TECHNICAL UNIVERSITY

OF MOMBASA

UNIVERSITY EXAMINATIONS

2015/2016 ACADEMIC YEAR

FOUTH YEAR EXAMINATIONS

FOR THE DEGREE OF

BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

COURSE CODE: ECE 2403

COURSE TITLE: TRAFFIC ENGINEERING I

TIME: 2 HRS

INSTRUCTIONS TO CANDIDATES

- ***THIS PAPER CONTAINS FIVE QUESTIONS***
- ***ANSWER QUESTIONS ONE ANY OTHER TWO QUESTIONS***
- ***MARKS TO QUESTIONS ARE AS SHOWN***
- ***DO NOT USE A PROGRAMMABLE CALCULATOR***
- ***NO MOBILE PHONES ALLOWED IN THE EXAMINATION ROOM***

THIS PAPER CONSISTS OF (4) PRINTED PAGES

Question One

Table Q1a shows data collected on a rural highway during a speed study. Determine the standard deviation of the speeds observed. **(13 Marks)**

Table Q1a

Car No.	**Speed mi/h**	**Car No.**	**Speed mi/h**	**Car No.**	**Speed mi/h**	**Car No.**	**Speed mi/h**
1	46.1	23	47.8	46	35.1	70	53.4
2	54.2	24	47.1	47	44.0	71	53.3
3	52.3	25	34.8	48	45.8	72	62.1
4	57.3	26	52.4	49	54.0	73	48.2
5	46.8	27	49.1	50	54.1	74	56.6
6	57.8	28	37.1	51	45.7	75	61.8
7	36.8	29	65.0	52	55.2	76	48.7
8	55.8	30	49.5	53	45.4	77	52.1
9	43.3	31	52.2	54	54.3	78	48.8
10	55.3	32	48.4	55	50.2	79	60.1
11	39.0	33	42.8	56	55.1	80	63.4
12	53.7	34	49.5	57	41.1	81	49.8
13	40.8	35	48.6	58	45.2	82	52.0
14	54.5	36	41.2	59	44.6	83	48.6
15	51.6	37	48.0	60	38.3	84	45.4
16	51.7	38	58.0	61	50.8	85	48.5
17	50.3	39	49.0	62	51.8	86	56.4
18	59.8	40	41.8	63	50.1	87	49.2
19	40.3	41	48.3	64	42.1	88	56.0
20	55.1	42	45.9	65	54.0	89	49.2
21	45.0	43	44.7	66	36.3		
22	48.3	44	49.5	67	44.3		

b) Speed and density observations at a rural road yielded the results shown in Table 2. Determine the maximum flow using Greensberg model. **(17Marks)**

Table Q1b

Speed (mi/h)	**Density(veh/mi)**
53.2	**20**
48.1	**27**
44.8	**35**
40.1	**44**
37.3	**52**
35.2	**58**
34.1	**60**
27.2	**64**
20.4	**70**
17.5	**75**
14.6	**82**
13.1	**90**
11.2	**100**
8.0	**115**

Question Two

a) Enumerate FOUR benefits of a properly designed and timed traffic signal **(4marks)**

b) Distinguish between local controller and master controller as hardware components of a signal system **(4marks)**

c) Using the Webster's delay model determine the average intersection delay per vehicle (d) given the following data;

Flow = 600 vehicles per hour

Green time = 28 sec

Cycle length = 60sec

Yellow time = 60 sec

Saturation flow = 1800 vehicles per hour

Starting delay = 2 sec **(12 Marks)**

Question Three

a) State THREE primary objectives of street lighting **(3Marks)**

b) (i) Distinguish between photometric and lighting installation terms

(ii) define the following terms as used in street lighting installations:

(a) Luminous flux

(b) Luminous intensity

(c) Illuminance

(d) Luminance

(iii) with the aid of a sketch show the components of a street lighting lamp post

(12 marks)

c) State five characteristics of a bright street lighting patch **(5 marks)**

Question Four

a) Explain the difference between simultaneous and alternate signal timing **(5 Marks)**

b) Figure Q4 shows vehicular flow at an intersection. Determine the signal timing plan for the North-South and East-West segments given the following data:-

System is a two phase signal design

Cycle length = 60 sec

Approach = 30 miles per hour

Driver-perception-reaction time for stopping = 1 sec

Deceleration rate for stopping = 10 feet per sec^2

Length of clearing vehicle = 20 feet

Width of the intersection in feet, measured from the upstream stop bar to the downstream extended edge of pavement = 85 feet

Through movement saturation flows are as follows;

- S_{eb} = 993
- S_{wb} = 1240
- S_{nb} = 1150
- S_{sb} = 960

Left turn saturation flows are as follows;

$$S_{nb} = S_{sb} = S_{eb} = S_{wb} = 1000$$

(15 Marks)

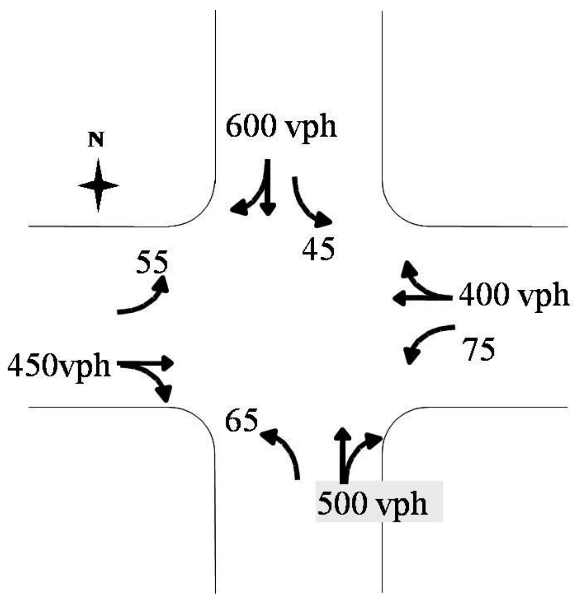

Figure Q4

Question Four

a) State key elements affecting intersection performance for motor vehicle **(5 marks)**

b) A non-nearside lane of a traffic signal approach has a width at entry of 3.0 m and downhill gradient of 3%. 40 % of vehicles turned right with a turning radius of 25 m. The cycle time is 60 seconds and the effective green time is 40 seconds. The right turning vehicles are opposed by a straight-ahead lane with a degree of saturation of 0.85. If two right turning vehicles may wait within the intersection without obstruction to following straight away vehicles and the ratio of passenger car units per vehicle is 1.5, calculate the saturation flow for this lane.

(15 marks)

Question Five

a) The Eastbound approach of a signalized intersection carries a flow of 1000 veh/h/lane at a velocity of 50 mi/h. The duration of the red signal indication for this approach is 15 seconds. If the saturation flow is 2000 veh/h/lane with a density of 75 veh/lane, the jam density is 150 veh/mi, determine the following;

i) The length of the queue at the end of the red phase

ii) The maximum queue length

iii) The time it takes for the queue to dissipate after the end of the red indication

(12 Marks)

b) Using Greenshields model, show that for maximum flow velocity is given by half the free mean speed and density is given by half the jam density. **(8 Marks)**