

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: HIGHWAY MAINTENANCE
(COURSE CODE: 3356004)**

Diploma Programme in which this course offered	Semester in which offered
Transportation Engineering	5 th Semester

1. RATIONALE

Proper road maintenance contributes to reliable transport at reduced cost, as there is a direct link between road condition and vehicle operating costs (VOC). An improperly maintained road can also represent an increased safety hazard to the user, leading to more accidents, with their associated human and property costs. To be a successful road engineer, it is essential to have a sound knowledge of various defects that are likely to occur, causes of failure for different types of roads and methods of their rectification. At diploma level, students are expected to study about these aspects of highway engineering so as to develop their understanding and apply their knowledge in maintaining the high ways.

2. LIST OF COMPETENCY

The course should be taught and implemented with the aim to develop required skills in students so that they are able to acquire following competency:

- **Analyse failures on highways to undertake remedial measures and repairs using the relevant equipment**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Evaluate roughness and skid resistance of pavement surfaces for assessing the condition from user point of view.
- Describe importance and the factors governing skid resistance of road surface.
- Discuss road inventorying and its methodology.
- Explain maintenance procedure for different types pavement, culverts and bridges.
- Interpret overlay design and construction for implementation
- Maintain different types of roads

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Schedule				
L	T	P		Theory Marks		Practical Marks		Total Marks
			C	ESE	PA	ESE	PA	
3	0	2	2	70	30	20	30	150

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topic and Sub-topics
Unit-I Pavement Evaluation	1a. Describe the methods of pavement evaluation 1b. Explain Pavement Serviceability Index(PSI) 1c. Describe the roughness measurements methods and importance of smooth riding surface 1d. Explain Towed Fifth Wheel Bump Integrator Method 1e. Describe the factors governing skid resistance, methods measurements of skid resistance 1f. Explain need of Pavement Deterioration Research	1.1 Methods of Pavement Evaluation 1.2 Visual Rating 1.3 Pavement Serviceability Index(PSI) 1.4 Roughness Measurements: Importance of smooth riding surface, measurement of road roughness, Towed Fifth Wheel Bump Integrator 1.5 Skid Resistance: Measurement, Importance, governing Factors 1.6 Pavement Deterioration Research
Unit-II Road Inventorying	2a. Justify the need for Road Inventorying and the Road Features Covered by Inventorying 2b. Describe Manual Methods of inventorying 2c. Explain Instrument-aided Inventorying 2d. Prepare Computer-aided Road Data Bank System	2.1 Road Inventorying: Features, Periodicity 2.2 Manual Methods of inventorying 2.3 Instrument-aided Inventorying 2.4 Computer-aided Road Data Bank System
Unit-III Pavement Failures	3a. Explain with sketches the failures in Flexible Pavements 3b. Explain with sketches failures in cement concrete pavement	3.1 Failures in Flexible Pavements: Typical Flexible Pavement Failures 3.2 Failures in Cement Concrete Pavements: Typical rigid pavement failures
Unit-IV Overlay Design and Construction	4a. Justify the need of design of Overlays and its types 4b. Explain different overlay design methods for flexible pavements 4c. Describe Benkelman beam Deflection studies with field procedure 4d. Analyse field data to calculate overlay thickness by design Benkelman beam Deflection	4.1 Overlay: Need, Types, 4.2 Overlay design methods for flexible pavements 4.3 Flexible overlay over flexible pavement by conventional design method 4.4 Overlay Design method by Benkelman beam Deflection studies 4.5 Benkelman beam method field

	<p>studies</p> <p>4e. Describe the various types of rigid overlays</p> <p>4f. Explain Overlay Design Methods for Rigid Pavements</p> <p>4g. Explain Flexible overlays over rigid slabs</p>	<p>procedure- Analysis of field data</p> <p>4.6 Overlay thickness design with data Falling Weight Deflection Method</p> <p>4.7 I.R.C. Guidelines</p> <p>4.8 TRRL procedure</p> <p>4.9 Asphalt Institute Method</p> <p>4.10 Types of rigid overlays</p> <p>4.11 Overlay Design Methods for Rigid Pavements</p> <p>4.12 Flexible overlays over rigid slabs</p>
Unit-V Maintenance of different types of Roads	<p>5a. Describe procedure of Maintenance of Earth Roads, Gravel Roads, Water-bound Macadam Roads, Bituminous Surfaces, Cement Concrete Surfaces</p> <p>5b. Describe maintenance of Shoulders and Slopes of Embankments</p> <p>5c. Describe the maintenance procedure of Bridges and Culverts</p> <p>5d. Explain Special Problems in Hill Road maintenance.</p>	<p>5.1 Maintenance of Earth Roads, Gravel Roads, Water-bound Macadam Roads, Bituminous Surfaces, Cement Concrete Surfaces, Shoulders, Slopes of Embankments</p> <p>5.2 Maintenance of Bridges and Culverts</p> <p>5.3 Special Problems in Hill Road maintenance</p> <p>5.4 Maintenance Management System</p>

6. SUGGESTED SPECIFICATION TABLE WITH HOURS AND MARKS (Theory)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Pavement Evaluation	06	03	03	04	10
II	Road Inventorying	06	03	03	04	10
III	Pavement Failures	08	04	04	10	18
IV	Overlay Design And Construction	12	06	06	06	18
V	Maintenance of Different Types of Roads	10	04	05	05	14
	Total	42	20	21	29	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED EXERCISES/PRACTICALS/EXPERIMENTS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (*outcomes in psychomotor and affective domain*) so that students are able to acquire the competencies/course outcomes. Following is the list of practical exercises for guidance.

*Note: outcomes in psychomotor domain are listed here as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical / Exercise (outcomes in psychomotor domain)	Approx. Hrs. Required
1	I	Prepare pavement evaluation formats	4
2	II	Make a visit to nearby highway and Prepare road inventorying reports	4
3	III	Make a visit to nearby damaged road and measure pot holes, small and find out reasons for the typical failures	4
4	III	Make a report on failures of rigid pavement	2
5	IV	Prepare overlay design with the Benkleman beam deflection data.	2
6	V	Prepare a remedial maintenance measures for different types of road failures	4
7	I to V	Seminar (Topic of Seminar shall be given to a group of three to five students. The students are required to submit and present / defend the Seminar in presence of students and teachers.)	8
Total			28

8. SUGGESTED STUDENT ACTIVITIES

- i. Make a visit to nearby highway and Prepare road inventory reports
- ii. Make a visit to nearby damaged road and prepare a report of pot holes and major failures of flexible pavement
- iii. Visit road repairing work under process.
- iv. Visit nearby road having major cracks.
- v. Students will appear files/journal for the above mentioned experiments/exercise.
- vi. Student may be asked to collect, enlist and study IRC Code list for highway maintenance.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Arrange expert lecture of Engineers working in highway maintenance work
- ii. Arrange field visits.
- iii. Provide Hands on experience.
- iv. Show video films/photographs of defects/failures in roads and remedial procedures.

10. SUGGESTED LEARNING ACTIVITIES

A. List of books

S. No.	Title of Book	Author	Publication
1	Highway Engineering	Khanna, S.K. and Justo, C.E.G.	Nem chand Bros. Roorkee
2	Highway Engineering	S.P.Bindra	Dhanpat Rai and Sons, New Delhi
3	Highway Engineering	Kadiyali, L.R.	Khanna Publishers, New Delhi
4	Traffic Engineering and Transportation Planning	Kadiyali, L. R.	Khanna Publishers, New Delhi

B. List of major equipment/instrument with Broad Specification

- i Benkelman Beam
- ii Falling weight deflectometer
- iii Towed Fifth Wheel Bump Integrator

C. List of software/learning websites

- i. <http://www.tecmagazine.com/>
- ii. [http://en.wikipedia.org/wiki/Traffic_engineering_\(transportation\)](http://en.wikipedia.org/wiki/Traffic_engineering_(transportation))

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty members from polytechnics

- Prof (Mrs.) S. B. KHARA , Lecturer in Civil Engineering, G.P.G. Himatnagar,
- Prof. Ketan P. Varmora, Lecturer in Civil Engineering, G. P. Ahmedabad

Coordinator and Faculty Members from NITTTR Bhopal

- Dr Subrat Roy, Professor Department of Civil and Environmental Engineering
- Dr. Joshua Earnest, Professor, Department of Electrical and Electronics Engineering