SHEET (4)

SHOCKWAVES & QUEUING ANALYSIS

1. The demand in a four lane highway is 6400 vph. An accident blocks 2 lanes of the highway. It took 30 mins till capacity is fully restored. Consider the following flow-density relationship u=100-1.1628k, where u is in km/hr and k is in veh/km per lane:
    a) Sketch the above incident in a flow-density as well as time-space diagrams.
    b) Using shockwave analysis:
        i. Estimate the maximum Queue
        ii. How long will it take for the queue to completely clear?
        iii. How far will the queue reach?

2. Trucks begin to arrive at a gated industrial zone at 6:45 A.M. with a deterministic rate of 2 trucks/min. The security gate attendants start working at 7:00 A.M. Each truck takes a deterministic processes time of 20 seconds at the gate for security checks.
    a) Calculate the maximum queue at the gate?
    b) When will the queue cleared?
    c) Calculate the average vehicle delay?

3. A highway has a capacity of 3000 vph per direction and a constant traffic flow rate of 2000 vph per direction. At 10:00 am, a traffic accident closed the highway (i.e., no vehicles can pass through the accident site). At 10:15 am, the highway was partially opened to traffic with a capacity of 1500 vph. At 10:30 am, the accident was completely removed and the highway was cleared and restored to its full capacity (i.e., 3000 vph per direction).
    a) Sketch the cumulative arrival and departure curves.
    b) Determine the maximum queue length
    c) Calculate total delay and average delay due to this accident.
    d) When will the queue be cleared?
    e) What was the queue length at 11:00 am?

4. A traffic signal operating with effective green and red times of 40 and 25 seconds respectively. Vehicles arrive at the intersection at a rate of 800 vph. During the effective green time, vehicles discharge from queue at a rate of 1800 vph. Determine the following:
    a) Max queue length
    b) Total Delay for this cycle