TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT BUILDING AND CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:

BSC IN CIVIL ENGINEERING

ECE 2520: TRAFFIC ENGINEERING III

END OF SEMESTER EXAMINATION

SERIES: APRIL2016

TIME: 2HOURS

DATE: 16May2016

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.

QUESTION ONE

a) Discuss the queuing theory and explain the roles played Erlang and Little. (5 Marks)

b) Discuss the applicability of shockwave analysis and queuing analysis to the analysis of traffic systems. (4Marks)

c) Arrival processes in traffic queuing systems can be static or dynamic. Discuss while explaining the various types of customers likely to be encountered. (7 Marks)

d) Discuss queuing disciplines. (6 Marks)

QUESTION TWO

An incident occurs on a freeway that has a capacity in the North-bound direction, before the incident, of 4000 vehicles/hour and a constant flow of 2900 vehicles/hour during the morning commute (no adjustments to traffic flow result from the incident). At 8.00 am a traffic accident closes the freeway to all traffic. At 8.12 am the freeway is partially opened with a capacity of 2000 vehicles/hour. Finally, the wreckage is removed and the freeway is restored of 4000 vehicles/hour at 8.31 am. Assuming a D/D/1 queuing and FIFO, determine:

a) The time of queue dissipation
b) The longest queue length
c) The total delay
d) The average delay per vehicle
e) The longest wait of any vehicle

(20 Marks)

QUESTION THREE

After observing arrivals and departures at the Naivasha-Nakuru toll booth at Naivasha over a 60-minutes period, the observer noted that the arrival and service rates are deterministic, but instead of being uniform, they change over time according to known function. The arrival rate is given by the function $\lambda(t) = 2.2+0.17t-0.0032t^2$, and the departure/service rate $\mu(t) = 1.2+0.07t$, where t is in minutes after the beginning of the observation period and $\lambda(t)$ and $\mu(t)$ are in vehicles per minute.

Determine the total vehicle delay at the tollbooth and the longest queue, assuming a D/D/1 queuing system, computationally using the equations. Draw a queuing diagram of the system.

(20 Marks)

QUESTION FOUR

a) Explain what is meant by "saturation" and "under-saturation" of queuing systems for both stochastic and stochastic cases. Clearly explain the difference in performance of stochastic queuing system and deterministic queuing system when they are under-saturated. (4 marks)
b) A roadside survey point is set up on a highway where vehicle arrivals are random and one way traffic volume is 900 vehicles/hour. All vehicles are required to stop at the survey point while a tag is being attached, the operation taking a uniform time of 2.5 seconds.
    i) Determine the expected number of vehicles waiting at the roadside point and the number of vehicles in the system.
    ii) Compute the average waiting time spent on the queue at the survey point and the time spent in the system.
    iii) Determine the probability that there are no vehicles in the system and the service facility utilization factor.

(16 Marks)

QUESTION FIVE

a) Explain when simulation analysis approach should be used in the analysis of the queuing systems. (4 marks)

b) A pay parking ticket booth has a mean arrival rate of 3 vehicles per minute and a mean service rate of 4 vehicles per minute, both arrivals and departures depicting randomness. Calculate the characteristics of the system by determining:

i) The mean number vehicles in the system (L)
ii) The mean number of vehicles in the waiting line (Lq)
iii) The mean time in the system (W)
iv) The mean time in the queue (Wq)
v) The percentage idle time

(13 Marks)

c) Using suitable diagrams, explain clearly the economics of operating characteristics of queuing system. (4 Marks)