



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BSC IN CIVIL ENGINEERING

ECE 2411: TRAFFIC ENGINEERING II

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

DATE: 11 May 2016

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID

This paper consists of five questions. Attempt question ONE (Compulsory) and any other TWO questions

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Answer question **ONE (COMPULSORY)** from **SECTION A** and any other **TWO** questions from **SECTION B**

Maximum marks for each part of a question are clearly shown

This paper consists of **TWO** printed pages

ECE 2411 TRAFFIC ENGINEERING II

SECTION A (COMPULSORY -30 MARKS)

QUESTION ONE

- a. With the aid of diagrams and equations, discuss traffic flow stationarity. (5marks)
- b. With respect to microscopic flow of traffic show from first principles that;
 - i. $k(x,t,s) = \frac{\text{total time spent by all vehicles in } s}{\text{area (s)}}$
and
 - ii. $q(x,t,s) = \frac{\text{total distance covered by vehicles in } s}{\text{area (s)}}$
while explaining all the variables and using suitable diagrams for the derivations
(7mark)
- c.
 - i. Distinguish the terms “space occupancy” and “occupancy” and define relative occupancy ‘b’ mathematically. (4 marks)
 - ii. Consider a stream of traffic with with speed of 80km/hr and headway of 3seconds. All vehicles are 6 metres in length. What is the relative occupancy?
 - iii. What is the difficulty in using the mathematical formula of relative occupancy in practical situations?
(6marks)
- d. Discuss the ‘continuum approximation’ to a discrete flow while explaining its validity scheme. (6marks)

SECTION B (Answer any TWO questions from this section)

QUESTION TWO

- a. Briefly explain what a road hierarchy is (3marks)
- b.
 - i. Outline the main objectives of a road hierarchy (2 marks)
 - ii. State FOUR ways in which hierarchy principles assist planning agencies in the development in the development of policies relating to management of roads (4marks)

- c. Briefly describe the FOUR main functional levels of a road hierarchy in relation to land use (11marks)

QUESTION THREE

- a. Explain the following methods used to assign traffic in given networks
- All-Or-Nothing
 - Capacity Restraint
 - Incremental Assignment (10marks)
- b. Two routes connect a city and a suburb. During the peak-hour morning commute, a total of 4500 vehicles travel from the suburb to the city. Route 1 has a 96kph speed limit and is 9.6km in length; route 2 is 4.8km in length with a 72kph speed limit. Studies show that the total travel time on route 1 increases two minutes for every additional 500 vehicles added. Minutes of travel time on route 2 increases with the square of the number of vehicles expressed in thousands of vehicles per hour. Determine user equilibrium travel times.
(Make the necessary assumptions)

QUESTION FOUR

- Discuss graph theory.
- Differentiate coverage from connectivity with regard to quantitative description of road network, stating clearly how each can be measured. Further, outline two other criteria used to describe road network in a quantitative manner. (7marks)
- Discuss the law of conservation of vehicles with respect to traffic flow in a transportation network (4marks)
- With the aid of sketches, describe the three main types of road network patterns (6marks)
- Consider a stream of traffic with mean speed of 60km/hr and a flow rate of 1200 vehicles/hour. All vehicles are 4 metres in length. What is the relative occupancy? (3marks)

QUESTION FIVE

- a. Using the fundamental diagrams describe the following terminologies:
- Completely free flowing traffic (2marks)
 - Saturated traffic (2marks)
 - Capacity traffic (2marks)
- b. With the aid of diagrams describe the following three traffic regimes:
- Free flow (3marks)
 - Congested flow (3marks)
 - Capacity flow (3marks)

- c. Digo road highway section between Moi Avenue/Nkuruma Road and Jomo Kenyatta Avenue (Barclays Bank) round about measures 1.6km and has a capacity of 1400vphpl.
- i. What is the LOS “C” capacity of the principal Mombasa City arterial?
 - ii. If the link’s free flow speed is 72kph and the standard values of **a** and **b** are used (Bureau of Public Roads-BPR function), what is the link travel time for traffic flow rates $V=0, V=500, V=1000,$ and $V=1500$? (5marks)