TECHNICAL UNIVERSITY OF MOMBASA

INSTITUTE OF COMPUTING AND INFORMATICS

UNIVERSITY EXAMINATION FOR:

Bachelor of Technology in Applied Physics/Bachelor of Technology Renewable Environmental Resources/Bachelor of Technology in Information Communication Technology

EIT 4312/EIT 4416: **SIMULATION AND MODELING**

END OF SEMESTER EXAMINATION

SERIES: APRIL 2016

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attemptquestion ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question One

a) List at least two disadvantages of the following methods in getting information on reality (6 Marks)

   i) Experiment

   ii) Analytical

   iii) Simulation

b) Explain the steps involved in a simulation study. [10 Marks]

c) Explain the following terms: (4 Marks)

   i) Model

   ii) Simulation

d) List and briefly explain five properties desired of a random number generator [5 Marks]

e) Generate three random numbers based on the multiplicative, congruental method using b=9, c=5, and m=12. The seed is u_0 = 11 (5 marks)

Question Two

a) Differentiate between:

i) Physical and mathematical models

ii) Static and dynamic models [6 marks]

b) 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 reorder level of 10, or order 15 units at a reorder level of 15units , 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 at ksh 15 per unit per day.

Ordering costs ksh 50 per order.

Loss of good- will for

- Each Unit out of stock ksh 30.
- Lead time 3 days.
- Opening stock 17 units.
- The probability distribution is to be based on the following random numbers

  41 92 05 44 66 07 00 00 14 62

  20 07 95 05 79 95 64 26 06 48

Note: the reorder level is physical stock plus any replenishment orders outstanding.

REQUIRED:

To simulate the behavior of two ordering policies-order 15 at reorder level of 15 and order 10 at Reorder level of 10- to establish the cheaper policy. [14 Marks]

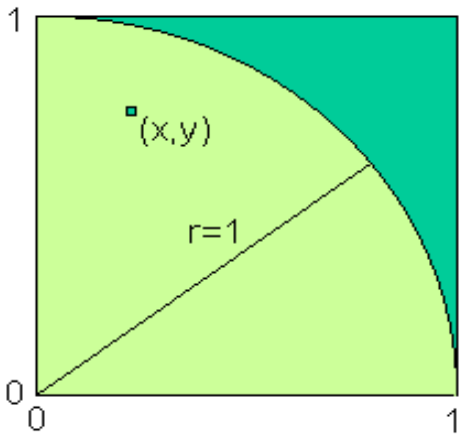
Question Three

a) State three characteristics of Monte Carlo simulation (3Marks)

b) State the law of large numbers (2 Marks)

c) Differentiate between analogue and continuous types of simulations. (5 Marks)

d) Use the quadrant below to explain the estimation of π (Pi).



(10 marks)

Question Four

a) List five examples when simulation is the appropriate tool and when it is not [10 marks]

b) A baker bakes 30 dozens of bread loafs each day. Probability distribution of customers is in table 1. Customers order 1, 2, 3 or 4 dozens of bread loafs according to the following distribution given in table 2. Assume that on each day all the customer's order same dozens of bread loafs. The selling price is 5.4/dozen and making cost is 3.8/dozen. The left over bread loafs will be sold for half price at the end of each day. Based on 5 days simulation, calculate the profit of the baker. Instead of 30 dozens, if 40 dozens are baked per day will it be more profitable

Table 1: Probability distribution of customers

Number of customers/day				8	10	12	14
Probability	0.35	0.30	0.25	0.10			

Table 2: probability distribution of dozens ordered

Number of dozens/customers	1	2	3	4
probability	0.40	0.30	0.20	0.10

Random number digits for customers: 50,61,73,24,96

Random number digits for dozens: 5,3,7,0.8 [10 Marks]

Question Five

Faida bank is in the process of divesting a loan policy that involves a maximum of $12 million. The following table provides the pertinent data about available types of loan.

Type of loan	Interest rate	Bad-debt ratio
Personal	.140	.10
Car	.130	.07
Home	.120	.03
Farm	.125	.05
Commercial	.100	.02

Bad debts are unrecoverable and produce no interest revenue.

Competition with other financial institutions require that the bank allocate at least 40% of the funds to farm and commercial loans. T assist the housing industry in the region, home loans must equal at least 50% of the personal, car, and home loans. The bank also has a stated policy of not allowing the overall ratio of bad debts on all loans to exceed 4%.

Required: - Device an optimal model for the bank **(20 marks)**

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Question One

a) Define is simulation (2 marks)

b) Distinguish between solution derived from simulation models and solutions derived from analytical models [4 Marks]

c) Explain three approaches used to describe discrete event simulation (9 Marks)

d) Explain why Monte Carlo simulation is considered a special case of stochastic simulation [5 Marks].

e) Explain three methods used to get information on objective reality (6 Marks)

f) Describe the discrete and continuous simulation language with one daily life example.[4 Marks]

Question Two

In preparation for the rain season, a clothing company is manufacturing sweaters, overcoats, Caps, and gloves. All products are manufactured in four different departments: Cutting, Insulating, Sewing and packaging. The Company has received firm orders for its products. The contract stipulates a penalty for undelivered items. The following table provides the pertinent data of the situation.

	Time per Units (hrs)				
Department	Sweaters	Overcoats	Caps	Gloves	Capacity (hrs)
Cutting	.30	.30	.25	.15	1000
Insulating	.25	.35	.30	.10	1000
Sewing	.45	.50	.40	.22	1000
Packaging	.15	.15	.1	.05	1000
Demand	800	750	600	500	
Unit profit	$30	$40	$20	$10	
Unit Penalty	$15	$20	$10	$8	

Required:

Device a model for the optimal production for the company. (20 marks)

Question Three

a) State the key factors considered when selecting a simulation language [6 Marks]

b) A filling station is being planned and it is required to know how many attendants will be needed to maximize earnings. From traffic studies it has been forecast that customers will arrive in accordance with the following table:

Probability of 0 customer arriving in any minute 0.72

Probability of 1 customer arriving in any minute 0.24

Probability of 2 customer arriving in any minute 0.03

Probability of 3 customer arriving in any minute 0.01

From past experience it has been estimated that service times vary according to the following Table:-

Service time in

Minutes 1 2 3 4 5 6 7 8 9 10 11 12

Probability 0.16 0.13 0.12 0.10 0.09 0.08 0.07 0.06 0.05 0.05 0.05 0.04

If there are more than two customers waiting, in addition to those being serviced, new arrivals Drive on and the sale is lost. A petrol pump attendant is paid ksh20 per 8 hour day, and the average contribution per customer is estimated to be ksh2.

REQUIRED:

Perform a simulation analysis and Calculate the number of attendants are needed and explain why more are required? [14 Marks]

Question Four

a) Simulation techniques have been used to analyze problems of two distinct types: Practical Real life problems and theoretical problems related to basic sciences. Illustrate the statement giving examples of each type. (5 marks)

b) A plant has a large number of similar machines. The machine breakdowns or failures are random and independent. The shift in-charge of the plant collected the data about the various machines breakdown times and the repair time required on hourly basis, and the record for the past 100 observations as shown below was:

Time Between Recorded Machine Breakdown (hours)	Probability	Repair Time Required (hours)	Probability
0.5	0.05	1	0.28
1	0.06	2	0.52
1.5	0.16	3	0.20
2	0.33		
2.5	0.21		
3	0.19		

For each hour that one machine is down due to being or waiting to be repaired, the plant loses Rs. 70 by way of lost production. A repairman is paid at Rs. 20 per hour.

i) Simulate this maintenance system for 15 breakdowns.

ii) Obtain the total maintenance cost.

Use following pairs of random numbers:

(61,87), (85,39),(16,28),(46,97),(88,69),(08,87),(82,52),(56,52),(22,15),(49,85) [15 Marks]

Question Five

Suppose that the equation of a circle is:

$$(x - 3)^2 + (y + 2)^2 = 16$$

Define the corresponding distributions f(x) and f(y), and then show how a sample point (x, y) is determined using the (0, 1) random pair (R_1, R_2) . use the random number table below. (20 marks)

Short list 0f 0 – 1 Random Numbers

.0589	.3529	.5869	.3455	.7900	.6307
.6733	.3646	.1281	.4871	.7698	.2346
.4799	.7676	.2867	.8111	.2871	.4220
.9486	.8931	.8216	.8912	.9534	.6991
.6139	.3919	.8261	.4291	.1394	.9745