1. Match the following random access MAC protocols to the descriptions below: ALOHA, Slotted ALOHA, 1-persistent CSMA, nonpersistent CSMA, p-persistent CSMA.

    [5 points]

    - A network has ten nodes. When a node has a frame to send, it listens to the channel. If the channel is idle it sends the frame immediately and if the channel is busy it waits till the end of the ongoing transmission and sends the frame.

      Ans. 1-persistent CSMA

    - A network has five nodes. When a frame is generated at a node, it waits till the end of the current slot and then transmits the frame.

      Ans. Slotted ALOHA

    - A network has eight nodes. When a node has a frame to send, it listens to the channel. If the channel is idle, it sends the frame immediately and if the channel is busy it waits for a random amount of time and listens to the channel again.

      Ans. Nonpersitent CSMA

    - A network has six nodes. When a node has a frame to transmit it just sends the frame.

      Ans. ALOHA

    - A network has seven nodes. When a frame is generated at a node, it waits till the end of the current slot and then listens to the channel. If the slot is busy, it waits till the slot ends and listens to the channel again. If the slot is idle, it is equally likely to transmit its frame or defer until the next frame.

      Ans. p-persistent CSMA

2. In a queueing system which has reached the steady state, customers arrive at the rate of 5 customers per minute. They spend an average of 10 minutes in the system and an average of 5 minutes waiting in the queue. What is the average number of customers in the queueing system? What is the average number of customers waiting in queue? [5 points]

    Ans. Since the system has reached steady state, Little's theorem is applicable here.

    Average number of customers in the queueing system = Arrival rate × Average time spent by a customer in the queueing system = $5 \times 10 = 50$ customers

    Average number of customers waiting in the queue = Arrival rate × Average time spent by a customer waiting in the queue = $5 \times 5 = 25$ customers