

## TRANSPORTATION ENGINEERING

Course Code	21CV52	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	(32:02:02:0)	SEE Marks	50
Total Hours of Pedagogy		Total Marks	100
Credits	04	Exam Hours	03

**Course objectives:**

- Gain knowledge of different modes of transportation systems, history, development of highways and the organizations associated with research and development of the same in INDIA.
- Understand Highway planning and development considering the essential criteria's (engineering and financial aspects, regulations and policies, socio economic impact).
- Get insight to different aspects of geometric elements and train them to design geometric elements of a highway network.
- Understand pavement and its components, pavement construction activities and its requirements.
- Gain the skills of evaluating the highway economics by B/C, NPV, IRR methods and also introduce the students to highway financing concepts

**Teaching-Learning Process (General Instructions)**

1. Blackboard teaching/PowerPoint presentations (if needed)
2. Regular review of students by asking questions based on topics covered in the class.

**Module-1**

**Principles of Transportation Engineering:** Importance of transportation, Different modes of transportation. Characteristics of road transport, Importance of Roads in India, Current Road development Programmes in India.

**Highway Development and Planning:** Highway Development in India, Highway Planning, Planning Surveys and Interpretation, Highway Planning in India.

**Highway Alignment and Project preparation:** Highway Alignment, Engineering Surveys for Highway Alignment, Drawings and Reports, Highway Projects, Preparation of Detailed Project Report

<b>Teaching-Learning Process</b>	1.Blackboard teaching/PowerPoint presentations (if needed)
	2.Regular review of students by asking questions based on topics covered in the class.

**Module-2**

**Highway Geometric Design of horizontal alignment elements:** Cross sectional elements, Sight distance, Design of Horizontal alignment, Design of vertical alignment.

**Pavement Design:** Pavement types, component parts of flexible and rigid pavements and their functions, ESWL and its determination (Graphical method only)-Examples.

<b>Teaching-Learning Process</b>	1.Blackboard teaching/PowerPoint presentations (if needed)
	2.Regular review of students by asking questions based on topics covered in the class.

**Module-3**

**Pavement Materials:** Sub-grade—soilgrade soil -desirable properties-HRB soil classification-determination of CBR and modulus of sub grade reaction with Problems, Aggregates- Desirable properties. Bituminous Binders & Mixes- Types, desirable properties. Pavement Quality concrete- Materials, Requirements.

**Pavement Construction:** General features, Embankment and Subgrade, Construction of Flexible pavements, Construction of CC pavements.

<b>Teaching-Learning Process</b>	1.Blackboard teaching/PowerPoint presentations (if needed)
	2.Regular review of students by asking questions based on topics covered in the class.
	3. Compliment the understanding of Pavement materials with Lab demos.
	4. Plan for site visits for students, where pavement construction is going on.

**Module-4**



**Highway Drainage:** Significance and requirements, Surface drainage system and Design-Examples, sub surface drainage system, design of filter materials, Types of cross drainage structures, their choice and location.

**Highway Economics:** Highway user benefits, VOC using charts only-Examples, Economic analysis - annual Cost method-Benefit Cost Ratio method-NPV-IRR methods- Examples, Highway financing-BOT-BOOT concepts.

<b>Teaching-Learning Process</b>	1.Blackboard teaching/PowerPoint presentations (if needed)
	2.Regular review of students by asking questions based on topics covered in the class.

#### Module-5

**Elements of Traffic Engineering** – Traffic characteristics, Traffic Engineering Studies and Analysis, Traffic Regulation and Control.

**Elements of Railways and Airport Engineering - Railways:** Introduction, classification of routes; railway gauge, coning of wheels and canting of rails, train resistance and hauling power; track components: rails, sleepers, fastenings, ballast and formation. **Airports:** Introduction, Layout of an airport with component parts and functions of each, Aircraft Characteristics – Airport Classifications, - Site selection- regional Planning. Orientation of runway by using wind rose diagram with examples

<b>Teaching-Learning Process</b>	1.Blackboard teaching/PowerPoint presentations (if needed)
	2.Regular review of students by asking questions based on topics covered in the class.
	3. Conduction of Basic traffic studies by students in the field.

#### PRACTICAL COMPONENT OF IPCC

##### Experiments

1. Tests on Aggregates
  - a. Aggregate Crushing value
  - b. Los Angeles abrasion test
  - c. Aggregate impact test
  - d. Aggregate shape tests (combined index and angularity number)
2. Tests on Bituminous Materials
  - a. Penetration test
  - b. Ductility test
  - c. Softening point test
  - d. Specific gravity test
3. Tests on Soil
  - a. Wet sieve analysis
  - b. CBR test
4. Tests on Bituminous Mixes
  - a. Marshall Method (Demo Experiment)

#### Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Acquire the capability of proposing a new alignment or re-alignment of existing roads, conduct necessary field investigation for generation of required data.
2. Evaluate the engineering properties of the materials and suggest the suitability of the same for pavement construction.
3. Design road geometrics, structural components of pavement and drainage.
4. Evaluate the highway economics by few select methods and also will have a basic knowledge of various highway financing concepts.

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### Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

#### CIE for the theory component of IPCC

Two Tests each of 20 Marks (duration 01 hour)

- First test at the end of 5<sup>th</sup> week of the semester
- Second test at the end of the 10<sup>th</sup> week of the semester

Two assignments each of 10 Marks

- First assignment at the end of 4<sup>th</sup> week of the semester
- Second assignment at the end of 9<sup>th</sup> week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for 30 marks.

#### CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The 15 marks are for conducting the experiment and preparation of the laboratory record, the other 05 marks shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (duration 03 hours) at the end of the 15<sup>th</sup> week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for 20 marks.

#### SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

#### Suggested Learning Resources:

##### Text Books

1. S K Khanna and C E G Justo, "Highway Engineering", Nem Chand Bros, Roorkee.
2. L R Kadiyali, "Highway Engineering", Khanna Publishers, New Delhi.
3. R Srinivasa Kumar, "Highway Engineering", University Press.
4. K. Subramaniam, "Transportation Engineering", SciTech Publications, Chennai.
5. Saxena Subhash C and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi.
6. Chandra S. and Agarwal M.M. "Railway Engineering", Oxford University Press India.



7. Khanna S K, Arora M G and Jain S S, "Airport Planning and Design", Nem Chand and Bros.
8. Khanna S.K. and Justo C.E.G. Highway Material Testing, Nem Chand & Bros

#### Reference Books:

1. Relevant IRC Codes.
2. Specifications for Roads and Bridges-MoRT&H, IRC, New Delhi.
3. C. Jotin Khisty, B. Kentlal, "Transportation Engineering", PHI Learning Pvt. Ltd. New Delhi.

#### Web links and Video Lectures (e-Resources):

<https://nptel.ac.in/courses/105101087>

#### Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Seminars/Quiz (To assist in GATE Preparations)
- Demonstrations in Lab
- Self-Study on simple topics
- Simple problems solving using Excel
- Discussion of case studies
- Virtual Lab experiments

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