Tutorial – 2

1. A vehicle of weight 2.0-ton skids through a distance equal to 40 m before colliding with another parked vehicle of weight 1.0 ton. After collision both the vehicle skid through a distance equal to 12 m before stopping. Compute the initial speed of the moving vehicle. Assume coefficient of friction as 0.5.
2. A truck of weight 2.0 T skids through a distance equal to 50 m before colliding with another parked Minibus of weight 1.0 T. After collision both the vehicle skid through a distance equal to 12 m before stopping. Compute the initial speed of the moving vehicle. Assume coefficient of friction as 0.4.
3. Two vehicles A and B approaching at right angles, A from West and B from South, collide with each other. After the collision, vehicle A skids in North direction 50^o North of West and vehicle B, 60^o East of North. The initial skid distances of vehicle A and B are 38m and 20m respectively before collision. The skid distances after collision is 15m and 36m respectively. If the weights of vehicles B and A are 6.0 T and 4.0 T, calculate the original speeds of the vehicles. The average skid resistance of the pavement is found to be 0.55.
4. It is observed that on an average a vehicle driver drives 500 km during the course of a year. The probability of having an accident is 100 per 200 million vehicles-kms. What is the probability of a driver having at least two accidents during his driving career extending to 25 years?
5. The accident records for three consecutive years at an uncontrolled junction indicate the number of accidents as 3, 6 and 9 in the year 1972, 1973 and 1974 A.D. respectively. Calculate the probability of 4 accidents occurring per year at the site.
6. Following are the data collected in a spot speed studies carried out at certain stretch of a highway. Determine i) 85^{th} percentile and 15^{th} percentile speeds for the regulation of mixed traffic. ii) the 98^{th} percentile design speed for checking the geometric design elements of highway iii) the dispersion speed iv) the modal speed.

S.No.	Speed Range	No. of vehicles observed
1	0-10	15
2	10-20	20
3	20-30	45
4	30-40	89
5	40-50	200
6	50-60	275
7	60-70	120
8	70-80	45
9	80-90	30
10	90-100	10

7. Given that the speed in a certain section of a street follows a normal distribution with μ = 50kmph and σ = 10kmph, find the probability that speed in this section lies between 45kmph and 62kmph.
8. A certain traffic stream has a mean speed of 40 kmph and standard deviation of 2 kmph. Assuming that speed follows a normal distribution, what percentage of vehicles in the stream will have the speed exceeding 43 kmph?

9. A roadway has an average hourly volume of 360 veh/h. Assuming that the arrival of vehicle is Poisson distribution, estimate the probabilities having 0, 1, 2, 3, 4 and 5 or more vehicles over a 20 secs interval. Plot the histogram of Poisson distribution for $\lambda = 360$ veh/h.
10. An officer commutes daily from his suburban home to his downtown office. On an average the trip one way takes 24 minutes, with a standard deviation of 4 minutes. Assume the distribution of trip-times to downtown to be normally distributed.
    a. What is the probability that the trip will take atleast half an hour?
    b. If the working hour starts at 9:00 AM and he leaves his house at 8:45 AM in the morning, what percentage of the time he is late at work?
11. A traffic stream has a free flow speed of 90 kmph and a jam density of 80 veh/km. Estimate the maximum flow per lane. Determine the density of traffic stream in a two-way four lane road if the one-way flow in the road is 6400 veh/h in one direction.
12. Three vehicles are travelling a 1.5 km segment of a highway and the following observations are made:

    Vehicle A: 1.2 min
    Vehicle B: 1.5 min
    Vehicle C: 1.7 min

    a. What is the average travel speed of the three vehicles?
    b. What is the time mean speed and space mean speed of three vehicles?
13. An impatient car driver stuck behind a slow truck travelling at 32 kmph decides to overtake the truck. The accelerating characteristics of the car is given by:

    $\frac{dv}{dt} = 2.0 - 0.05v$

    Where, v is the speed in m/secs and t is the time in seconds.

    a. What is the acceleration after 2, 3, 20 and 250 seconds?
    b. What is the maximum speed attainable by the car?
    c. When will the acceleration of the car approach zero?
    d. How far will the car travel in 200 secs?
14. Derive the working expression for estimating speed at time t, acceleration at time t and distance covered after time t by a vehicle given that the acceleration is related to speed by:

    $\frac{dv}{dt} = \alpha - \beta v$