JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS AND ACTUARIAL SCIENCES
UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OFSCIENCE IN

ACTUARIAL SCIENCE WITH IT

4thYEAR 1stSEMESTER 2022/2023 ACADEMIC YEAR

MAIN REGULAR

COURSE CODE: WAB2413

COURSE TITLE: SURVIVAL ANALYSIS

EXAM VENUE: **STREAM: (BSc. Actuarial Science)**

DATE: 13/12/2022 **EXAM SESSION: 15.00-17.00PM**

TIME: 2.00 HOURS

Instructions:

i. Answer questions one and any other two.
ii. Candidates are advised not to write on the question paper.
iii. Candidates must hand in their answer booklets to the invigilator while in the examination room.

QUESTION ONE (30 marks)

a) State and explain four types of censoring (4 marks)

b) Define the uniform distribution of deaths (2 marks)

c) Given an exponential distribution

$$f(t) = \begin{cases} \lambda\, e^{-\lambda t}, & \lambda > 0, \quad t > 0 \\ 0, & elsewhere \end{cases}$$

i. Find s(t) (5 marks)

ii. Find h(t) (5 marks)

d) Explain any four types of life tables stating the cohort and nature of attrition. (4 marks)

e) Given ${}_tP_x = \frac{100-x-t}{100-x}$ for $0 \leq x \leq 100$ and $0 \leq t \leq 100 - x$

Calculate μ_{45} (5 marks)

f) You are provided with the following extract from a life table,

x	l_x
50	99813
51	97702
52	95046

Calculate ${}_{0.75}P_{50.5}$ (5 marks)

QUESTION TWO (20mks)

A group of 15 laboratory rats are injected with a new drug. They are observed over the next 30 days. The following events occurs.

Day	Event
3	Rat 4 dies from the effect of the drug
4	Rat 13 dies from the effect of the drug
6	Rat 7 dies from the effect of the drug
11	Rat 6 and 9 dies from the effect of the drug
17	Rat 1 is killed by other rats
21	Rat 10 dies from the effect of the drug
24	Rat 8 is freed during raid by animal laboratory activist
25	Rat 12 is accidentally freed by journalists reporting earlier raid
26	Rat 5 dies from the effect of the drug
30	Investigation closes and remaining rats holds a street party

Using the Kaplan Meier method,

a) Estimate s(t) and var(S(t))for the problem. (10 marks)

b) Represent question graphically. (5 marks)

c) Compare and contrast the results using a Nelson Aalen method (5 marks)

QUESTION THREE (20mks)

Consider the following data from two groups x and y

x	3	5	7	9+	18
y	12	19	20	20+	33+

Test the hypothesis H_0: $S_x(t)=S_y(t)$ vs

H_0: $S_x(t)\neq S_y(t)$

QUESTION FOUR (20mks)

a) Show that

$$h(t) = h_0(t)e^{\beta \acute{x}}$$ for a cox proportional hazard model.(8 marks)

b) The following table refers to the survival times (in years) of the patients in a certain chemical trial. An asterisk indicates that the observation was censored. It is assumed that censoring was done at random and that the patients were randomly assigned to the treatment or control arms.

Control arm	3 6^* 7 8^* 8^* 8^* 9 11 13
Treatment arm	4^* 5 8^* 8^* 8^* 8^* 10 12^*14^*

Assuming a proportional hazards model, find the estimate of the log hazard ratio β using the cox proportional hazard methods. (12 marks)

QUESTION FIVE (20mks)

a) Given ${}_tP_x = 1 - \left(\frac{t}{100}\right)^{1.5}$ for x=60 and 0<t<100.

Calculate $E(T(x))$ (10 marks)

b) Given $\mu_{x+t} = \frac{1}{85-t} + \frac{3}{105-t}$ for $0 \leq t < 85$

Calculate ${}_{20}P_x$ (10 marks)