GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL (TRANSPORTATION ENGINEERING) (13)
Master of Engineering
Subject Code: 3731309
Semester – III
Subject Name: TRAFFIC FLOW THEORY AND SIMULATION

Type of course: Program Elective - V

Prerequisite: Traffic Engineering

Rationale:
1. To understand the important traffic flow theory and its application for heterogeneous traffic flow condition.
2. To impart the knowledge of macroscopic, mesoscopic and macroscopic traffic flow variables and their measurement at field.
3. To know the concept and methodology for estimating capacity and LoS of various category of roads.
4. To provide a strong foundation on concept of simulation, and modeling in traffic engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
2	0	2	3	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Traffic Stream Characteristics:** Fundamentals of traffic flow, Time – distance plot of a traffic stream, Measurement of speed, concentration, flow, time headway and space headway, peak hour factor, use of counting, interval and translated distributions for describing vehicle arrivals, headway, critical gaps and lags; fitting of distributions, goodness of fit tests.	6
2	**Traffic Stream Characteristics:** Macroscopic traffic stream models: Greenshield's model, Greenberg's logarithmic model, Underwood's exponential model, pipe's generalized model, multi-regime models, Continuity equation, Mesoscopic Flow Models: Gas kinetic theory Microscopic traffic stream models: General Motor and Fuzzy inference model of car-following behavior, Lighthill-Withams theory, Boltzman like behaviour of traffic. Shock wave theory: Fixed bottleneck, moving bottleneck, Lane changing models: Conceptual framework, lane selection model, gap acceptance models.	16
3	**Queuing Analysis:** Fundamentals of queuing theory, demand service characteristics, deterministic queuing models, stochastic queuing models, multiple service channels, models of delay at intersections and pedestrian crossings.	6

4	**Highway Capacity & Level of Service:** Concepts, factors affecting capacity & level of service, Base conditions for capacity estimation, Speed – Flow relationship, Adjustment factors for carriage way width, paved shoulder, directional split, road geometry, riding quality, Dynamic passenger car units, Level of service – A to F, Estimation of LoS based on density (PCU/km/direction), v/C ration and service volume as per Indo-HCM.	**8**
5	**Traffic Simulation:** System simulation, simulation languages, Elements and attributes, Random number generation, Pseudo random number generation, generation of inputs – vehicle arrivals, vehicle characteristics, road geometrics, design of computer simulation experiments, different types of traffic simulation models (macroscopic and microscopic), microscopic traffic simulator (VISSIM).	**9**
	Total Hrs	**45**

Suggested Specification table with Marks (Theory): (For ME only)

Bloom's Taxonomy for theory marks weightage (%) for cognitive Domain/level

Cognitive Domain	Remembrance	Comprehension	Application	Analysis	Evaluate	Create
Weightage (%)	10	10	20	20	20	20

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.

Reference Books:

1. TRB - SR No.165 - Traffic Flow Theory, Transportation Research Board, Washington - D.C.
2. May A.D., Traffic Flow Fundamentals, Prentice-Hall, New Jersey.
3. Drew, D.R., Traffic Flow Theory and Control, McGraw-Hill, New York.
4. TRB Special Report 209: Highway Capacity Manual, Transportation Research Board, Washington DC, 1985.
5. Wohl M. and Martin, B V., Traffic System Analysis for Engineers and Planners, McGraw-Hill, New York.
6. McShane W R & Roess R P, Traffic Engineering, Prentice-Hall, NJ, 1990.
7. Neylor, T.H. et al., Computer Simulation Techniques, John Wiley.
8. Highway Capacity Manual, Transportation Research Board, Washington DC, 2010.
9. Indian Highway Capacity Manual, Indo-HCM, 2017.
10. Barcelo, J., Fundamentals of Traffic Simulation, Springer, (2010).
11. Law, A. M., David Kelton W., Simulation Modeling and Analysis, McGraw Hill.
12. Treiber, M., Kesting, A., Traffic Flow Dynamics: Data, Models and Simulation, Springer.
13. Ortuzar de D.O. & Willumsen, L.G., "Modelling Transport", John Wiley & Sons.
14. R. Haberman, Mathematical Models. Prentice Hall.
15. D.P. Maki and M. Thompson, Mathematical Models and Applications. Prentice Hall.

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List of Experiments:

1. Determination of classified traffic volume count along with spot speed data on congested urban road mid-block section (Preferably using videography).
2. Generation of speed-flow-density relationship from the collected data.
3. Statistical analysis of the collected data for the parameters like - vehicle arrival pattern, headway, speed, gap, overtaking, queuing etc.
4. Determination of Intersection volume count and delay.
5. Pedestrians flow measurement and their crossing behavior analysis.
6. Determination of highway capacity and level of service.
7. Computer simulation of observed traffic data, using programme or software.
8. Simulation experiments for improving the traffic conditions.

Course Outcomes: At the end of the course, Student will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Comprehend the fundamental principles of traffic flow theories.	10
CO-2	Understand the various traffic flow models for application in the field.	30
CO-3	Know an application of queuing theory in traffic engineering.	15
CO-4	Estimate the capacity and level of service of roads.	25
CO-5	Design simulation models for various traffic flow condition for analysis.	20

Major Equipment: Video Camera, Traffic counter, Endoscope etc.

List of Open Source learning website / software

1. http://www.nptel.iitm.ac.in/courses/
2. VISSIM, VISUM - Academic version for the students