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UNIVERSITY EXAMINATIONS 2022/2023

THIRD YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR
OF EDUCATION TECHNOLOGY IN CIVIL ENGINEERING

ECT 3358: TRAFFIC ENGINEERING

DATE: APRIL 2023

TIME: 2 HOURS

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

- a) State any FOUR factors which affect the Level of Service for a particular type of facility (4 Marks)
- b) Briefly define TWO main types of traffic Flow (2 Marks)
- c) Outline any FOUR methods of collecting traffic Data (2 Marks)
- d) Outline any FOUR vehicle factors that affect the performance of the transportation system (2 Marks)
- e) Differentiate between Capacity and Level of Service. (2 Marks)
- f) The proposed Mombasa road will have four lanes in each direction. The Mlolongo capacity is 8200 veh/hr/lane and the free-flow speed is 65 mph. Calculate the maximum flow rate, maximum density and jam density. (6 Marks)
- g) Using relevant equations, discuss the following terms related to traffic stream parameters
 - i. Gap (2 Marks)

- ii. Jam Density (2 Marks)
- iii. Flow (2 Marks)
- iv. Density (2 Marks)
- h) Briefly discuss Speed-Flow-Density Relationship (4 Marks)

QUESTION TWO (20 MARKS)

- a) Differentiate the following traffic flow conditions at an intersection
 - i. Under saturated traffic conditions (2 Marks)
 - ii. Oversaturated traffic conditions (2 Marks)
- b) Define highway capacity and three conditions which determine highway capacity. (4 Marks)
- c) Describe the following traffic categories
 - i. Generated traffic (1 Mark)
 - ii. Development traffic (1 Mark)
 - iii. Normal traffic (1 Mark)
 - iv. Current traffic (1 Mark)
- d) Fig 2 below shows vehicles travelling at constant speeds on a two – lane highway between sections X and Y with their positions and speeds obtained at an instant of time by photography. An observer located at point X observes the four vehicles passing point X during a period of T Sec. The velocities of the vehicles are measured as 45, 40, 35 and 20mph respectively. Calculate
 - i. The flow (2 Marks)
 - ii. The density (2 Marks)
 - iii. The time mean speed (2 Marks)
 - iv. The space mean speed (2 Marks)

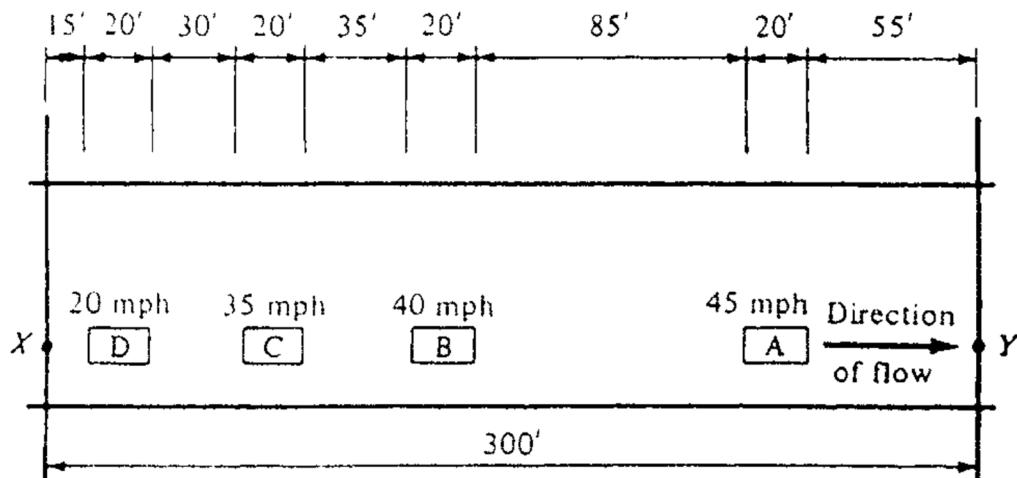


Fig 2: Location and Speeds of Four Vehicles on a Two-Lane Highway at a instant of Time

QUESTION THREE (20 MARKS)

- State FIVE most important problems considered in the field of transport policy and road system development (5 Marks)
- Define the term Road furniture (1 Mark)
- Describe four types of road furniture (8 Marks)
- A traffic Engineer working with KURA and based in Bungoma County wanted to determine the AADT on a rural road D65. The road D65 has the volume distribution characteristics shown in Tables 4.2, 4.3 and 4.4. The engineer collected the data shown on Table 4.1 below on a Tuesday during the month of May. Determine the AADT of D65 road. (6 Marks)

Table 4.1 Traffic Volume counts

Time	Traffic count
7.00-8.00am	400
8.00-9.00am	535
9.00-10.00am	650
10.00-11.00am	710
11.00-12.00am	650

Table 4.2 Hourly Expansion Factors for a Rural Primary Road

<i>Hour</i>	<i>Volume</i>	<i>HEF</i>	<i>Hour</i>	<i>Volume</i>	<i>HEF</i>
6:00–7:00 a.m.	294	42.00	6:00–7:00 p.m.	743	16.62
7:00–8:00 a.m.	426	29.00	7:00–8:00 p.m.	706	17.49
8:00–9:00 a.m.	560	22.05	8:00–9:00 p.m.	606	20.38
9:00–10:00 a.m.	657	18.80	9:00–10:00 p.m.	489	25.26
10:00–11:00 a.m.	722	17.10	10:00–11:00 p.m.	396	31.19
11:00–12:00 p.m.	667	18.52	11:00–12:00 a.m.	360	34.31
12:00–1:00 p.m.	660	18.71	12:00–1:00 a.m.	241	51.24
1:00–2:00 p.m.	739	16.71	1:00–2:00 a.m.	150	82.33
2:00–3:00 p.m.	832	14.84	2:00–3:00 a.m.	100	123.50
3:00–4:00 p.m.	836	14.77	3:00–4:00 a.m.	90	137.22
4:00–5:00 p.m.	961	12.85	4:00–5:00 a.m.	86	143.60
5:00–6:00 p.m.	892	13.85	5:00–6:00 a.m.	137	90.14
Total daily volume = 12,350.					

Table 4.3 Daily Expansion Factors for a Rural Primary Road

<i>Day of Week</i>	<i>Volume</i>	<i>DEF</i>
Sunday	7895	9.515
Monday	10,714	7.012
Tuesday	9722	7.727
Wednesday	11,413	6.582
Thursday	10,714	7.012
Friday	13,125	5.724
Saturday	11,539	6.510
Total weekly volume = 75,122.		

Table 4.4 Monthly Expansion Factors for a Rural Primary Road

<i>Month</i>	<i>ADT</i>	<i>MEF</i>
January	1350	1.756
February	1200	1.975
March	1450	1.635
April	1600	1.481
May	1700	1.394
June	2500	0.948
July	4100	0.578
August	4550	0.521
September	3750	0.632
October	2500	0.948
November	2000	1.185
December	1750	1.354

Total yearly volume = 28,450.
 Mean average daily volume = 2370.

QUESTION FOUR (20 MARKS)

- a) Outline the difference between grade separated and at-grade intersections (2 Marks)
- b) With the aid of line diagrams, distinguish between a full diamond and a half cloverleaf interchanges (6 Marks)
- c) i. Outline THREE functions of Traffic Control devices (3 Marks)
 ii. Describe THREE basic requirements in which should be met by any traffic control device (3 Marks)
- d) The speed of five vehicles were measured by radar at the mid-point of a 0.5mile section of highway; the speeds were 44, 42, 51, 46 and 49 mi/h. Assuming all vehicles were travelling at a constant speed, calculate time mean and space mean speeds? (6 Marks)

QUESTION FIVE (20 MARKS)

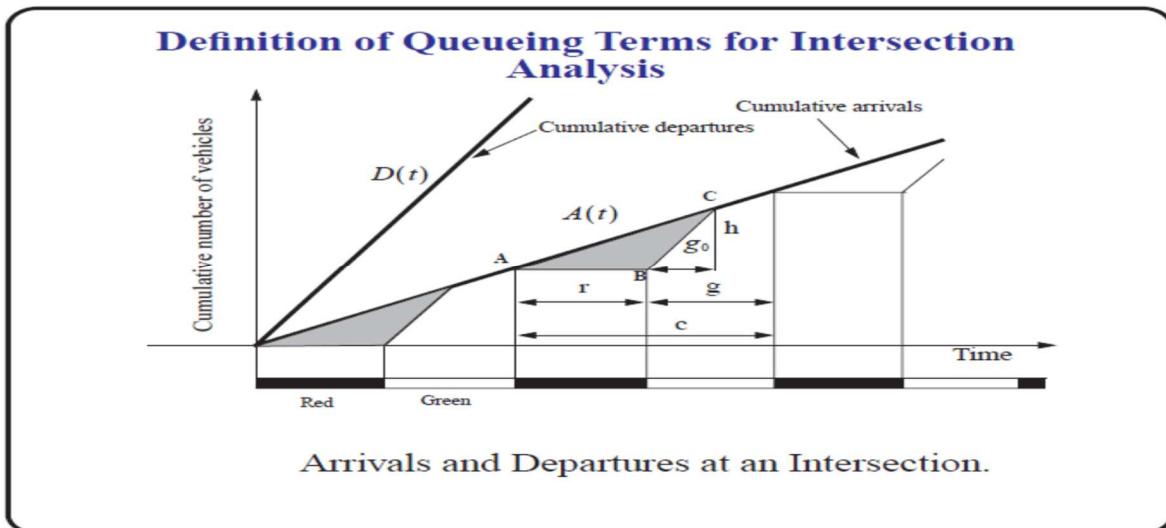
Using the figure below derive an expression for average delay per vehicle at the intersection where the time period g_0 required for queue to dissipate equals:

$$g_0 = \frac{\lambda r}{\mu - \lambda} \quad r = \text{effective red time}$$

μ = vehicles

Where λ = vehicles arrival rate

(12 Marks)



The cycle length at a signalized intersection is 90 seconds. The considered approach has a saturation flow of 2,200 vehicles per hour, the green time duration is 27 seconds and a flow rate of 600 vehicles per hour.

- i. Determine the type of traffic flow at the vicinity of the intersection (2 Marks)
- ii. Calculate the average delay per vehicle (6 Marks)