Question 6.1

A roundabout has an inscribed circle diameter of 65 m, an entry width of 8.5 m and an approach half-width of 7.3 m. The effective length over which flare is developed is 30 m, the entry radius is 40 m and the entry angle is 60 metres. The design reference flows to be used for a preliminary design, expressed as entry capacity in passenger car units per hour, are given n Table Q5.1.

From	To			
	N	S	E	W
N	-	850	200	100
S	700	-	450	250
E	150	350	-	700
W	350	450	350	-

Table Q5.1

Calculate both the ratio of flow to capacity and the reserve capacity of each approach to the intersection

Solution 5.1

k = 0.92035
F = 2534
f_c = 0.667
tD = 1.1888
M = 1.6487
X_2 = 8.3638
S = 0.064
Q_E=0.92035(2534-0.667Q_c) = 2332-0.614 Q_c

NORTH

Entry flow	1150
Qc=	1250
Qe=	1565
RFC=	0.734929
Reserve cap	0.360676

SOUTH

Entry flow	1400
Qc=	959
Qe=	1743
RFC=	0.802993
Reserve cap	0.245341

EAST

Entry flow	1200
Qc=	1400
Qe=	1473
RFC=	0.81485
Reserve cap	0.22722

WEST

Entry flow	1150
Qc=	1300
Qe=	1534
RFC=	0.749639
Reserve cap	0.333976

Question 6.2

An approach road to a signalised junction carries a flow of 660 pcu/hr. The saturation flow on this approach is 2750 pcu/hr. Its effective green time is 33 seconds out of a total cycle time of 120 seconds.

- Calculate the average delay time (d) on this approach
- Calculate the average queue (N) at the start of its green period

Where:
$d = 0.9(cA + B/q)$
$A = (1-\lambda)^2/[(2(1-\lambda x)]$
$B = x^2/[(2(1-x)]$

Solution 6.2

λ = 33/120 = 0.275
q = 0.183 v/sec
s = 0.275 v/sec
x = 0.871
A = 0.33
B = 2.91
d = 50 secs
N = 16 cars (0.18*87) or (0.18*(50+44))

Question 6.3
An approach road is composed of two lanes, both 3.0 metres wide.

The nearside lane is for both left-turning and straight-ahead traffic, with a ratio of 1:3 in favour of the straight through movement.

The non-nearside lane is for right-turning traffic. This movement is opposed.

The degree of saturation of the opposing traffic from the north is 0.5.

The turning radius for all vehicles is 10 metres

Zero gradient and one effective 30 second effective green period per 60 second traffic cycle can be assumed ($\lambda = 0.5$).

The traffic is assumed to be composed of 100% private cars

There are 2 storage spaces beyond the stop line for right-turning traffic

Calculate the saturation flow for each of the two movements

Solution 6.3

The values of the relevant parameters are as follows:

d_n=1
f=0.25
r=10
G=0
w=3.0
Therefore
S_0 = 2080 – ($42d_g \times 0$) + 100(3.0 - 3.25))
=2055
and
S_1=(2055 - 140)/(1 + (1.5 × 0.25/10))
=1846 pcu/hr

For the non-nearside lane, the saturation flow can be calculated using above equations as follows
f=1 (all vehicles turning)
X0=0.5
N_s=2 (storage spaces)
t_1=12 $(0.5)^2$/(1 + 0.6(1 – 1)×2)
=3.0
t_2=1 – $(1\times0.5)^2$
=0.75
T=1 + (1.5/10) + (3/0.75)
=1 + 0.15 + 4
=5.15
S_g=(2055 - 230)/(1 + (5.15 – 1)×1)
=1825/5.15
=354 pcu/hr
P=1
S_c=1×(1 + 2) $(1\times0.5)^{0.2}$ × 3600/(0.5×60)
=313 pcu/hr
Therefore:
S_2=354 + 313
=667 pcu/hr

Question 6.4

Actual flows and saturation flows from a 2-phase signalised intersection are as follows:

	Actual Flow (pcu/hr)	Saturated Flow (pcu.hr)
North	660	2400
South	495	2000
East	990	3000
West	825	3000

The intergreen period equals 9 seconds, amber time equals 3 seconds.

Lost time due to starting delays equals 2 seconds

Calculate the optimum cycle time and the effective and actual green times

Solution 6.4

	Ratio	Critical Ratio
North	0.275	0.275
South	0.248	-
East	0.33	0.33
West	0.275	-

L	= 2 x 2 + (6 x 2)
	= 16 seconds
C_0	= 1.5 (16 + 5) / (1 - (0.275 + 0.333))
	= 73.4 seconds
total effective green	= 73.4 - 16 = 57.4
g_1/g_2	= 0.275 / 0.33
g_1	= 57.4 x .275/(.275+.33) = 26.1
g_2	= 31.3 (11 mks)

Actual green times are 1 second less, i.e. 25s and 30 s.