KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONIC ENGINEERING)

SCE 437: SIMULATION AND MODELLING

DATE: **Friday 25th November 2010** **TIME:** **2.00p.m -4.00p.m**

INSTRUCTIONS: Answer Question One and any other Two questions.

QUESTION 1 (30 MARKS)

a) i) Why is the concept of model basic to the technique of simulations? [3marks]

ii) What are the advantages and disadvantages of simulation? [4marks]

b) State and explain the steps of constructing a simulation model. [6marks]

c) In each of the following situations identify the customer and the server.

i) Letters processed in a post office. [1mark]

ii) Legal court cases [1mark]

d) Suppose that the equation of a circle is $(x-2)^2 + y^2 = 30.25$

Define the corresponding pdfs f(x) and f(y) and then show how a sample point (x,y) inside or on the circle can be determined using (0,1) random pair (R_1, R_2) [3marks]

e) Electronic component are received randomly at a one – machine repair workshop. The time needed to repair one component is uniform between 1.1 and 2.6 hours. The time between arrivals is exponential with a mean of 1.5 hours. Assume the first component (1st job) arrives at time o, determine the arrival and departure of the first 3 jobs using the (0, 1) random numbers in column 1 of table 18.1. [4marks]

f) What is the difference between observation based and time-based variables? Give an example in each case to illustrate your explanation. [4marks]

g) A player tosses a coin repeatedly until a head occurs. The associated pay of is 2^n, where n is the number of tosses until a head comes up.

i) Derive the sampling procedure of the game. [2marks]

ii) Use the random numbers in column 1 of table 18.1 to determine the cumulative pay off after two heads occur. [2marks]

QUESTION 2 (20 MARKS)

a) The demand for an expensive spare part of a passenger jet is 0, 1, 2, or 3 units per week with pro 0.5, 0.2, 0.4 and 0.35 respectively. The airline maintenance department starts operation with a stock of 5 units and will bring the stock level back to 5 units immediately it drops below 3 units.

- Derive the procedures for determining the demand samples.

[5marks]

- How many weeks will elapse until the third replenishment occurs?

[5marks]

For this question, use random numbers in column 2 table 18.1.

b) Show how a random sample can be obtained from the following geometric distribution.

$f_1x) = p(1+p)^\wedge, x=0;1.2,\ldots\ldots$

The parameter *x* is the number of (Bernoulli) failures until a success occurs and *p* is the probability of success, $0<p<1$. [6marks]

Generate two samples for $p=0.6$ using random numbers in column 2 of table 18.1.

[4marks]

QUESTION 3 (20 MARKS)

a) Show how random sample can be obtained from the Weilbull distribution whose pdf if defined as $f(x) = \alpha\beta^{-\alpha}x^{\alpha-1}e^{(x/\beta)^{\alpha}}, x > 0$

Where $\alpha > 0$ is the shape parameter and $\beta > o$ is the scale parameter. [10marks]

b) Consider a probability distribution that consists of a rectangle franked on the left and on the right sides by the two symmetrical right triangles. The respective ranges for the triangle on the left the rectangle and the triangle on the right are [a,b] [b,c] and [c,d] a<b<c<d. Each triangle has the same height as the rectangle.

i) Develop a sampling procedure. [6marks]

ii) Determine 2 samples with (a,b,c,d) = (1,2,4,6) using the random numbers in columns 3 table 18.1. [2marks]

QUESTION 4 (20 MARKS)

a) The following table represents the variation in number of waiting customers in a queue as a function of the simulation time.

Simulation tin T (Hours)	**No. of Waiting customers**
$0 < T \leq 3$	0
$3 < T \leq 4$	1
$4 < T \leq 6$	2
$6 < T \leq 7$	1
$7 < T \leq 10$	0
$10 < T \leq 12$	2
$12 < T \leq 18$	3
$18 < T \leq 20$	2
$20 < T \leq 25$	1

Compute the following measures of performance

i) The average length of the queue. [5marks]

ii) The average waiting time in the queue for those who must wait. [5marks]
(Add illustration diagrams)

b) The interarrival time for customers at Hair Care is described by the following distribution: $f_1(t)=k_1/t$. $12 \leq t < 20$.

The time to get a haircut is represented by the following distribution:
$f_2(t)=k_2/t^2$, $18 \leq t \leq 22$.

The constants k_1 and k_2 are determined such that $f_1(t)$ and $f_2(t)$ are prob. density functions. Use the acceptance –rejection method to determine when the first customer will leave Hair Care and when the next customer will arrive. Assume the first customer arrive at T=o [10marks]

QUESTION 5 (20 MARKS)

The ACT score for the 1994 senior class Springdale High are normal, with a mean of 27 points and a standard deviation of 3 points. Suppose that we draw a random sample of six seniors from the class, use the Box-Muller method to determine the mean and standard deviation of the sample. [10marks]

Cars arrive at a one-bay car wash facility where the inter arrival time is exponential with a mean arrival of 0.10 per minute. Arriving cars line up in a single lane that can accommodate at most five waiting cars. If the lane is full, newly arriving cars will go elsewhere. It takes between 10 and 15 minutes, uniformly distributed, to wash a car. Stimulate the system for 60 minutes and estimate the time a car spends in the facility.

[10marks]