KIMATHI UNIVERSITY COLLEGE OF TECHNOLOGY

University Examination 2011/2012

**FOURTH YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY
AND
THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

ICS 2307: SIMULATION AND MODELLING

DATE: 10TH AUGUST 2011   **TIME: 2.00 PM – 4.00 PM**

Instruction: Answer Question ONE and any other TWO

QUESTION ONE (30 MARKS)

a). What is simulation?   **(2 Marks)**

b). Explain the difference between pseudo random numbers and random numbers.

(2 Marks)

c). List five desirable properties of a good random number generation.   **(5 Marks)**

d). State any six reasons that justify the need for using simulation   **(6 Marks)**

e). Use an inversion method to develop a function for generating random variates based on an exponential distribution given that any generated random variate is a (0,1) random number.   **(4 Marks)**

f). Why would an analyst ever prefer a general purpose language such as BASIC in simulation when there are advantages of using special purpose languages such as GPSS, SIMSCRIPT, XCELL or SLAM?   **(6 Marks)**

g). Explain why random sampling procedures are useful in simulation   **(5 Marks)**

QUESTION TWO (20 MARKS)

a). Explain the distinction fixed time state simulation model and next event model.

(2 Marks)

b). Which of the models in (a) above will you prefer for simulating the following:
   i).   Crime rate in a city   **(2 Marks)**
   ii).   Number of customers in a queue at a supermarket   **(2 marks)**
   iii).   Birth and death at a national hospital   **(2 Marks)**

   Give reasons in each case

c). A wholesaler stocks an item for which demand is uncertain. He wishes to assess two re-ordering policies i.e. order 10 units at a re-order level of 10 or order 15 units at a re-order level of 15 units to see which is most economical over a 10 day period.

The following information is available

Demand per day (units)	Probability
4	0.10
5	0.15
6	0.25
7	0.30
8	0.20

Carrying costs £15 per unit per day. Ordering costs £50 per order. Loss of good will for each unit out of stock £30. Lead time 3 days. Opening stock 17 units. The probability distribution is to be based on the following random numbers

20	07	95	05	79	95	64	26	06	48
41	92	05	44	66	07	00	00	14	62

Simulate the behaviour of the two ordering policies to establish the cheaper policy.

(20 marks)

QUESTION THREE (20 MARKS)

a). Explain Monte Carlo simulation. **(6 Marks)**

b). What are the advantages of using a special purpose language in simulation instead of a general purpose language? **(4 Marks)**

c). A dentist schedules all her patients for 30 minutes appointments. Some of the patients take more or less than 30 minutes depending on the type of dental work to be done. The following summary shows the various categories of work, their probabilities and the time actually needed to complete the work.

Category	Time required	Probability of category
Filling	45 minutes	0.40
Crown	60 minutes	0.15
Cleaning	15 minutes	0.15
Extraction	45 minutes	0.10
Check up	15 minutes	0.20

Simulate the dentist clinic for four hours and determine the average weight in time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrival time starting at 8am. Use the random numbers 40, 82, 11, 34, 25, 66, 17, 79. **(10 Marks)**

QUESTION FOUR (20 MARKS)

a). Given a multiplicative congruential pseudo- random number generator

Random (N+1) =11*Random (N) [Modulo] 128

And that Random (1) =1234

Generate Random (2) up to Random (5) **(4 Marks)**

b). The random numbers below were generated from a given generation. Using run test, test the hypothesis;

H_0: random

H_a: Not random

0.3	0.7	0.6	0.1	0.7	0.6	0.1
0.3	0.8	0.9	0.94	0.1	0.2	0.3
0.4	0.5	0.7	0.3	0.1	0.2	0.8
0.3	0.2	0.1	0.5	0.4	0.3	0.1
0.4	0.7	0.6	0.3	0.2	0.8	0.2
0.3	0.4	0.5	0.7	0.1	0.9	0.7
0.2	0.1	0.3	0.4	0.7	0.6	0.1

(6 Marks)

c). Briefly describe three measures of performance of a single server queuing model.

(6 Marks)

d). Explain the meaning of the following terms
- i). Input variables **(1 Mark)**
- ii). Status variables **(1 Mark)**
- iii). Output variables **(1 Mark)**
- iv). Parameters **(1 Mark)**

QUESTION FIVE (20 MARKS)

a). State and explain briefly the steps involved in a computer simulation experiment

(12 Marks)

b). Use a congruential multiplicative random number generator with $a = 5$, $m = 113$ and seed 7947 to generate the first five variates on the $(0,1)$ interval. (5 Marks)

c). Generate a random variate from the p.d.f $f(x) = \begin{cases} 3x^2 & 0 < x < 1 \\ 0 & \text{elsewhere} \end{cases}$ (3 Marks)