



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
 i. All-Or-Nothing
 ii. Capacity Restraint
 iii. 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

- i. Discuss graph theory.
 ii. 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)
 iii. Discuss the law of conservation of vehicles with respect to traffic flow in a transportation network (4marks)
 iv. With the aid of sketches, describe the three main types of road network patterns (6marks)
 v. 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:
 i. Completely free flowing traffic (2marks)
 ii. Saturated traffic (2marks)

- iii. Capacity traffic (2marks)
- b. With the aid of diagrams describe the following three traffic regimes:
 - i. Free flow (3marks)
 - ii. Congested flow (3marks)
 - iii. 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)