

## GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

### COURSE CURRICULUM

**Course Title: Highway Material and Testing**  
(Code: 3336001)

Diploma Programme in which this course is offered	Semester in which offered
Transportation Engineering	Third Semester

#### 1. RATIONALE

Transportation engineering is a diversified branch of civil engineering discipline. Now a day's highways and Roads are being constructed using variety of materials depending upon availability and their engineering properties. A diploma student must know the requirement of standards of various materials their test procedures on field and in laboratory.

This course is designed in view of ensuring and maintaining the quality of materials to be used for Roads construction. More thrust is given on testing of materials in laboratory and in fields so that requisite skills can be developed in the pass-pouts of Diploma programme.

#### 2. COMPETENCY

The course is leading to the achievement of the following competences.

**i.) Explain the engineering properties and characteristics of materials used in highway and Roads construction.**

**ii.) Apply standard test procedures for testing of highway/ Roads materials and Interpret test results for suitability.**

#### 3. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
2	1	2	5	70	30	20	30	

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

#### 4. COURSE DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics
<b>Unit – I SOIL SUBGRADE AND ITS TESTING</b>	1a. Explain the importance of soil as a Highway Material. 1b. Describe the quality requirement of soil in highway construction. 1c. Classify the soil according to particle size. 1d. Explain the Soil Strength for Sub-grade of roads/ highway 1e. Evaluate soil properties	1.1 Significance of Sub-grade Soil 1.2 Characteristics of Soil 1.3 Desirable Properties 1.4 Index Properties of Soil 1.5 Soil Classification based on grain Size 1.6 Soil Classification System 1.7 Sub-grade Soil Strength 1.8 Evaluation of soil Strength 1.8.1 Bearing Test 1.8.2 Tri-axial Compression Test 1.8.3 Unconfined Compression Test 1.8.4 California Bearing Ratio Test
<b>Unit – II ROAD AGGREGATE AND ITS TESTING</b>	2a. Appreciate the applications of rocks and stones in roads construction 2b. Describe the process of stone quarrying 2c. Evaluate properties of Road Aggregate	2.1 Introduction 2.2 Classification of Rocks 2.3 Sources of Stone 2.4 Rock forming Minerals 2.5 Texture or Structure of a Rock 2.6 Uses of Stone 2.7 Natural bed of Stone 2.8 Stone Quarrying 2.9 Desirable Properties of Road Aggregate 2.12 Tests for Roads Aggregate Crushing Test, Abrasion Test, Impact Test Soundness Test, Shape Test 2.12.6 Specific Gravity and Water Absorption Test 2.12.7 Bitumen Adhesion Test
<b>Unit – III BITUMINOUS MATERIAL AND ITS TESTING</b>	3a. elaborate the different types of bituminous material used in flexible pavement 3b. List the properties of Bitumen 3c. Evaluate engineering properties of Bitumen	3.1 Introduction 3.2 Types of Bituminous Materials 3.2.1 Bitumen, Cutback Bitumen, Bituminous Emulsion, Tar 3.3 Tests on Bitumen 3.3.1 Penetration Test, Ductility Test, Viscosity Test, Float Test, Specific Gravity Test, Softening Point Test, Flash and Fire Point Test, Solubility Test, Spot Test, Loss on heating Test 3.3.11 Water Content Test
<b>Unit – IV CEMENT AND ITS TESTING</b>	4a. Describe the properties of Cement 4b. Explain the composition of cement and function of its ingredients. 4c. Understand the manufacturing process of OPC. 4d. Appreciate the packing	4.2 Properties of Cement 4.3 Composition of Ordinary Cement 4.4 Functions of Cement ingredients 4.7 Site for Cement Factory 4.9 Packing and Storage of Cement 4.12 Types of Cement 4.13 Field Tests for Cement 4.14 Laboratory Tests for Cement Fineness Test, Compressive Strength,

Unit	Major Learning Outcomes	Topics and Sub-topics
	and storage of cement 4e. explain the uses of different type of cement 4f. Test the different properties of cement on field and in Laboratory.	Tensile Strength, Consistency Test, Setting Time Test, Soundness Test
<b>Unit – V CEMENT CONCRETE AND ITS TESTING</b>	5a. Elaborate Cement Concrete 5b. Enlist the properties of Cement Concrete 5c. Discuss the ingredients used in RCC work. 5d. Describe the concept of W/C ratio 5e. Test the different properties of Cement Concrete in Laboratory. 5f. Explain the process of Mixing and handling of Concrete. 5g. Explain the Curing and its methods 5h. Describe the procedure of form work and its precautions. 5i. Explain the pre-cast concrete and its application. 5.j Explain importance of quality control of concrete	5.1 Definition 5.2 Properties of Cement Concrete 5.3 Materials used in R.C.C. Work 5.4 Corrosion of Steel in Concrete Theory of Corrosion, Causes of Corrosion, Effect of Corrosion, Prevention of Corrosion 5.5 Water Cement Ratio 5.6 Workability 5.7 Slump Test 5.8 Mixing the Material of Concrete 5.9.1 Hand Mixing, Machine Mixing 5.9 Transporting and Placing of Concrete 5.10.2 types Vibrators 5.11 Curing of Concrete 5.12 Types of Concrete Water Proofing Cement Concrete, Colored Concrete, Light Weight Concrete, No fines Concrete, Joints in the Concrete 5.13. Expansion and Contraction Joints 5.14 Form Work of Concrete Precautions in form work 5.15 Pre-cast Concrete 5.15.1 Advantages and Disadvantages of Pre-cast Concrete 5.16 Quality Control of Concrete

### 5. 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	Soil Sub grade and Its Testing	08	2	3	5	10
II	Road Aggregate and Its Testing	06	3	5	7	15
III	Bituminous Material and Its Testing	08	3	5	7	15
IV	Cement and Its Testing	10	3	5	7	15
V	Cement Concrete and Its Testing	10	3	5	7	15

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
<b>Total</b>		42	14	23	33	<b>70</b>

## 6. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills so that students are able to acquire the competency.

Following is the list of experiments for guidance.

S. No.	Unit No.	Practical/Exercise	Apprx. Hrs. Required
1	I	Test on Soil Sub-grade: California Bearing Ratio Test	02
2	II	Test on Aggregates determine the hardness determine the toughness Impact test. determine the flakiness index and elongation index of aggregates by shape test	08
3	III	To determine the penetration value of an asphalt cement sample by Penetration test	02
4	III	To determine the softening point of a bitumen sample using the ring and the ball apparatus.	02
5	III	To determine the flash and fire point of bitumen by Pensky-Martens closed tester	02
6	IV	To determine Fineness of cement using sieving method.	02
7	IV	To determine consistency limit of OPC by VICAT apparatus.	02
8	IV	To Measuring the initial setting time and the final setting time of the standard consistence of the cement paste by VICAT apparatus	02
9	IV	To determine Soundness of cement by Le-Chatelier method	02
10	V	To determine consistency of concrete by Slump test.	02
<b>Total</b>			<b>24</b>

## 7. SUGGESTED LIST OF STUDENT ACTIVITIES

- Students will submit files/journal for the above mentioned experiments.
- Student may be asked to collect photographs from internet which is related to field application of various topics.

## 8. SUGGESTED LEARNING RESOURCES

### (A.) List of Books:

S. No.	Title of Books	Author	Publication
1.	Highway Engineering	S.K.Khanna and C.E.G.Justo	Nem chand Bros. Roorkee.
2.	Highway Engineering	S.P.Bindra	Dhanpat Rai & Sons, Delhi
3.	Principles and Practice of Highway Engineering	S.C.Sharma and C. C. Sharma	Asia publishing House ,Delhi
4.	Highway Engineering	L.R.Kadiyali	Khanna Publishers
5.	Highway Engineering & Airports	K.L.Bhagat & S.B.Bhagat	S. Chand , New Delhi
6.	Highway Engineering	S.C. Rangwala	Charotar Publishing House
7.	Transportation Engineering Vol. I & II	Vazirani & Chandola	Khanna Publishers

### (B.) List of Major Equipment/Materials

#### Equipments:

- 1 CBR Test apparatus
- 2 Los-Angeles Abrasion Testing Machine
- 3 Impact Value Testing Machine
- 4 Apparatus for flakiness and elongation test
- 5 Penetrometer
- 6 Ring and Ball apparatus
- 7 Pensky-Martens Apparatus
- 8 Sieve-set as per IRC
- 9 Vicat apparatus
- 10 Le-Chatelier Apparatus
- 11 Slump Test Mould
- 12 concrete cubes and cylinders

#### Materials:

Aggregate, Cement, Sand, Bitumen, Concrete Cube Mould, Storage Tank for Curing, Gauges- for Flaky & Elongated Aggregates, Balance for wt.,

### (C.) List of Software/Learning Websites

[www.nicet.org](http://www.nicet.org)

[www.ewit.edu](http://www.ewit.edu)

[www.scientificdealers.com](http://www.scientificdealers.com)

[wikipediya /encyclopedia / en.wikipediya.org](http://wikipediya /encyclopedia / en.wikipediya.org)

**9. INSTRUCTIONAL STRATEGIES**

- Lecture
- demonstrations
- case studies
- assignments

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

- **MR. A. K. PATEL**, LCE, G. P. Himatnagar
- **MRS. S. B. KHARA** , LCE, G.P.G., Ahmedabad
- **MR. P. A. PANDYA** , LCE, G. P. Himatnagar
- **MS. M. A. MILISIA**, LCE, G.P.G., Ahmedabad

**Coordinator and Faculty Members from NITTTR Bhopal**

- (1) **Prof. J.P.TEGAR - Prof. & Head of Civil Engineering**
- (2) **Prof. A. K. JAIN Prof. of Civil Engineering**