Solutions : CE 434 Midsem Examination

Q.4:

Given:

V =1900 vph; h = 2 sec; G = 40 sec; Y = 5 sec; L = 3 sec; R = 35sec;

Effective green, g = G+Y-L = 40+5-3 = 42 sec

Cycle time C = 40+5+35 = 80sec

g/C = 42/80 = 0.525

Saturation Flow, S = 3600/h = 1800 vph

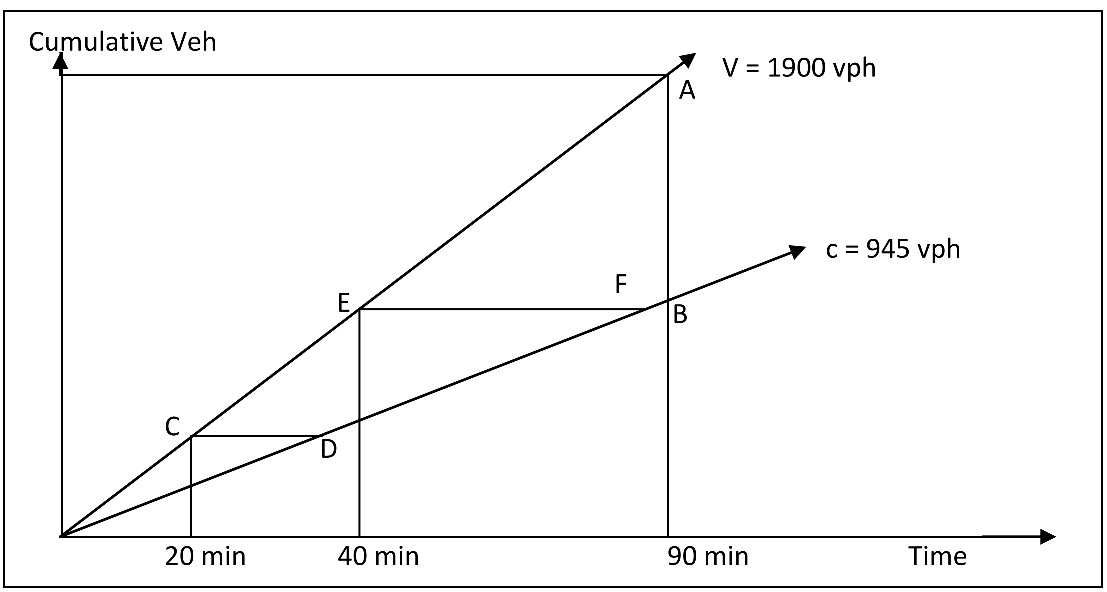
Capacity, c = S x $\frac{g}{C}$ = 1800x0.525 = 945 vph

$\frac{V}{C}$ = 1900/945 = 2.010 (>1 i.e. Overflow Delay)

(i) Cumulative no. of vehicles arriving at 90 min (point A in Fig.) = 1900 x 1.5 = 2850 veh

Cumulative no. of vehicles departing at 90 min (point B in Fig.) = 945 x 1.5 = 1417.5 veh

No. of vehicles in queue at 90 min = A-B = 2850 - 1417.5 = 1432.5 veh



(ii) Solution: Actual Waiting Time

If vehicle arrives at 20th min (at C);

Vehicle will be discharged at point D = $\frac{\frac{20}{60}\times 1900}{945} \times 60$ = 40.21 min

Time in waiting = 40.21 - 20 = 20.21 min

If vehicle arrives at 40th min (at E);

Vehicle will be discharged at point F = $\frac{\frac{40}{60}\times 1900}{945} \times 60$ = 80.42 min

Time in waiting = 80.42 - 40 = 40.42 min

Waiting time between 20 min and 40 min = (20.21+40.42)/2 = **30.315 min**

Alternate Solution (Approximate): Assuming the analysis period is 20-40 min.

Total Delay = Uniform Delay (UD) + Overflow Delay(OD)

UD = $\frac{C}{2}(1-\frac{g}{C})$ = $\frac{80}{2}(1-\frac{42}{80})$ = 19 sec

OD = $\frac{T1+T2}{2}(\frac{V}{C}-1)$ = $\frac{20+40}{2}$(2.010-1) = 30.3 min = 1818 sec

Total Delay = 19 + 1818 = 1837 sec = **30.62 min**

Q.5:

	Phases (i)	i	1			2		3			4	
	Lane no		1	2	3	4	5	6	7	8	9	10
	Lane flows (unadjusted)	fl	275.0	125.0	350.0	202.5	247.5	220.0	100.0	280.0	135.0	165.0
	Lane flows (adjusted)	fi	290.0	125.0	440.0	211.5	301.5	232.0	100.0	352.0	141.0	201.0

No	Phases	i	1	2	3	4
1	Critical flows (Vci=max(fa,fb))	Vci	440.0	301.5	352.0	201.0
2	Total critical flows (Sum of all Vci)	Vc	1294.5	veh/hr/lane		
3	Saturation flow (s=3600/h)	s	1800.0	veh/hr		
4	Cycle time	C	79.6	sec		
5	Total effective green time Tg = C - NL	Tg	63.6	sec		
6	Actual green time Gi = Tg / Vc * Vci	Gi	22.0	15.0	18.0	10.0
4	Cycle time	C	77.0	sec		

	Phases (i)	i	1			2		3			4	
	Lane no		1	2	3	4	5	6	7	8	9	10
7	Effective green time g1 = G1 + Y - L	gi	21.0	21.0	21.0	14.0	14.0	17.0	17.0	17.0	9.00	9.00

Sample calculation : Phase 1

Lane Flow (unadjusted)

Lane 1 = (750 x 0.2) + (750 x (1 - 0.2 - 0.3))/3 = 275
Lane 2 = (750 x (1 - 0.2 - 0.3))/3 = 125
Lane 3 = (750 x 0.3) + (750 x (1 - 0.2 - 0.3))/3 = 350

Lane Flow (adjusted for turning movements)

Lane 1 = (750 x 0.2 x 1.1) + (750 x (1 - 0.2 - 0.3))/3 = 290

Lane 2 = (750 x (1 - 0.2 - 0.3))/3 = 125

Lane 3 = (750 x 0.3 x 1.4) + (750 x (1 - 0.2 - 0.3))/3 = 440

Q.6:

Given:

v = 25 m/s

h = 2 s/veh

S = 3600/h = 1800 vph/lane

L = 2 sec

t-ideal = dist/v

t actual = t-ideal - Q x h - L   (L= 0 for signals other than the 2nd signal)

Signal no	Ref	cycle time	green time	Q	Dist, d (m)	v (m/s)	t-ideal = d/v	t-actual = t-ideal - Qxh	Cum t-actual
2	1	60	25	2	400	25	16	10	10
3	2	60	25	2	200	25	8	4	14
4	3	60	30	0	600	25	24	24	38

Performance evaluation:

(a) Speed of platoon = 25 m/s

Band Width = 15 sec

Capacity of band width (Assuming 1 lane) = $(\frac{BW}{C} \times s)$ = $(\frac{15}{80} \times \frac{3600}{2})$ = 337.5 veh/hr/lane

(a) Speed of platoon = 20 m/s

Band Width = 8sec

Capacity of band width (Assuming 1 lane) = $(\frac{BW}{C} \times s)$ = $(\frac{8}{80} \times \frac{3600}{2})$ = 180 veh/hr/lane

Legend:

x axis – 10 units = 5 sec

y axis – 10 units = 100m

Band widths:

1. veh speed = 25 m/s ; Band width = 15 sec
2. veh speed = 20 m/s ; Band width = 8 sec

A1 – Trajectory of 1st veh @ 25 m/s speed

A2 – Trajectory of last veh @ 25 m/s speed

B1 – Trajectory of 1st veh @ 20 m/s speed

B2 – Trajectory of last veh @ 20 m/s speed