National Exams December 2008

98-Civ-B10, Traffic Engineering

3 hours duration

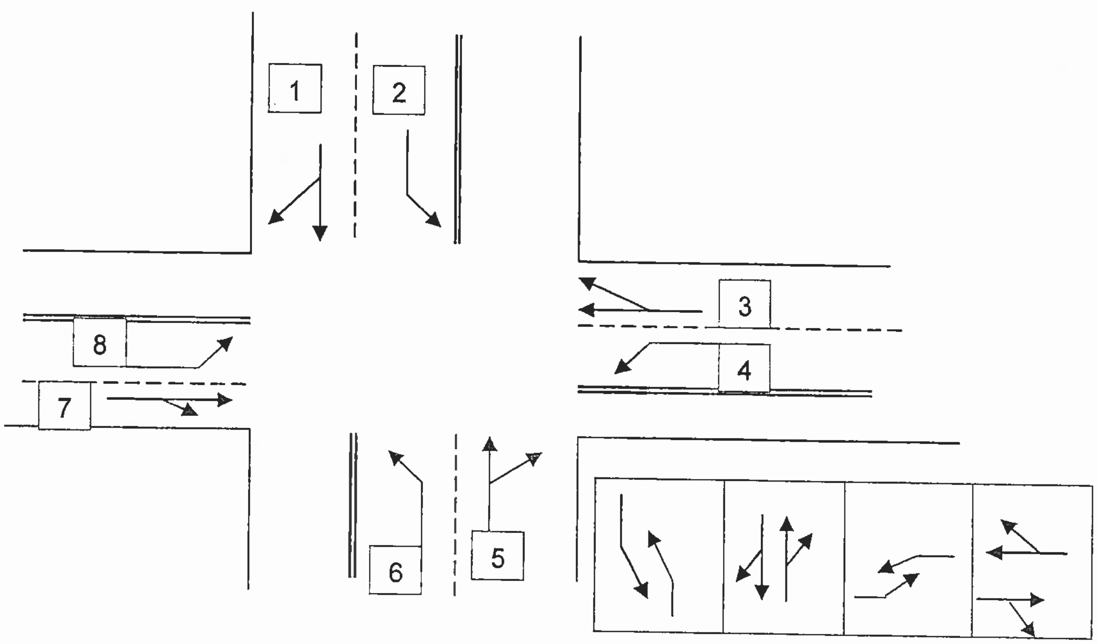
NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.
   Any two calculators Casio or Sharp approved models.
3. FIVE (5) questions constitute a complete exam paper. The first five questions as they appear in the answer book will be marked.
4. Each question is of equal value.
5. Most questions require an answer in essay format. Clarity and organization of the answer are important.

QUESTION 1

For the following intersection and demand table, using Webster's Equations as shown below, determine the minimum and optimum cycle time and the green split. Assume a four phase timing plan as shown with 4 seconds of inter green per phase and a maximum cycle length of 180 seconds. Ignore left turn on intergreen and Right Turn on Red. Using a queuing diagram, calculate the total and average delay for lane 5.

Lane	1	2	3	4	5	6	7	8
Volume	500	200	275	55	325	115	350	60
Saturation Flow	1650	1500	1700	450	1600	1450	1850	550



$$C_{min} = \frac{L}{1-\sum y_{ci}}$$

$$C_{opt} = \frac{1.5L+5}{1-\sum y_{ci}}$$

$$g_i = \frac{y_{ci}}{\sum y_{ci}}(C-L)$$

Where:

C_{min}	=	Minimum Cycle time (s)
C_{opt}	=	Optimum Cycle time (s)
y_{ci}	=	Critical Flow Ratio "y" for phase "i"
y_{ji}	=	Flow ratio for lane "j" in phase "i", given by ratio of Demand Volume to Saturation flow rate for lane "j" in phase "i"
L	=	Total Lost time per cycle (s)
g_i	=	Green time for phase "i" (s)

QUESTION 2

An approach lane to a signalized intersection has a demand of 760 vph, a minimum headway of 2.5 seconds per vehicle, a cycle time of 100 seconds and a displayed green of 64 seconds. If the amber is 3.5 seconds, the all red is 2.5 seconds, the start loss is 2 seconds and the end gain is 3 seconds, calculate and illustrate with a queuing diagram:

a. Effective green
b. Effective red
c. Capacity of approach
d. Maximum queue size
e. Total and average vehicle delay
f. Delay to a vehicle that arrives 15 seconds after the light turns red
g. Delay to a vehicle that arrives 10 seconds after the light turns green

QUESTION 3

For the following u-q relationship, determine the maximum flow, free flow speed and jam density. Sketch the resulting uq, uk and kq graphs.

$$q = 280u - 72u\ln u$$

QUESTION 4

Discuss in detail the following:

h. Actuated Signal Control
i. Dynamic Signal Control
j. MUTCD (Manual on Uniform Traffic Control Devices)
k. Random versus Uniform delay at Signalised Intersections.
l. Warrants for Signalised Traffic

QUESTION 5

A traffic stream travelling at 60 kph and a flow of 1200 vph encounter an accident that blocks their lane. This condition lasts for 15 minutes after which the accident is cleared and the traffic is allowed to discharge from the queue at rate of 2000 vph at 35 kph. If the jam density is 120 vpk, calculate;

a. maximum number of vehicles in the queue,

b. maximum length of the queue,

c. time to dissipate the queue, and

d. time until upstream conditions reach the site of the accident

QUESTION 6

The complexity of urban traffic requires the extensive use of computer tools and simulation software. Discuss in detail any five of the following:

a. TRANSYT

b. SCOOT

c. FREESIM

d. NETSIM

e. EMME/2

f. PASSER

g. SYNCHRO

h. HCS