GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering- Transportation Engineering
Subject Code: 3721319
Semester – II
Subject Name: Traffic Flow Theory and Simulation

Type of course: Program Elective - III

Prerequisite: Traffic Engineering

Rationale:

Increased vehicular ownership has created problems of congestion, pollution and accidents on urban road network acutely. Hence, it is necessary for the Traffic Engineer to understand behavior of traffic flow, its characteristics and theories developed to prepare its model and its quantification. These theories are also useful to develop the traffic simulation models. The actions for traffic control and measures for mitigating the impacts can be implemented effectively after studying the simulation of traffic conditions. Therefore, it is essential for the Traffic Engineer to know about the procedure of traffic simulation. This course includes various traffic flow theories and procedures for developing traffic simulation models.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks		Practical Marks				
				ESE (E)	PA (M)	PA (V)		PA (I)		
						ESE	OEP	PA	RP	
3	**0**	**2**	**4**	**70**	**30**	**20**	**10**	**10**	**10**	**150**

Content:

Sr. No.	Content	Total Hrs
1	Traffic Stream Characteristics: Measurement, microscopic and macroscopic study of traffic stream characteristics - flow, speed and concentration; use of counting, interval and translated distributions for describing vehicle arrivals, headways, speeds, gaps and lags; fitting of distributions, goodness of fit tests, gap acceptance	**10**
2	Traffic Stream Models: Fundamental equation of traffic flow, speed-flow-concentration relationships, normalised relationship, fluid flow analogy approach, shock wave theory, platoon diffusion and Boltzmann like behaviour of traffic flow, car-following theory, linear and non-linear car-following models, acceleration noise	**10**
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	**8**
4	Highway Capacity & Level-of-Service Studies: Concepts, factors affecting capacity & level-of service, capacity analysis of different highway facilities, passenger car units, problems in mixed traffic flow	**7**
5	Traffic Simulation: System simulation, simulation languages, generation of random	**10**

	numbers, generation of inputs – vehicle arrivals, vehicle characteristics, road geometrics, design of computer simulation experiments.	
	TOTAL	**45 Hr.**

Suggested Specification table with Marks (Theory):

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	**Marks Weightage (%)**
Recall	10
Comprehension	10
Application	20
Analysis	20
Evaluate	20
Create	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, NJ
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, 2000, 2010.
9. Bratley, P., Fox B. L., Schrage, L. E. B., Guide to Simulation, Springer- Verlag, New York 1983.
10. Leigh, J. R., Modelling and Simulation, Peter Peregrinus, London, 1983.
11. Bernard, Z., Theory of Modelling and Simulation, John- Wiley, New York, 1976.
12. Ortuzar, J. and Willumsen, L.G, Modelling Transport, Wiley, Chinchestor, 1994.
13. Hansher, D. A., and Button. K. J., Handbook of Transport Modelling, Pergamon, Oxford, UK, 2000
14. Partho Chakraborty and Animesh Das, Principles of Transportation Engineering, PHI

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

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	To understand and classify the traffic stream characteristics models.	10%
CO-2	To develop the relationship of fundamental stream characteristics through real field data.	30%

CO-3	To analyse and estimate the traffic delay due to incidents or at toll plaza using the fundamental queuing theory.	20%
CO-4	To access the LoS of the highway segments through the traffic stream data.	20%
CO-5	To create or generate the vehicles through simulation or software for given characteristics and should conclude the result.	20%

List of Experiments:

1. 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. Intersection volume count and delay measurements.
5. Pedestrians flow measurement and their crossing behaviour analysis.
6. Data collection for determining 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

List of Open Source Software/learning website:
VISSIM, VISUM - Academic version for the students