

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: HIGHWAY ENGINEERING
(COURSE CODE: 3350606)**

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering	5 th Semester

1. RATIONALE

Road transport is one of the most common modes of transport. Population of the country is increasing day by day. The need for travel to various places at faster speed has also increased. In this scenario standards of highway engineering are continuously being improved. Highway engineers must know the future traffic flows, design of highway intersections/interchanges, geometric alignment and design, highway pavement design and materials, structural design of pavement thickness, and pavement maintenance etc. At diploma level, students are expected to study about these aspects of highway engineering because they are supposed to design and construct different types of roads in villages, towns and also roads connecting different villages and towns.

2. LIST OF COMPETENCY:

The course content should be taught and learning imparted with the aim to develop required knowledge & skills so that they are able to acquire following competency:

- **Design simple roads for connecting towns and villages in hilly and plain areas.**
- **Supervise testing of materials, construction of roads including highways.**

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.

- i. Explain the importance of highway engineering
- ii. Explain the geometrical aspects with respect to design and construction of roads
- iii. Discuss traffic and its characteristics.
- iv. Conduct various tests on the materials used in highway construction work.
- v. Explain essential features and requirements of hill roads.
- vi. Explain various aspects related to the construction and maintenance of highways.
- vii. Explain ideal road alignment
- viii. Demonstrate the basic Requirements of Curves
- ix. Supervise construction of road pavements, drainage and materials

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
3	0	2	5	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)	Topics and Sub-topics
Unit—I Introduction to Highway Engineering	1a Discuss various types of roads development plans. 1b Explain ideal road alignment. 1c Comprehend Highway Project Report.	1.1 Importance of roads in India & its' Characteristics. 1.2 Road classifications in India (Nagpur plan & Third road development (Lucknow) plan. 1.3 Fixing location of Urban roads. 1.4 Requirements of an ideal road alignment & the factors affecting road alignment. 1.5 Details of highway project report.
Unit—II Geometric Design of Highway.	2a Describe various terms used in Highway and its standards. 2b Demonstrate the basic Requirements of Curves. 2c Calculate minimum and maximum Super elevation	terms used in Highway 2.1 Camber – definition, purpose, types, IRC – recommendations. Kerbs, Road margin, road formation, right of way. 2.2 Design speed IRC – recommendations. 2.3 Gradient - definition, types IRC – Recommendations. 2.4 Sight distance - definition, types IRC - recommendations. 2.5 Curves - Necessity, types- Horizontal, vertical and transition curves, Widening of roads. 2.6 Super elevation, definition, formula for calculating minimum and maximum 2.7 Super elevation and method of providing super elevation 2.8 Simple problems on geometric design of roads.
Unit—III Construction of Road Pavements, Drainage and Materials.	3a Discuss Highway construction materials and their relevant Tests. 3b Explain pavement structure. 3c Describe various Equipments used in High Way construction. 3d Explain importance of Drainage and it's Maintenance 3e Describe Construction of bituminous road 3f Define following terms Bitumen, Emulsion, Cutback, Tar, grades of bitumen, prime coat, tack coat, seal coat	3.1 Types of road materials and their Tests -Soil, Aggregates, bitumen, cement concrete, test on soil sub grade- C B R test, Test on Aggregate- Los Angeles abrasion, Impact, & shape test, test on Bitumen- penetration, Ductility and Softening point test. 3.2 Pavement – Types, Components and structure of pavement. 3.3 Construction of bituminous road- Terms used –Bitumen, Emulsion, Cutback, Tar, grades of bitumen, prime coat, tack coat, seal coat, surface dressing construction, it's Merits & demerits. 3.4 Construction of cement concrete pavement, Construction joints, joints filler & sealers. 3.5 Equipments used in Highway Construction. 3.6 Importance, necessity and methods of drainage.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
		3.7 Surface drainage – side gutter, catch water drain, surface drainage. 3.8 Sub surface drainage –Longitudinal & cross drains.
Unit—IV Traffic Engineering.	4a Discuss traffic and its characteristics. 4b Explain causes of accident with Collision diagram. 4c Enumerate various traffic control devices.	4.1 Traffic characteristics and traffic volume study. 4.2 Passenger car unit and factors affecting it. 4.3 Accident studies and its causes, collision diagram. 4.4 Traffic control devices – road signs, marking, Signals, traffic island. 4.5 Advantages & disadvantages of signals. 4.6 Road intersections, Intersection at Grade, grade 4.7 Separators.
Unit—V Hill Road.	5a Describe hill roads and its component 5b Explain drainage and protective works. 5c Discuss landslides for Causes & Prevention 5d Classify landslides	5.1 Hill roads, its' components , functions types of curves. 5.2 Width of pavement formation, camber, sight distance, widening at curve. 5.3 Drainage: Side drains; catch water drains, cross drains, retaining wall & breast wall. 5.4 Construction procedure of hill roads. 5.5 Causes of landslides & its classification. 5.6 Prevention of landslides.
Unit—VI Maintenance and Repair of Roads.	6a Comprehend necessity of road maintenance. 6b Explain pavement failures. 6c . Classify maintenance 6d Discuss Maintenance and repairs of pavements.	6.1 Flexible & Rigid pavement failures and their causes. 6.2 Need for high way maintenance. 6.3 Classification of maintenance. 6.4 Special repair of flexible & Rigid pavements.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Highway Engineering	4	1	1	3	5
II	Geometric design of Highway	8	2	3	10	15
III	Construction of road pavements, drainage and materials.	8	2	5	13	20
IV	Traffic Engineering.	8	2	3	5	10
V	Hill Road.	6	2	3	5	10
VI	Maintenance and Repair of Road.	8	1	2	7	10
Total		42	10	17	43	70

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

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

7. SUGGESTED LIST OF EXERCISES/PRACTICAL

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

Note: Here only course outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of **Programme Outcomes/Course Outcomes in affective domain** as given in a common list at the beginning of curriculum document for this programme.

Faculty should refer to that common list and should ensure that students also acquire those programme outcomes/course outcomes related to affective domain.

S. No.	Unit No.	Practical/Exercise/Project (Outcomes in Psychomotor Domain)	Approx. Hrs. Required for Practical	Approx. Hrs. Required for Project
1	I	Draw the dimensional sketches of cross section of road, road junction, road curve and widening.	2	0
2	II	Demonstration the following tests. - On Aggregate 1. Impact test. 2. Crushing test. 3. C B R test. - On Bitumen 1. Flash & Fire test. 2. Softening point 3. Penetration test	2	0
3	IV	Visit to a road under construction/constructed to study of 1.WBM road 2. Rigid & Flexible pavement for observing the type of Construction with brief report.	4	0
4	V	Visit Road construction site to study Equipments. And draw the line sketches of various Equipments and note down their special features and specification.	4	0
5	VI	Traffic volume study and its representation on an intersection of road	8	8
6	VII	Seminar	8	
Total			28	08

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i. Undertake site visit related to road construction and maintenance work and prepare report.
- ii. Visit to material Testing Laboratory for awareness related to other material Testing
- iii. Visit websites of road construction equipment/heavy earthmover manufacturing companies and prepare a report on different kind of equipments/earthmover being used in road construction.

9. SPECIAL INSTRUCTIONAL STRATEGIES (If any)

- i. Lecture cum demonstration of various types of equipments used in road construction.
- ii. Field demonstration about the maintenance of Roads.

10. SUGGESTED LEARNING RESOURCES

S. No.	Title of Books	Author	Publication
1	High way Engineering	Dr. L R Kadiyali & Dr. N B Lal	Khanna Publishers. Delhi
2	Traffic Engg. & Transport planning	Dr. L R Kadiyali	Khanna Publishers. Delhi
3	High way Engineering	S K Khanna & Justo	Khanna Publishers. Delhi
4	Highway Engineering	S P Bindra	DhanpatRai & Sons Delhi
5	Highway Engineering	Gur charan singh	Standard Publishers. Delhi
6	Highway Engineering	C A O'Flaherty	Edward Arnold ltd. London
7	Road, Railway, Bridge & Tunnel Engineering	Ahuja & Birdi	Standard book house Delhi
8	Transportation Engineering Vol. I & II	V N Vazirani & S P Chaondola	Khanna Publishers. Delhi
9	Road Engineering	P K Bhattacharjee	Orient Longmans Delhi Calcutta-Bombay-Madras

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. N. J. Patel**, Lecturer in Civil Engineering, Shri K J Polytechnic Bharuch

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. Subrat Roy**, Professor, Department of Civil and Environmental Engineering