MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 406 TRANSPORTATION ENGINEERING

DATE: **TIME:**

INSTRUCTIONS

- *This paper comprises five questions*
- *Answer question number one and any other two questions*
- *All the optional questions carry equal marks*
- *Candidates to have relevant design manuals*

QUESTION ONE(COMPULSORY) (30 MARKS)

a) Define the term model. (3 marks)

b) State two main categories of a model (6 marks)

c) Using a neat sketch, highlight any five links between transportation and society goals (7 marks)

d) Clearly explain the main ten problems encountered in data collection for transportation studies in developing countries like Kenya. (10 marks)

e) Describe two characteristics that a study area should fulfill in origin-destination studies? (4 marks)

QUESTION TWO (20 MARKS)

a) A gravity model was calibrated with the results as shown in table 1

Table 1

Impedance (travel time, min), w	4	6	8	11	15
Friction factor, F	0.035	0.029	0.025	0.021	0.019

Calculate the parameters A and C given that the relationship between the impedances (w) and friction factor (F) is given by the equation

$$F_{ij} = \frac{A}{Wij^{C}}$$ (8 marks)

b) Briefly and with the aid of suitable diagrams explain the following terms as used in establishment of study areas for purposes of gathering data for transport studies:

i. Screen line

ii. Cordon line

iii. Desire lines (12 marks)

QUESTION THREE (20 MARKS)

a) Define the following terms with respect to traffic survey

i. Population of interest

ii. Sampling unit (4 marks)

b) Having identified the desired survey population and selected a sampling unit it is necessary to obtain a sampling frame from which to draw the sample. Outline five deficiencies that these sampling frames suffer from. (10 marks)

c) Explain three sampling methods that are commonly used in road-side interview (RSI) method (6 marks)

QUESTION FOUR (20 MARKS)

a) i) Clearly distinguish between revealed preferences (RP) survey and stated preferences (SP) survey with regard to data collection for transportation studies. (4 marks)

ii) Explain the stages in an SP- data collection process. (5 marks)

b) Data gathering for transport studies is one of the most expensive stages of the study process. Discuss the most typical constraints in the transport studies that need to be considered beforehand and to be clearly addressed. (5 marks)

c) The spot speed at a particular location on highway is known to be normally distributed with a mean of 80 K.P.H and a standard deviation of 15 K.P.H. What is the probability that if a sample of 100 vehicles are tested the mean speed observed will exceed 75 K.P.H (6 marks)

QUESTION FIVE (20 MARKS)

a) Briefly explain the following:

i) trip generation models

ii) trip distribution models

iii) trip assignment models

iv) modal split (modal choice) models. (8 marks)

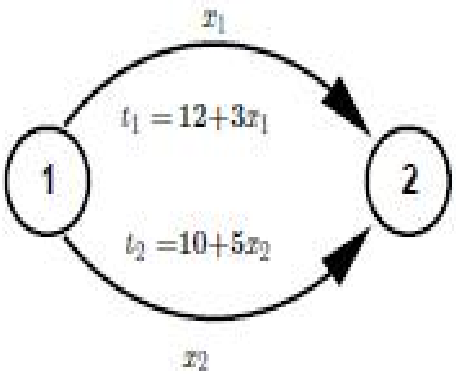
b) The trip rate (y) and the corresponding household sizes (x) from a sample are shown in table 2 below. Using regression method, compute the trip rate if the average household size is 3.25. **(**6 marks)

Table 2

	House hold size (x)			
	1	2	3	4
Trips per day (y)	1	3	4	5
	3	4	5	8
	3	5	7	8

c) i) Calculate the system travel time and link flow by doing user equilibrium assignment for the network in figure 1below. (3 marks)

ii) Verify that the flows are at user equilibrium. (**Note, sum of flows x_1 and x_2 equals 12**) (3 marks)


x_1
$t_1 = 12+3x_1$
1
2
$t_2 = 10+5x_2$
x_2

z	$\emptyset(z)$	z	$\emptyset(z)$	z	$\emptyset(z)$
1·40	0·9192	1·90	0·9713	2·40	0·99180
·41	·9207	·91	·9719	·41	·99202
·42	·9222	·92	·9726	·42	·99224
·43	·9236	·93	·9732	·43	·99245
·44	·9251	·94	·9738	·44	·99266
1·45	0·9265	1·95	0·9744	2·45	0·99286
·46	·9279	·96	·9750	·46	·99305
·47	·9292	·97	·9756	·47	·99324
·48	·9306	·98	·9761	·48	·99343
·49	·9319	·99	·9767	·49	·99361
1·50	0·9332	2·00	0·97725	2·50	0·99379
·51	·9345	·01	·97778	·51	·99396
·52	·9357	·02	·97831	·52	·99413
·53	·9370	·03	·97882	·53	·99430
·54	·9382	·04	·97932	·54	·99446
2·55	0·99461	2·75	0·99702	2·95	9·99841
·56	0·99477	·76	·99711	·96	·99846
·57	·99492	·77	·99720	·97	·99851
·58	·99506	·78	·99728	·98	·99856
·59	·99520	·79	·99736	·99	·99861
2·60	0·99534	2·80	0·99744	3·00	0·99865
·61	·99547	·81	·99752	·10	·99903
·62	·99560	·82	·99760	·20	·99931
·63	·99573	·83	·9·767	·30	·99952
·64	·99585	·84	·9·774	·40	·99966
2·65	0·99598	2·85	0·99781	3·50	0·99977
·66	·99609	·86	·99788	·60	·99984
·67	·99621	·87	·99795	·70	·99989
·68	·99632	·88	·99801	·80	·99993
·69	·99643	·89	·99807	·90	·99995
2·70	0·09653	2·90	0·99813	4·00	0·99997
·71	·99664	·91	·99819		
·72	·99674	·92	·99825		
·73	·99683	·93	·99831		
·74	·99693	·94	·99836		

Fig. 1