THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATIONS FOR DEGREE IN
BACHELOR OF SCIENCE IN BUILDING & CIVIL ENGINEERING

ECE 2404 : HIGHWAY ENGINEERING I

END OF SEMESTER EXAMINATION

SERIES: AUGUST/SEPTEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer booklet*

This paper consists of **FIVE** questions in **TWO** sections **A & B**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

SECTION A (*COMPULSORY – 30 MARKS***)**

Question 1

a) The geometric design of highways refers to the arrangement of the visible dimensions of streets and highways. State the **THREE** main purposes of geometric design of highways (6 marks)

b) The principal agency on highway design research is called AASHTO. Give the full name of AASHTO. (2 marks)

c) Explain the **FOUR** major areas of concern for the highway design engineer (8 marks)

d) A passenger car is travelling at an initial speed of 50 (mph) miles per hour on a dry level road. Using figure 1 provided:

(i) What will be the final speed it accelerates for a distance of 1000 ft? (7 marks)

(ii) Form the final speed of part (i) above, what distance will it need to travel to decelerate comfortably to 50mph (7 marks)

SECTION B (*Answer any TWO questions from this section***)**

Question 2

a) Highway design should be done to provide an operating speed that satisfies the majority of drivers. Operating design speed is dependent on SIX conditions. State the SIX conditions (18 marks)

b) Describe the most frequently used measure for the operating speed (2 marks)

Question 3

a) Define "brake reaction time" (5 marks)

b) What is the recommended deceleration rate (ft/sec^2) threshold for determining stopping sight distance according to AASHTO? (5 marks)

c) The stopping sight distance of a vehicle on a roadway may be expressed by the empirical formula:

$$S = \frac{V^2}{30\left[\left(\frac{a}{32.2}\right) \pm G\right]} + 1.4\,V.tr$$

State all the variables and units (10 marks)

Question 4

An alert driver (with a reaction time of 0.5 seconds is driving downhill on a 5% grade road at 50 miles per hour and dry pavement when suddenly a school child runs on the road at a distance of 200 ft.

Using the formula:

$$S = \frac{V^2}{30\left[\left(\frac{a}{32.2}\right) \pm G\right]} + 1.4\,V.tr$$

(i) Will the driver knock down the child upon applying the emergency brakes assuming a deceleration rate of 16ft/s2? (10 marks)

(ii) AASHTO designates six level of service for highway design: A, B, C, D, E and F. State the general operating conditions for the SIX levels of service (10 marks)

Question 5

a) Define the term "critical length" in reference to vertical alignment design (4 marks)

b) Using fig 5.0, determine the critical length of grade for a highway with a design of 70 mph with an upgrade of 2% (10 marks)

c) Explain the **THREE** most important pavement characteristics in relation to geometric design (6 marks)