CEL 843: TRAFFIC MODELLING AND SIMULATION

Major | **Maximum Marks: 35; Time: 2 hrs** | **04th May 2010**

*Instructions: i) Answer **ALL** the questions; ii) Some useful formulas are given at the end, and iii) Assume any data required suitably*

Question 1 (11 marks)

a) The fundamental diagram relating q to k can have different shapes. Explain the underlying features if q vs. k diagram has i) parabolic, and b) triangle (piece-wise linear) shape. (3)

b) Suppose that the two observers record the following *N*-curves *A(t)* and *D(t)*:
A(t) = min {*t*, 2*t*-2}
D(t) = min {*t*-1, 2*t*-8}
Plot these curves and then a set of (*t,x*) vehicle trajectories that would be consistent with these data (use two families of parallel lines). (4)

c) Show with the help of figures the characteristics/waves when a traffic hump is encountered. A traffic hump is a parcel of increased density, such as might occur on a freeway with constant level traffic and when a short term influx of traffic on to it from an on ramp. (4)

Question 2 (8 marks)

In order to fully utilize the width of the approaching lines to a signal having two-phase control and effective green times of g_1 and g_2, it is assumed that maximum possible rate of flow across the stop line was proportional to the width of the approaches, w_1, and w_2 as shown in Fig. 1. Identify the values of the minimum widths of the sections with lengths d_1 and d_2 that would maximize the flows during fully saturated conditions.

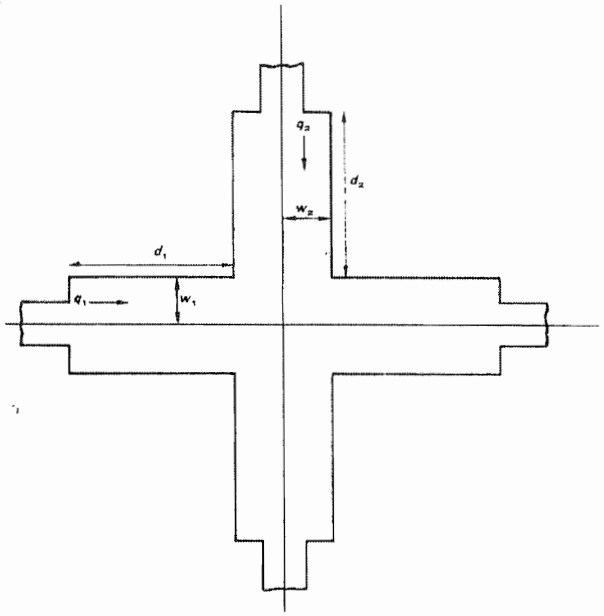

Fig. 1

Question 3 (8 marks)

a) Explain with figures on how the pedestrian characteristics and external conditions such as i) age, ii) cultural differences, iii) type of infrastructure, and iv) walking direction, influence the fundamental diagrams (4)

b) A line of vehicles are in car-following mode and all vehicles are traveling at 13 m/s with a distance headway of 34 m. The lead vehicle suddenly decelerates at a rate of 1 m/s^2 until it stops completely. Calculate the trajectory of the lead and only the first following vehicle for every second of time upto 4 time steps, using the GM first model (l=m=0). The reaction time (Δt) and sensitivity parameter (α) are 1.0 s and 0.17 respectively (4)

Question 4 (8 marks)

a) How does a discrete event simulation model differ from the continuous model? (2)

b) It is known that 15% of the vehicles approaching an intersection will turn left, 60% will go straight through and the rest will turn right. Construct the corresponding cumulative distribution and translate the following 20 uniformly distributed random numbers to outcomes of this process: 0.5954, 0.4501, 0.2590, 0.7081, 0.1405, 0.9740, 0.8676, 0.2729, 0.4474, 0.0166, 0.40344, 0.2932, 0.4314, 0.2883, 0.0881, 0.4680, 0.8153, 0.5142, 0.4546, 0.0367. Also generate the time headways of these vehicles if the mean and minimum headways are 3.5 s and 1.0 s respectively. (6)

Some useful formulas: