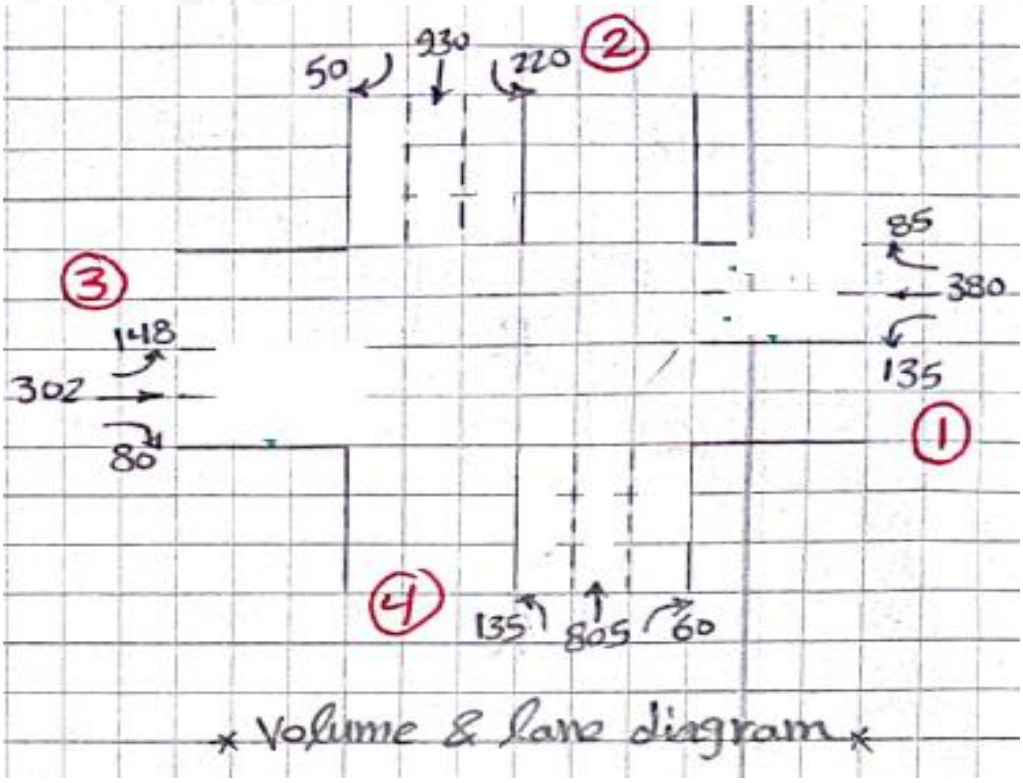
1. The following diagram shows the traffic volumes in passenger car units at the approaches of a four-leg intersection. Reviewing the warrants of the MUTCD, a traffic engineer found out that the intersection must be operated by a traffic signal. Design the traffic signal using the critical lane volume method. The design should include:

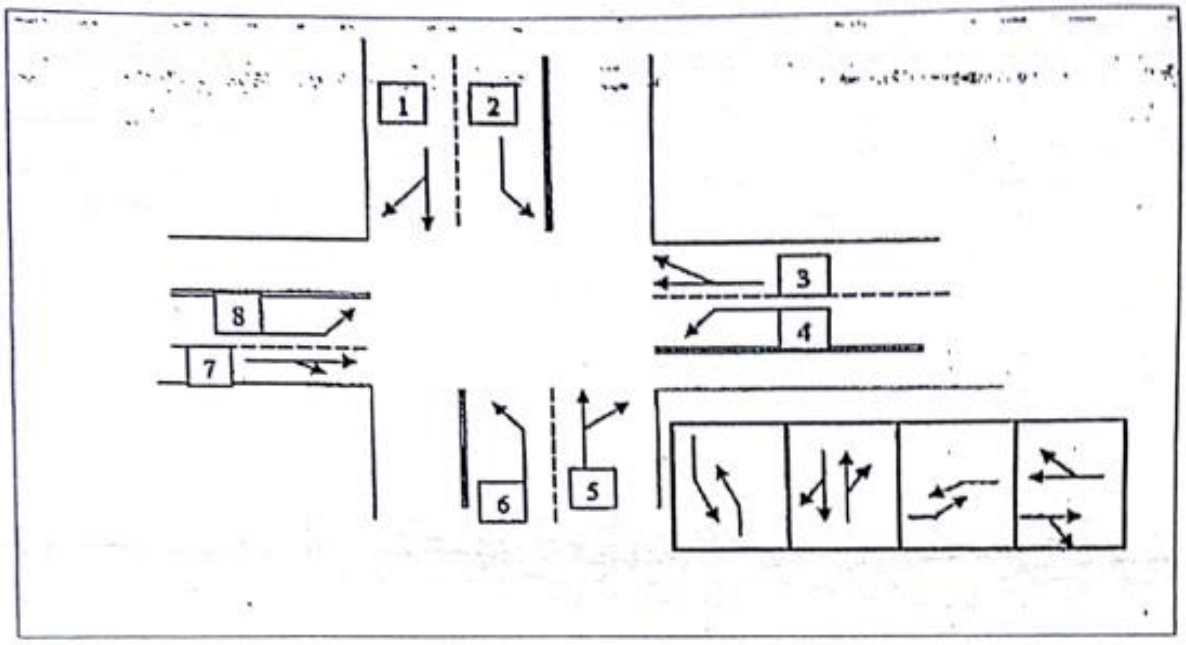
- Volume and lane diagram,
- Phasing diagram,
- Minimum cycle length calculation

Use the following information:

- PHF = 0.93,
- Target volume to capacity ratio = 0.9,
- Average deceleration rate = 3.05 m/s^2,
- Lane saturation flow rate = 1200 vehicle/hr/lane for exclusive left turn lanes, and 1700 vehicle/hr/lane for through-only and through-shared lanes,
- Pedestrian volumes on the four approaches = zero.



2. For the following intersection and demand table, using Webster's Equations as shown below, determine the optimum cycle time and the green splits. Assume a four phase timing plan as shown with 4 seconds of inter green per phase and a maximum cycle length of 180 seconds. Assume a peak hour factor of 1 and target (v/c) of 1.0 for all lanes.

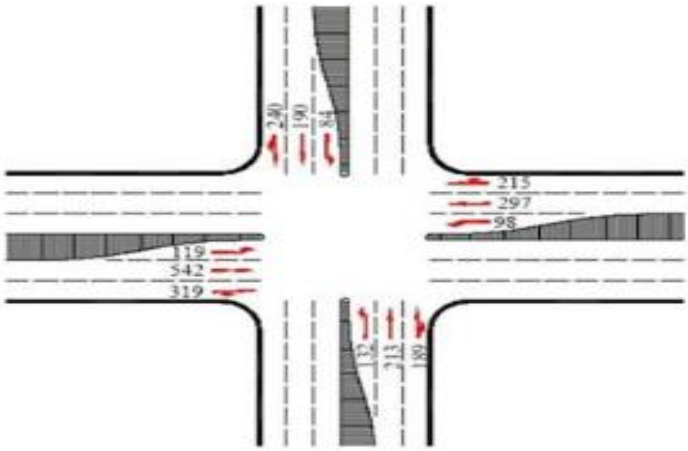


Lane	1	2	3	4	5	6	7	8
Eqv. Volume	500	200	275	55	325	115	350	60
Saturation Flow	1650	1500	1700	450	1600	1450	1850	550

Question (3):

The peak-hour volumes for a major intersection on an expressway are shown in the following figure. Using the Webster method, determine suitable signal timing for the intersection using the suggested phasing system shown in the figure. The following data is given:

- PHF = 0.95 • Left-turn factor = 1.4 • PCE for buses and trucks =1.6
- Truck percentage = 2 percent for south approach traffic and zero otherwise.
- Saturation flow: Left and through lanes 2000 veh/h/ln
- Each phase has a 3.5 seconds total lost time and 3.0 seconds yellow interval.



Question (4):

Using appropriate diagrams identify all possible conflict points for three leg intersection with all traffic directions using one phase, 2- phases and 3-phases systems. (**Graphically show the assumed phasing system**).

Question (5):

A six-lane rural multilane divided highway is on rolling terrain with five access points per mile and has 11 ft lanes, with a 6-ft shoulder on the right side and a 4-ft shoulder on the left side. The peak hour factor is 0.85 and the directional peak-hour volume is 2800 veh/h. There are 5% large trucks, 3% buses, and 1% recreational vehicles. Assume the base free flow speed is 60 mph. **Determine the level of service**.

Question (6):

A section of a four-lane (two lanes in each direction) freeway that is 3 miles long and has a sustained grade of 5% is to be improved to carry a regular weekday a heavy volume of 2600 vph, consisting of 87% passenger cars, 8% trucks, 2% buses, and 3% recreational vehicles. The PHF is 0.9. **Determine the additional number of 12 -ft lanes required in each direction if the road is to operate at level of service B**. The free-flow speed is 65 mph, there is a lateral obstruction 4 ft from the pavement on the right side of the road, and interchange spacing is 1.25 mile.