# KISII UNIVERSITY
## UNIVERSITY EXAMINATIONS

### FIRST YEAR EXAMINATION FOR THE AWARD OF
### THE DEGREE OF MASTER OF SCIENCE APPLIED STATISTICS
### FIRST SEMESTER 2022/2023
### (JUNE-SEPTEMBER, 2022)

### MATH 880: PROBABILITY AND STOCHASTIC PROCESSES I

**STREAM:  Y1S1**                                    **TIME:   3 HOURS**

**DAY: FRIDAY, 2.00 PM – 5.00 PM**              **DATE:  23/09/2022**

**INSTRUCTIONS:**

1. *Do not write anything on this question paper.*
2. *Answer Question ONE (Compulsory) and Any Other TWO Questions*

**QUESTION ONE-30 MARKS**

a)   Define the terminology below;
   i)   Pure birth process                                    [2 Marks]
   ii)   Stochastic process                                   [2 Marks]
b)   What is the difference between a random and stochastic process.   [2 marks]
c)   List four examples of stochastic models.                          [4 marks]
d)   If the tmp of a Markov chain is

$$\begin{bmatrix} 0 & 1 \\ \frac{1}{4} & \frac{3}{4} \end{bmatrix}$$

   Find the steady state distribution of the chain.                    [6 Marks]
e)   Suppose that the number of snake bites cases seen at Kenyatta National Hospital in a year has a Poisson distribution with average 8 bite cases
   What is the probability that in a year;
   i)   The no. of snake bite cases will be 9?                          [3Maks]

   ii)   The no. of snake bites bite cases will be less than 2?         [3 Marks]

iii) What is the probability that there will be 10 snake bite cases in 2 years?

[3 Marks]

iv) What is the probability that there will be no snake bite cases in a month?

[2 Marks]

f) Sam will read either one chapter of his probability book or one chaper of his history book. If the number of misprints in a chapter of the probability book and history book are posson distributed with mean 4 and 6 respectively, find the expected number of misprints he is likely to come across. [5 Marks]

## QESTION TWO-20 MARKS

a) An engineer analysing a series of digital signals generated by a testing system observes that only 3 out of 10 distorted signals followed a highly distorted signal with no recognizable signal, whereas 20 out of 25 recognizable signals follow recognizable signals with no highly distorted signals. Given that only highly distorted signals are not recognizable. Find the fraction of signals that are highly distorted.

[10 Marks]

b) A training process is considered as two state Markov chain. If it rains, it is considered to be state 0 and if it doesn't rain, it is considered to be in state 1. The tmp of the Markov chain is defined as;

$$\begin{bmatrix} 0.2 & 0.8 \\ 0.6 & 0.4 \end{bmatrix}$$

i) Find the probability that it will rain for three days from today assuming that it is raining. [5 Marks]

ii) Find the unconditional probability that it will rain after 3 days with initial state probability as 0.3 and 0.7 respectively. [5 Marks]

## QUESTION THREE-20 MARKS

a) When is a process said to be $2^{nd}$ order stationery [4 Marks]

b) Differentiate between $1^{st}$ order and $2^{nd}$ order distribution function [6 Marks]

c) Show that a $1^{st}$ order stationery process has a constant mean [10 Marks]

## QUESTION FOUR-20 MARKS

a) When is a random process said to be Markovian? [4 Marks]

b) Give two examples of a Markov process [2 marks]

c) A housewife buys the same cereal in successive weeks. If she buys cereal A, the next week she'll buy cereal B. However if she buys B or C, the next week she is 4 times as likely to buy A as the other cereal. In the long run, how often does she buy the 3 cereals? [14 Marks]

## QUESTION FIVE-20 MARKS

a) Give an example of a Stationery random process and justify your claim [10 Marks]

b) Examine whether Poisson process is stationery [10 Marks]