

Traffic Flow Theory and Control
(CE- 1023)

Time: 3 Hours

Full Marks: 70

Answer any Five questions
Assume data suitably reasonably, if required

1. a) State how a queuing system can be a state of n , where $n > 0$.
b) Derive the equation for the expected number in a queuing system having single channel queue configuration (M/M/1), poisson distributed arrivals, exponentially distributed service rate and in steady state condition.

[6+8]
2. a) Explain the term 'response' related to General Motors' car following model.
b) Derive the flow-concentration relationship from General Motors' car following model.
c) Show the relationship between third microscopic car following model and Greenberg's macroscopic model.

[2+6+6]
3. a) Define Saturation Flow Rate (SFR) of a signal control intersection? Discuss with neat sketch the discharge flow rate at an approach to a signalized intersection.
b) Determine the effective green time for a signalized intersection having saturation flow rate (S), signal cycle length (C_0), actual green time (G), amber time (A), starting lost time (l_s) and ending lost time (l_e) respectively.

[2+6+6]
4. a) What is early cut off and late start facility for a signalized intersection? State the purpose of introducing early cut-off and late start facility of the opposing flow.

b) The following hourly flow and saturation flow of a three leg intersection to be controlled by two phase signal system incorporating a late start facility is given below. Minimum green time is employed and starting delay is 2 second. Design the traffic signal.

Approach	Movement	Flow (PCU/hr)	Saturation flow (PCU/hr)
North	Straight ahead	940	2800
	Left turn	170	1700
South	Straight ahead	1060	2800
	Right turn	410	1200
East	Right turn	160	1200
	Left turn	440	1600

[3+3+8]

5. a) State the parameters used to compute average delay per vehicle at signal control intersection based on Webster's delay model.

b) An approach has an effective green time of 75 second and optimum cycle time 120 second. The actual flow on the approach is 1200 vehicles per hour, with its saturation flow estimated at 1800 vehicles per hour. Examine whether the delay due to uniform arrival of vehicles is less than that of random arrival of vehicles.

[4+10=14]

6. a) Discuss with steps about the performance measure of a signalized intersection on the basis of HCM 2000 (TRB).

b) Define uniform delay and incremental delay considered in LOS analysis for signalized intersection methodology in HCM 2000 (TRB).

c) Define Progression adjustment factor (PF) used in uniform delay calculation considered in HCM 2000 (TRB)

[6+4+4]