TRANSPORTATION ENGINEERING I

ENCE 304

Lecture : 3 **Year : III**
Tutorial : 2 **Part : I**
Practical : 1

Course Objectives:
This course provides civil engineering students with foundational knowledge in transportation system components, planning, and engineering. Upon completion, students will be able to choose highway alignments, design highway geometrics, understand highway drainage components, and identify material requirements for highway construction.

1 Transportation System, Planning and Engineering (10 hours)

- 1.1 Transportation system
  - 1.1.1 Definition, scope and role of transportation
  - 1.1.2 Components and characteristics of transportation system
  - 1.1.3 Transportation system classification
  - 1.1.4 Modes of transportation
  - 1.1.5 Comparison of different modes of transportation
- 1.2 Transportation planning
  - 1.2.1 Need of transportation planning
  - 1.2.2 Classification and system approach in transportation planning
  - 1.2.3 Multimodal transportation planning
  - 1.2.4 Transportation planning and land use transportation model
- 1.3 Transportation engineering
  - 1.3.1 Scope of transportation engineering
  - 1.3.2 Highway engineering
  - 1.3.3 Airport engineering
  - 1.3.4 Railway engineering
- 1.4 Traffic engineering
  - 1.4.1 Definition and scope of traffic engineering
  - 1.4.2 Road user and vehicular characteristics
  - 1.4.3 Perception reaction process, skid resistance and brake efficiency
  - 1.4.4 Stopping sight distance and overtaking sight distance

2 Highway Engineering (4 hours)

- 2.1 Highway engineering and scope
- 2.2 Advantages of road transportation
- 2.3 History of road development
- 2.4 Classification of roads in Nepal (NRS, NRRS, NURS)

2.5 Highway alignment
- 2.5.1 Requirements of ideal alignment
- 2.5.2 Factors controlling highway alignment
- 2.5.3 Engineering survey for highway alignment
- 2.5.4 Special consideration in hill road alignment

3 Geometric Design of Highway (16 hours)

3.1 Factors controlling geometric design of highway
3.2 Design of cross-sectional elements of highway
- 3.2.1 Typical cross section of highways, urban roads and hill roads
- 3.2.2 Design of camber, super elevation and extra widening

3.3 Design of horizontal alignment: Tangents; Curves including transition curves; Hair pin bends; Setback requirement considering sight distance
3.4 Design of vertical alignment: Gradient; Grade compensation; Vertical curve
3.5 Combination of horizontal and vertical alignment, safety in road design

4 Highway Drainage (4 hours)

4.1 Highway drainage and its importance
4.2 Requirements of highway drainage
4.3 Causes of moisture variation in subgrade soil
4.4 Classification of highway drainage: Surface drainage; Subsurface drainage; Cross drainage
4.5 Erosion control and energy dissipation measures in highway drainage structures along with special drainage structures in hill roads

5 Highway Materials (11 hours)

5.1 Introduction and classification of highway materials
5.2 Subgrade soil: Desirable properties; CBR test
5.3 Road aggregates: Desirable properties; Lab tests; Gradation analysis
5.4 Bituminous binders: Introduction, types and lab tests
5.5 Bituminous mixes: Definition and types; Bituminous concrete mix design

Tutorial (30 hours)

1. Alignment selection in contour map and geometric design with preparation of plan, profile and cross section of at least 500 m long road section (Students will work in a group of 6 and prepare a report and presentation)
2. Design of camber, super elevation and extra widening
3. Design/calculation of different components of horizontal curves including transition curves
4. Calculation of stopping sight distance and overtaking sight distance
5. Design of vertical curves
6. Gradation analysis
7. Bituminous mix design (Marshall mix design)

8. Video presentations (Geometric elements/drainage components/hairpin bends)

Practical **(15 hours)**

1. Standard CBR test
2. LA abrasion, crushing, impact, elongation and flakiness index tests
3. Softening point, viscosity, penetration and ductility tests on bitumen
4. Gradation analysis of aggregate
5. Determination of optimum binder content by Marshall mix design method (Density void analysis and Marshall stability test)
6. Bitumen extraction test

Final Exam

The questions will cover all the chapters in the syllabus. The evaluation scheme will be as indicated in the table below:

Chapter	Hours	Mark distribution*
1	10	12
2	4	6
3	16	20
4	4	8
5	11	14
Total	**45**	**60**

* There may be minor deviation in marks distribution.

References

1. Sharma, S. K. (2014). Principles, Practice and Design of Highway Engineering (4th Edition). S. Chand & Company Ltd.
2. Khanna, S. K., Justo, C. E. G. (2021). Highway Engineering (Revised 10th ed.). Nem Chand & Bros.
3. Flaherty, C. A. (2002). Highway Engineering. Edward Arnold Publishers Ltd.
4. Department of Roads, Ministry of Physical Infrastructure and Transport. (2013). Nepal Road Standard 2070. Government of Nepal.
5. Ministry of Urban Development. (2019). Nepal Urban Road Standard 2076. Government of Nepal.
6. Ministry of Federal Affairs and Local Development. (2014). Nepal Rural Road Standards (2055, 2nd rev. 2071). Government of Nepal.
7. Shrestha, D. K., Marsani, A. (2020). Transportation Engineering II (4th Edition). Heritage Publisher and Distributors.
8. Khanna, S. K., Justo, C. E. G., Veeraragavan, A. (2013). Highway Materials and Pavement Testing. Nem Chand & Bros.