GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-IV

Course Title: Basic Transportation Engineering
(Course Code: 4340604)

Diploma programme in which this course is offered	Semester in which offered
Civil Engineering	4th Semester

1. RATIONALE

Economy of the nation is directly driven by movement of the people and goods effectively and efficiently. Moreover, In India population blast has made it mandatory to explore the quick and economical mode of transportation. Transportation is classified in general as Road transportation, Railway, Airway and Waterways. Out of all the available modes, water transportation is the cheapest one but it takes much more time; On the contrary, air ways provide quickest transport at costlier rates. Road transportation is easiest, flexible and most convenient mode of transportation for people and goods. Therefore, this course is designed to enrich students with knowledge about all the modes of transportation with the emphasis to road construction and maintenance to confidently execute construction, operation and maintenance as a part of their jobs in field.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competencies:

- **To supervise construction and maintenance of roads, railways, bridges, airways, docks and harbour.**
- **To carry out testing of materials used for road construction.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Explain different modes of transportation and its effectiveness in terms of economy.
b) Implement various types of road construction work with different tests of road materials.
c) Maintain different types of drainage, bridges and its components.
d) Maintain railway track and its components.
e) Explain the function of harbours, docks and airways.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/ 2+P/ 2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA*	ESE	CA	ESE	
3	-	2	4	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be

taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/ Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **CA** - Continuous Assessment; **ESE** - End Semester Examination.*

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.		Approx. Hrs. required
1	Draw the sketches showing standard cross section of NH/ SH, MDR/ ODR in embankment and cutting also draw road junction, Road curve and widening.	I		Home* assignment
2	Conduct Flakiness index test and Elongation index test on the aggregate.	II		04*
3	Conduct Los Angeles abrasion test on the aggregate.	II		02*
4	Conduct aggregate crushing test.	II		02*
5	Conduct aggregate Impact test.	II		02*
6	Conduct California Bearing Ratio Test	II		02
7	Conduct Softening Point test on Bitumen.	II		02*
8	Conduct Penetration test on Bitumen.	II		02*
9	Conduct Flash and Fire Point test on Bitumen.	II		02*
10	Conduct Ductility test on Bitumen.	II		02
11	Visit the site at which construction of flexible/ Rigid pavement is undergoing to have the knowhow of construction of sub-base and / or base and / or surfacing coat as well as provision of drainage and prepare a report of it.	II,III		04*
12	Visit the constructed road for visual inspection to identify defects and suggest remedial measures.	II,III		04
13	Draw neat sketches of Diamond crossing, Double slip crossing.	IV		02*
14	Prepare a visit report to a nearby Railway Station to visually observe fixtures, fasteners, track, slippers etc. and Junction/ Yard if any.	IV		04*
15	Draw sketches of layout of airport with brief description.	V		02*
16	Visit to nearby airport and prepare a report on types of runway and taxiway.	V		04
			Total	**28**

Note

*i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/ outcomes to match the COs. The above table is only a suggestive list.*

*ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/ deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..*

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 2, 3, 4, 5,6,7,8,9,10		
1	Preparation of experimental set up	10
2	Setting and operation	20
3	Safety measures	20
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 1,13,15		
1	Neatness, Cleanness on drawing sheet	10
2	Uniformity in Drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer the question	10
6	Submission of drawing in time	10
	Total	**100**

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
For PrOs 11,12,14,16		
1	Discipline	10
2	Involvement at construction site	20
3	Data collection at site	20
4	Organization of report	20
5	Answer the question	10
6	Timely submission of report	20
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practical's in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	-Thickness gauge containing openings for aggregate sizes 63, 50, 40,31.5, 25,20,16,12.5,10 & 6.3mm as per IS:2386(Part I)-1963. -Length gauge containing openings for aggregate sizes 63, 50, 40,31.5, 25.20,16,12.5,10 & 6.3mm as per IS:2386(Part I)-1963.	02

2	Compression testing machine-2000 kN capacity.	04
3	IS sieve set (sizes- 80 mm, 40 mm, 20 mm, 12.5mm,10 mm, 4.75 mm, 2.36 mm,1.18 mm, 600 µ, 300 µ. 150 µ and pan), sieve shaker with adaptors.	04,05,06
4	Los Angeles abrasion testing machine.	03
5	Crushing mould, measuring cylinder with plunger.	04
6	Impact testing machine.	05
7	California Bearing Ratio Test Apparatus.	06
8	Ring and Ball test apparatus (Hot plate 160mm dia. with magnetic stirrer, brass ring, steel ball and glass vessel 600ml and glass thermometer +80°c. Standard Penetrometer with penetration needle 100gm weight, container 55mm dia. and 53mm ht. as per IS:1203.	07
9	Standard Penetrometer with penetration needle 100gm weight, Container 55mm dia and 53mm ht. as per IS 1203.Water bath maintain (25°±0.1 °C), Thermometer range 0-44 °C.	08
10	Pensky Marten's Flash and Fire Point test apparatus 100x200x240mm with measurement range 0-95 as per IS:1209-1953. Thermometer range 0-200 °C.	09
11	Ductility Testing Machine with ductility mould and base plate.	10
12	Weighing Balance.	For All

7. AFFECTIVE DOMAIN OUTCOMES

The following ***sample*** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfill the development of this competency.

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site/ lab.
d) Practice good housekeeping.
e) Maintain tools and equipment.

The ADOs are best developed through the laboratory/ field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

i. 'Valuing Level' in 1st year
ii. 'Organization Level' in 2nd year.
iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I **Introduction**	1a. Discuss various modes of transportation. 1b. Interpret the various components of a road section. 1c. Describe the basic parts of railway track and its functions. 1d. Describe Harbour Classification and terms used in Harbour. 1e. Describe the airport classifications with various terminologies.	1.1 Modes of transportation. 1.2 Importance & Classification of roads, various terms used in road geometry. 1.3 Requirements of good roads and its advantages. 1.4 Importance of railways, role of civil engineer in construction and maintenance of railway. 1.5 Elements of harbor and their function. 1.6 Classification and types of Harbours based on their utility and location. 1.7 Airport classifications. 1.8 Air transport authorities, air transport activities.
Unit – II **Road Transportation**	2a. Describe road geometry. 2b. Describe the basic requirement of road alignment. 2c. Explain various types of tests on road materials. 2d. Describe various types of road construction methods. 2e. Explain various types of failures and maintenance of road.	2.1 Road geometry, Transition curve and Road Gradient, types of Pavement and Soil Stabilization. 2.2 Road alignment, Factors affecting the alignment, their types and its Importance. 2.3 Materials used in road Construction. 2.4 Various tests on Aggregate and bitumen. 2.5 Construction of Flexible and Rigid Pavement. 2.6 Types of Failures in roads. 2.7 Maintenance of roads and its components.
Unit – III **Drainage system and Bridges**	3a. Explain importance of drainage and its maintenance. 3b. Discuss the function of various parts of bridge. 3c. Explain requirement of an ideal bridge. 3d. Carry out the maintenance Report.	3.1 Importance of drainage. 3.2 Methods of Surface and Sub-surface drainage. 3.3 Maintenance of drainage system. 3.4 Component of Bridge and its function. 3.5 Requirement of an ideal bridge. 3.6 Classification and types of bridge. 3.7 Factor affecting the selection of Bridge site and Scour, Afflux, Runoff, Economic Span, Clearance, Freeboard etc. 3.8 Maintenance of Bridges and its components.
Unit– IV **Permanent**	4a. Describe the basic parts of railway track and its functions. 4b. Interpret the Joints and Gauge.	4.1 Typical cross section of various permanent ways as per IRS. 4.2 Function of Various Components.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
ways	4c. Interpret basic knowledge of points and Crossing. 4d. Discuss the function of various yards. 4e. Explain requirement of track Maintenance.	4.3 Method of fixing the rails with slipper. 4.4 Railway gauge, its types and uniformity of gauge. 4.5 Function of Rail joints. 4.6 Function of point and crossing. 4.7 Factors affecting point and crossing. 4.8 Components of Turn outs and types of crossing. 4.9 Classification of Yards. 4.10 Function of Various Yards. 4.11 Requirement of Track Maintenance. 4.12 Daily and periodical Maintenance. 4.13 Maintenance of Alignment, Drainage, Track Material and its components, Point and crossing and level crossing.
Unit– V **Water Transportation and Airway**	5a. Describe Harbour Classification and terms used in Harbour. 5b. Describe the natural phenomenon and site investigation. 5c. Describe various types of berthing structures. 5d. Explain Docks Dry dock, Wet dock, Entrances, Entrance lock and size, Break water. 5e. Describe Fenders, Mooring and Dredging. 5f. Explain aircraft components and its function. 5g. Describe Regional planning. 5h. Describe the requirements of an ideal airport layout.	5.1 Classification and types of Harbours based on their utility and location. 5.2 Growth of ports in India, Requirements of good harbour, Element of harbour and their function. 5.3 Wind characteristics, Wind rose, Tide, Tide forces and theories, types of currents. 5.4 Hydrographic and Topographic Survey, Site selection for Harbour 5.5 General aspects of selection for berthing structures, Piers, Wharf, Quay wall, Jetty, Dolphins, trestle, Moles and mooring accessories. 5.6 Construction of Dock wall, classification of Break water and construction method of Break water wall. 5.7 Necessity for Fenders, types of fenders, mooring system and types of dredger. 5.8 Aircraft components and their functions. 5.9 Location and planning aspects of various airport elements. 5.10 Ideal airport layout.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	**Introduction**	06	04	04	02	10
II	**Road Transportation**	12	02	06	12	20
III	**Drainage system and Bridges**	08	02	06	06	14
IV	**Permanent ways**	10	04	06	04	14
V	**Water Transportation and Airway**	06	04	04	04	12
Total		**42**	**16**	**26**	**28**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/ setters to formulate test items/ questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/ record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Collect the details of all types of existing NE, NH and SH constructed and under construction across the country.
b) Collect samples of alternative Green material for road construction and prepare a report.
c) Visit the crowded area i.e. city/ town/ village and note down the traffic control devices to suggest the possible action for smooth traffic.
d) Collect the sample of drawings and documents required for road project from R & B office.
e) Visit the nearby road construction site and collect the sample information of various materials for road construction in different layers.
f) Visit the nearby bridge site and inspect all components of it.
g) Visit nearby railway station for collect information about cross section of rail components, arrangements of station yard, layout of railway station.
h) Visit to nearby airport and prepare a report.
i) Collect the information of different codes related to Airport design.
j) Prepare a report depicting summarized procedure of Land Acquisition for any Transportation project.
k) Prepare a Proposal exploring connectivity to unconnected Habitations as part of a poverty reduction strategy of Govt. of India under PMGSY.
l) Visit nearby port site and collect the information about layout and its port components.
m) Undertake micro-project.
n) Give seminar on any relevant topic.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/ sub topics.
b) Guide student(s) in undertaking micro-projects.
c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
d) About ***20% of the topics/ sub-topics*** which are relatively simpler or descriptive in nature is to be given to the students for ***self-learning***, but to be assessed using different assessment methods.
e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/ her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/ he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

a) Collect the details of all types of existing NE, NH and SH across the country and prepare a report on it.
b) Collect the details of different types of bridges with its components and prepare a report on it.
c) Prepare a model of different types of interchanges in roadway.
d) Collect the information of failure in flexible and rigid pavements.
e) Inspect the nearby road to enumerate the defects (if any) and prepare the report suggesting the remedial measures.
f) Develop the 2D and 3D photographic model of pavement construction nearby site.
g) Develop the model of urban road showing the surface and sub-surface drainage system.
h) Collect information on latest technology used for maintenance of urban roads.
i) Green Road Approach in Rural Road Construction for the Sustainable Development of India.

j) Prepare a report on green highway and practice of green highway.
k) Develop the 2D and 3D model of rail components and layout of a railway station and yard.
l) Prepare a model/ prototype of different types of crossing in Railways.
m) Develop the models of different gauge used in Railway.
n) Collect the information of defects in railway track and suggesting the remedial measures for ensuring its stability.
o) Prepare a model of airport with all landing and take-off markings.
p) Prepare a model of artificial port with all facilities.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Highway Engineering	Khanna S.K, Justo, C.E G and Veeraragavan,A.	New Chand and Brothers, Roorkee, 2010. ISBN 978-8185240800.
2	Road, Railway, Bridge and Tunnel Engineering.	Birdi, Ahuja,	Standard Book House, New Delhi, March 2010, ISBN: 978-8189401337.
3	Road, Railway, Bridge & Tunnel Engineering	B L Gupta	Standard Publishers. Delhi
4	Traffic Engineering and Transport Planning	Kadiyali,L.R	Khanna Publishers, New Delhi, 2008, ISBN:978-8174092205
5	Principles, Practice and Design of Highway Engineering	Sharma, S.K	S. Chand Publication, New Delhi, 2012, ISBN: 9788121901314
6	Laboratory Manual in Highway Engineering	Duggal, Ajay K. and Puri, V.P	New Age International (P) Limited, Publishers, New Delhi, 2010, ISBN: 9788122403107.
7	Transportation Engineering Vol. I & II	V N Vazirani& S P Chaondola	Khanna Publishers. Delhi
8	Element of Bridge Tunnel and Railway Engineering	S P Bindra K Bindra	DhanpatRai& Sons Delhi
9	Dock and Harbour Engineering	H P Oza G H Oza	Charotar Publishing House, Anand
10	Harbour, Dock and Tunnel Engineering	R. Shrinivasan	Charotar Publishing House, Anand
11	Airport Engineering: Planning and Design	Subhash C. Saxena	CBS Publisher
12	Airport Engineering	Rangwala	Charotar Publishing House, Anand

14. SOFTWARE/ LEARNING WEBSITES

a) www.nptel.iitm.ac.in
b) https:/ / www.youtube.com/ watch?v=9HZE6DNfF5U&t=3s
c) https:/ / www.youtube.com/ watch?v=-yBXl4z70mI
d) https:/ / www.youtube.com/ watch?v=TE8zYxUJHt0
e) https:/ / www.khanacademy.org/

f) https:/ / www.youtube.com/ watch?v=37WMS483T7Y
g) https:/ / onlinepubs.trb.org/ onlinepubs/ millennium/ 00014.pdf
h) www.airports.deerns.com

15. PO-COMPETENCY-CO MAPPING

Semester III	Basic Transportation Engineering (Course Code: .....)									
	POs and PSOs									
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solutions	PO 4 Engineering Tools, Experimentation &Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning	PSO 1	PSO 2	PSO 3 (If needed)
Competency	i. To supervise construction and maintenance of roads, railways, bridges, airways, docks and harbour. ii. To carry out testing of materials used for road construction.									
Course Outcomes CO a) Explain different modes of transportation and its effectiveness in terms of economy.	3	-	-	-	-	-	2			
CO b) Implement the various types of road construction work with different tests on road material.	3	2	2	2	2	2	2			
CO c) Maintain different types of drainage, bridges and its components.	3	2	2	-	2	-	2			
CO d) Maintain railway track and its components.	3	2	2	-	2	2	2			
CO e) Explain the function of harbours, docks and airways.	3	-	-	-	2	-	2			

Legend: '**3**' for high, '**2**' for medium, '**1**' for low or '**-**' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Shri Darshan V. Patel	Govt.Poly., Ahmedabad	079-26301285	darshan.2228@gmail.com
2	Shri Munaf M. Jagadu	Govt.Poly., Ahmedabad	079-26301285	mjagadu@gmail.com
3	Shri Chirag B. Patel	Govt.Poly., Ahmedabad	079-26301285	patel.chig@gmail.com