



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

MEDICAL ENGINEERING DEPARTMENT

UNIVERSITY EXAMINATION FOR:

DEGREE

EEE 4503: RELIABILITY ENGINEERING.

END OF SEMESTER EXAMINATION

SERIES: MARCH 2025

TIME: 2 HOURS

DATE:

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt Question 1, Compulsory and any other Two Questions.

Do not write on the question paper.

Question ONE

- a) Briefly explain the following reliability terms
- i. *Redundancy*
 - ii. *Next higher level effect*
 - iii. *Failure mode effect analysis (FMEA)*
 - iv. *Corrective action*

v. *Event tree analysis*

vi. *Function hazard analysis*

[12 MARKS]

b) Using well labeled diagrams explain the following particular life distributions and their relevance in reliability engineering

i. Exponential distribution

ii. Weibull distribution

iii. Lognormal distribution

[9 MARKS]

c) Name and explain the THREE types of reliability modeling

[9 MARKS]

Question TWO

a) Explain using diagrams the generic product life cycle

[6 MARKS]

b) A telemetry transmission system of an earth satellite has an MTBF of 10,000 hours.

Estimate the probability of NO failure during a 1000-90 minutes orbits.

[6 MARKS]

c) Explain the following reliability testing schemes

i. Demonstration testing

ii. Environmental stress screening

[8 MARKS]

Question THREE

a) Name and explain **TWO** Reliability Engineering techniques used in failure identification and correction

[8 MARKS]

b) Briefly explain the following methodologies stating their functions and applicability in reliability Engineering

i. Failure reporting and corrective action system (FRACAS)

ii. In service data analysis

iii. Risk analysis

iv. REMM process

[12 MARKS]

Question FOUR

a) Show that the unreliability of a series system is $Q(s) = 1 - R_s(t)$

[4 MARKS]

b) Describe the two laws of probability relevant to reliability calculations

[6 MARKS]

- c) A computer system consists of 5 identical terminals in series. The required system reliability for unit time ($T=10$) hour is $R(1)=0.9998$. Determine each component's:
- System failure rate
 - System Unreliability
 - System reliability **[6 MARKS]**
- d) One thousand similar equipment which are known to have constant failure rates of 5% per 1000 hrs are put into similar operation at the same time; calculate the predicted times which will elapse before,
- 50 failed in service
 - 500 have failed in service **[4 MARKS]**

Question FIVE

- a) Describe the three categories of failure and for each category describe at least TWO failures **[6 MARKS]**
- b) By making appropriate assumptions show that
- $R(t) = e^{-\lambda t}$
 - $MTBF(MTTR) = \frac{1}{\lambda}$ **[6 MARKS]**
- c) Using a well labeled diagram describe the failure and the survival curves **[4Marks]**
- d) A wear out test gave the results shown in the Table Q5 below:
- Determine the estimated mean wear out life of items
 - Find the lower confidence limit for the true mean wear out life at 95% of confidence

Table Q5

Number of Items	4	3	5	7	5
Life per item(hrs)	900	1100	1200	1300	1600

