TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 2503: RELIABILITY ENGINEERING.

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 HOURS

DATE: Sep 2018

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 differentiate between the following terms as applied in Reliability Engineering.
   - *i. Predictive testing and inspection*
   - *ii. Reactive maintenance*
   - *iii. Proactive maintenance*
   - *iv. Preventive maintenance* [8 MARKS]

b) Distinguish between the TWO laws used as used in reliability Engineering calculations. [3MARKS]

c) Briefly state and explain THREE methodologies for estimating system failure and correctness applied in engineering reliability [9 MARKS].

d) Using a well labeled diagram describe the cause and effect analysis as applied in maintainability of components [6 MARKS]

e) 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,

i. 50 have failed in service

ii. *500 have failed in service* [4 MARKS]

Question TWO

a) Explain the following reliability testing schemes

i. Accelerated life testing

ii. *Reliability enhancement testing* [6 MARKS]

b) Describe the FOUR categories of failure and for each category describe at least TWO failures[4 Marks]

c) By making appropriate assumptions show that [6 Marks]

i. $R(t) = e^{-\lambda t}$

ii. $MTBF(MTTR) = \frac{1}{\lambda}$ [4 Marks]

d) Using a well labeled diagram describe the failure and the survival curves [4 Marks]

Question THREE

a) Using well labeled diagrams describe and appropriate boundary conditions describe the reliability and unreliability curves [6 Marks]

b) A wear out test gave the following results as shown in the Table Q3.

i. Determine the estimated mean wear out life of items

ii. *Find the lower confidence limit for the true mean wear out life at 95% of confidence* [6MARKS]

Table Q3

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

c) Distinguish between quantitative versus qualitative reliability [2 Marks]

d) Using well labled diagram describe the R out of N systems and their particular application in reliability engineering [4 MARKS]

e) Show that the unreliability of a TWO component series system is given by $Q_s = 1 - R_s(t)$ [2 MARKS]

Question FOUR

a) With the aid of a bath tub diagram, describe the three phases of an equipment life cycle and for each of the three phases describe at least TWO ways in which failure occurs and how they can be reduced. [6 marks]

b) Define the following terms with reference to reliability Engineering

i. *Reliability*
ii. *Maintainability*
iii. *Redundancy*
iv. *Availability*
v. *Unavailability*
vi. *Failure modes, effects and criticality analysis(FMECA)* [6 marks]

c) A computer system consists of 10 identical terminals in series. The required system reliability for unit time (T=1) hour is R(1)=0.999. Determine each component's:

i. *Reliability*
ii. *Unreliability*
iii. *Failure rate values* [3 MARKS]

d) Using a well illustrative flow chart describe the REMM process [5 MARKS]

Question FIVE

a) Define the following terms as used in reliability engineering

i. *Tie set*
ii. *Cut set*
iii. *Minimal tie set*
iv. *Minimal cut set* [4 Marks]

b) After 100h equipment has a reliability of 0.75. calculate its overall reliabilities which would be obtained if the equipment were

   i. *Duplicated*

   ii. *Triplicated* [4 Marks]

c) Explain the following reliability techniques

   i. Reliability block diagram

   ii. *Fault tree analysis* [6 MARKS]

d) Draw and explain FOUR main Reliability Block Diagrams (RBD) that are useful in the calculation of the reliability of systems with active non maintained redundancy [6 MARKS]