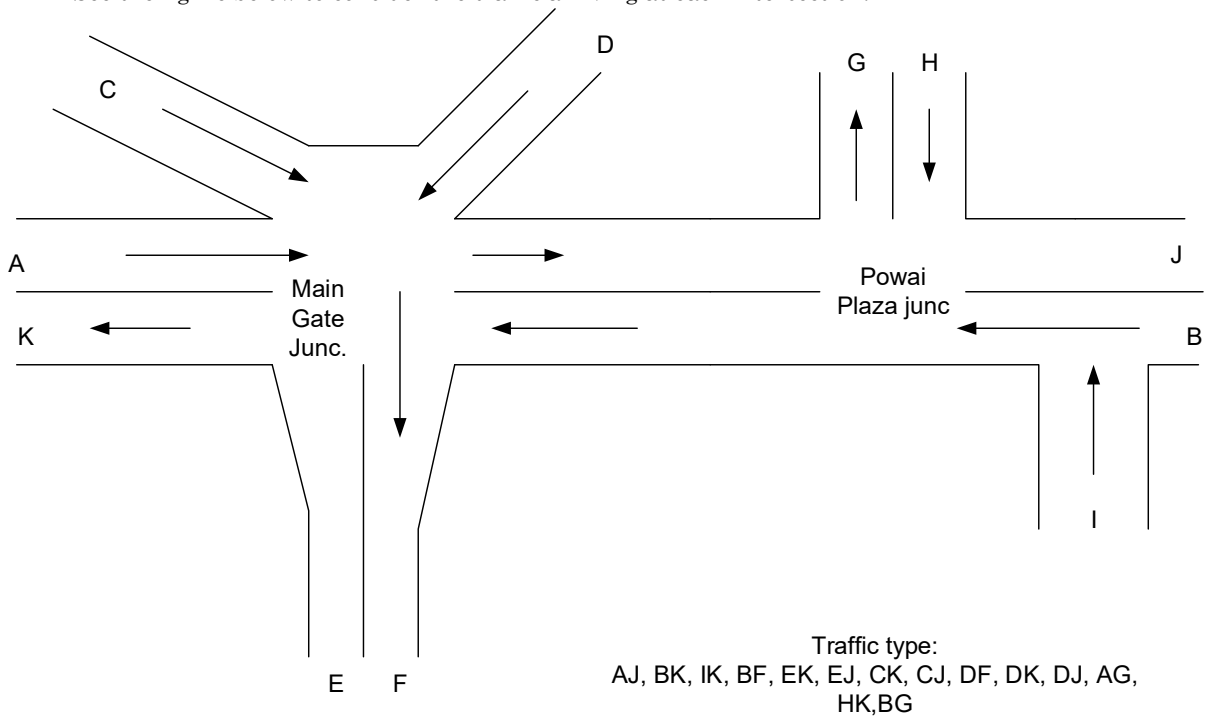
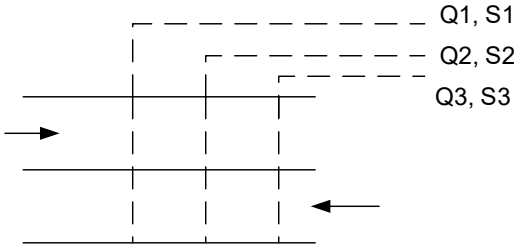
Design of traffic system for a city block.
You have to design the traffic system for the IIT maingate and Powai Plaza interconnection points. This is an automated system that needs to be implemented. The idea is that the duration of the traffic lights should change in time depending on the speed of the vehicles (indicating how crowded the traffic is)

- There are 5 roads that come into the IIT maingate intersection/junction. There are 3 roads that come into the pizzahut intersection/junction. Neglect traffic from I the lakeside gate.
- Vehicles that line up into the intersection pass through 3-coils embedded below the road that are spaced 5 meters apart indicating the speed of the approaching vehicles as well as the number of vehicles queued up at the traffic signals.
- Traffic signals move from red to amber to green and back to amber to red totally taking 3 seconds to change from red to green and vice versa. With one second as amber.
- The goal of the exercise is to minimize the queueing delay at each intersection.
- Design a state machine that will act as a centralized controller for the traffic signals at each of the two intersections.
- See the figure below to consider the traffic arriving at each intersection.





- Assumptions:
- Shown in the figure above are traffic types between places and at intersections. Your final design should take into account at least these traffic types.
- At an intersection, you will get the values Q1, S1, Q2, S2, Q3, S3 for each road that has active traffic leading into the intersection. The Q values are binary inputs that tell you the size of the queue at the corresponding traffic light. For example Q1=Q2=1 and Q3=0, would mean that the traffic queue is 66% full at red light. A Queue of Q1=Q2=Q3=1 means that there is quite a bit of traffic queued when it is a

red light. You can place your coils such that they give you an exact indication of how much traffic is queued up. Your goal would be to avoid jams as much as possible.

- The speed values S1, S2, S3 are used for measurement purposes and should help you change signal rates.
- Design a FSM and minimize the FSM (if you can) that would provide for traffic signaling at the two intersections. You must cater to the minimum set of traffic that is shown in the figure above.
- Implement the FSM as a VHDL code.
- Create a test-bench that would measure the system performance.
- Design considerations: The traffic on JVLR is 75x the traffic coming from the combined roads at IIT, powai market (C, D) etc. The traffic that enters and exits Hiranandani is $1/20^{th}$ of the JVLR traffic. IIT traffic is 1/3 of the traffic going and coming out of Powai market. However, traffic from JVLR cannot wait for more than 4 minutes to enter IIT. The speeds range from 10kmph to 70 kmph on JVLR and 10kmph on all other roads. The traffic speed on JVLR is a function of the time of the day and load on the road. The speed is average of all 3 lanes indicating no bias towards a vehicle type.
- Policy: JVLR must get max traffic throughput
- Your design must have a way to change traffic rate (speed, intensity).
- If there is a break-down in the traffic situation leading to a deadlock, you must recover from the deadlock (assume that motorist follow instructions).
- Draw timing diagrams to follow the red light and green light at each intersection.
- Make suitable assumptions wherever necessary and state the same.