

# CE434 Traffic Analysis and Design

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## **L 0 Introduction to Transportation System Engineering:**

### **Module I. Traffic stream characteristics**

- L 1 Fundamental parameters of traffic flow:** speed, density, volume, travel time, headway, spacing, time-space diagram
- L 2 Fundamental relations of traffic flow:** time mean speed, space mean speed and their relation, relation between speeds, flow, density, fundamental diagrams.
- L 3 Traffic stream models:** Greenshield's model, Greenberg's logarithmic model, Underwood's exponential model, pipe's generalized model, multi-regime models.
- L 4 Moving observer method:** Concepts and derivation, illustration, Calibration of Greenshield's model.

### **Module II. Traffic measurement procedures**

- L 5 Measurement at a point:** Traffic volume measurement, equipment for flow measurements, data analysis, concepts of ADT, AADT.
- L 6 Measurement over a short section:** Speed measurements, 15<sup>th</sup> and 85<sup>th</sup> percentile speeds, design speed, speed distributions.
- L 7 Measurement along a length of road:** Density measurement, travel time measurement.
- L 8 Automated traffic measurement:** GPS devices, loop detectors, video analysis, and other technologies.

### **Module III. Microscopic traffic flow modeling**

- L 9 Car-following models:** Concept of stimulus-response, general mottoes models, safety distance, pscho-physical, optimal velocity, fuzzy logic models, and applications
- L 10 Lane changing models:** Conceptual framework, lane selection model, gap acceptance models. **Advanced**
- L 11 Vehicle arrival models:** Poisson distribution, headway modeling, random vehicle generation. **Advanced**
- L 12 Microscopic traffic simulation:** Vehicle generation, design, calibration, validation, applications, operational models.

### **Module IV. Macroscopic and mesoscopic traffic flow modeling**

- L 13 Traffic flow modeling analogies:** Fluid flow analogy, heat flow analogy, granular flow, Lighthill-Withams theory, shock waves. **Advanced**
- L 14 Cell transmission models:** Flow conservation, flow transmission. **Advanced**
- L 15 Traffic progression models:** Robertson progression model, platoon movement, dispersion index, applications. **Advanced**
- L 16 Discrete simulation models:** Cellular automata concepts, discretization of time and space, rules for acceleration, deceleration, randomization, and vehicle updation. **Advanced**

### **Module V. Uninterrupted flow**

- L 17 Capacity and Level of service LOS:** Definitions, highway capacity, factors affecting LOS, HCM methods.
- L 18 Urban Street:** Classification, operational performance measures, congestion management. **Advanced**
- L 19 Multilane highways:** Characteristics, capacity and level of service. **Advanced**
- L 20 Freeway operations:** Operational considerations, capacity and level of service of a basic freeway segment, weaving operation. **Advanced**

- L 21 Ramp metering:** Merging and diverging areas; speed at ramps; fixed, reactive, and predictive systems. **Advanced**
- L 22 Corridor analysis:** Segment capacity, free flow travel time, queue delay, transit corridor. **Advanced**

#### **Module VI. Traffic intersection control**

- L 23 Principles of traffic control:** Requirements, basic driving rules, priority movements, principles of traffic control, intersections conflicts.
- L 24 Traffic signs and road markings:** Regulatory, warning, and information signs; longitudinal, transverse, and object marking.
- L 25 Uncontrolled intersection:** Level of service concept, priority streams, conflicting traffic, critical gap and follow-up time, capacity, queue length, control delay.
- L 26 Channelization:** channelizing devices, geometrical aspects, turning radius.
- L 27 Traffic rotary:** Conflict resolution in a rotary, geometric layout, design elements, capacity of rotary.
- L 28 Grade separated intersection:** Road over bridges, under pass, overpass, trumpet interchange, diamond interchange, fully and partial clover leaf intersection.

#### **Module VI. Traffic signal design**

- L 29 Elements of traffic signal:** Definitions, analysis of saturation headway, saturation flow, lost time, critical flows, derivation of cycle length.
- L 30 Design principles of a traffic signal:** Phase design, cycle time determination, green splitting, pedestrian phases, and performance measures.
- L 31 Evaluation of a traffic signal:** Definitions and measurement of stopped and control delay, Webster's delay model, oversaturated conditions.
- L 32 Capacity and Los analysis of a signalized I/S:** HCM 2000 method of analysis of a signalized intersection and determination of the level of service.
- L 33 Coordinated traffic signal:** Concepts of offset, common cycle length bandwidth, offset for one-way and two way streets. **Advanced**
- L 34 Vehicle actuated signals and Area traffic control:** Basic principles of vehicle actuation, collection of data, system architecture and algorithms. **Advanced**

#### **Module VIII. Traffic impact studies**

- L 35 Parking Studies:** Parking inventory, statistics, parking surveys; in-out, license plate, on-street and off-street parking.
- L 36 Accident Studies:** Accident data collection, statistics, safety audit, safety measures. **Advanced-self-study**
- L 37 Fuel consumption and emission studies:** Consumption models, pollutants, air quality models, mitigation measures. **Advanced-self-study**
- L 38 Congestion studies:** Performance measures, intensity, duration, extent of congestion, traveler perception, remedial measures, congestion pricing. **Advanced-self-study**
- L 39 Toll operation:** Design and configuration, queuing characteristics, operation and maintenance issues. **Advanced**
- L 40 Pedestrian studies:** Pedestrian counts, pedestrian volume and level of service, design principles of pedestrian facilities. **Advanced-self-study**

#### **Reference:**

1. Roess, R. P., McShane, W. R. & Prassas, E. S. ( 1998), Traffic Engineering, Prentice - Hall
2. May, A. D. (1990), Fundamentals of Traffic Flow, second edn, Prentice Hall.
3. Papacostas, C. S. (1987), Fundamentals of Transportation Engineering, Prentice-Hall, India
4. Kadiyali, L. R. (1987), Traffic Engineering and Transportation Planning, Khanna, India.
5. Highway Capacity Manual (2000), Transportation Research Board, USA
6. Khanna, S. K. & Justo, C. E. G. (1991), Highway Engineering, Nemchand Bros., Roorkee.
7. Pingnataro, G. J. (1970), Principles of Traffic Engineering, Mc Graw-Hill.