
| 1 | Introduction to highway engineering | To understand the basics of Highway engineering, planning and development | T1: Chapter-1 & 2 | a |
| 2 | Physical Tests on aggregates | To learn about different physical tests on aggregates | T1: Chapters 6 | a, b, c, d, e, f |
| 3-4 | Physical Tests on Bitumen and Bitumen Rheology | To test and evaluate physical and rheological properties of bitumen | T1: Chapters 6 and R5 | a, b, c, d, e, f |
| 5-7 | Mixture Design by Modified Marshall’s Method, Introduction to Superpave Mixture Design, Job Mix Formula | To design bituminous concrete mixtures and Superpave | T1: Chapters 6 and R5 | a, b, c, d, e, f |
| 8-10 | Flexible Pavement Design using IRC codes | To design flexible pavements using IRC 37 | T1: Chapter 7 and R3 | a, c |
| 11-13 | Rigid Pavement Design using IRC codes | To design rigid pavements using IRC 58 | T1: Chapter 7 and R3 | a, c |
| 14-16 | Pavement Failure and Rehabilitation | To learn about flexible and rigid pavement distresses. To be able to design an overlay on a flexible pavement structure | T1: Chapter 7 and R3 | a, c |
| 17-18 | Pavement construction | To learn about pavement construction techniques and equipment | T1: Chapter 7 and R4 | a, c |
| 19 | Highway Planning | To know about details on highway planning | T1: Chapter 2 | a, b, c, e |
| 20 | Factors affecting transportation | To learn about pavement construction techniques and equipment | T1: Chapter 2 | a, b, c, e |
| 21 | Cross sectional elements | To know highway related cross sectional elements | T1: Chapter 4 | a, b, c, e |
| 22-23 | Sight Distances | To design appropriate SSD, ISD and OSD | T1: Chapter 4 | a, b, c, e |
| 24-25 | Horizontal Alignment | To learn and apply different elements of horizontal alignment for highway design | T1: Chapter 4 | a, b, c, e |
| 26 | Transition Curve | To know the theory and application of Transition curve in real field | T1: Chapter 4 | a, b, c, e |
| 27 | Set Back Distance | To know the theory and application of Setback distance in real field | T1: Chapter 4 | a, b, c, e |
| 28-29 | Vertical alignment | To learn and apply different elements of vertical alignment for highway design | T1: Chapter 4 | a, b, c, e |
| 30-32 | Traffic Speed Flow Density | To learn the basic terms of traffic engineering, Establish relationship between Speed, Flow and Density | T1: Chapter 5 and R1 | a, e |
| 33 | Spot Speed Study | To conduct spot-speed study and analyze results | T1: Chapter 5 and R1 | a, e |
| 34-36 | Traffic Signal Design | To design Traffic Signals | T1: Chapter 5 and R1 | a, e |
| 37 | Vehicle Arrival | To learn vehicle arrival and headway modelling | T1: Chapter 5 and R1 | a, e |
| 38 | Intersections and Rotary | To know the basic elements of intersection and rotary | T1: Chapter 5 and R1 | a, e |
| 39-40 | Capacity and Level of Service | To learn the method for estimation of Capacity and Level of service of highways | R6 | a, e |
| 41-42 | Road Signs and Traffic Markings | To able to provide appropriate road signs and traffic markings | R3 | h, k |

**\*Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

1. An ability to apply knowledge of mathematics, science and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4. An ability to function on multidisciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. A recognition of the need for, and an ability to engage in life-long learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**LABORATORY COMPONENT**

**EXPERIMENTS**

|  |  |  |
| --- | --- | --- |
| **Expt. No** | **Name of the Experiment** | **SLOs** |
| E1 | Determination of Abrasion and Crushing value of Aggregates | **b,c, f,g,k** |
| E2 | Determination of Flakiness and Elongation Index of Aggregates, determine Stripping Value of the Aggregates with and without anti-stripping agents |
| E3 | To find the Specific Gravity and Impact Value of Aggregates |
| E4 | Spot Speed Study and traffic noise studies |
| E5 | Parking Inventory Study |
| E6 | To find Penetration, Softening Point and Specific Gravity of Bitumen samples |
| E7 | Determining ductility of bitumen and Elastic Recovery of a given modified bitumen |
| E8 | Preparation and Testing of Marshall’s Samples for Mixture Design |
| E9 | Spot test and viscosity of bitumen using Brookfield rotational viscometer |
| E10 | Rheological studies using Dynamic Shear Rheometer - Part 1 |
| E11 | Rheological studies using Dynamic Shear Rheometer - Part 2 |
| E12 | Demonstration of Scanning Electron Microscope |  |

**5. Evaluation Scheme:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage** | **Date & Time** | **Nature of Component** |
| Midterm Test (including the laboratory portion) | 90 Minutes | 25% | 15/03 11.00am to12.30pm | CB |
| Laboratory Experiments and related evaluation | Throughout the semester | 15% | Continuous | OB |
| Assignments | Throughout the semester | 5% | Continuous | OB |
| Term Project | Throughout the semester | 5% | Continuous | OB |
| Quiz (only 2) | 30 Minutes | 10% | Will be announced | CB |
| Comprehensive Exam (including the laboratory portion) | 120 Minutes | 40% | 17/05 AN | CB |

**6. Chamber Consultation Hour**:

To be announced during the first class

**7. Make Up Policy:**

* Make up requests received on social networking platforms / SMS / WhatsApp will be ignored and no further action is possible. Written makeup requests on the proforma available with the lab staff shall only be used
* Make up will be granted only for genuine reasons and will be considered on a case to case basis. However, prior permission is a must.
* For medical cases, a certificate from the concerned physician from the Medical Centre/hospital must be produced. In addition, copies of the prescription along with the medicine bills should be submitted as a proof.
* Made-up medical certificates / other proofs will be seriously considered and will be referred to disciplinary committee for further necessary action.
* Make up policy is applicable for Midterm and Comprehensive examinations and routine lab experiments only. All other components will not have any possibility of make-ups.

**8. 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.

**9. Notices:**

Notices, if any, concerning the course will be displayed through Google Classroom

**INSTRUCTOR-IN-CHARGE**

**CE F244**