ELIZADE UNIVERSITY ILARA MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

2019/2020 FIRST SEMESTER EXAMINATION

COURSE TITLE: RELIABILITY AND MAINTAINABILITY OF ELECTRICAL AND ELECTRONIC SYSTEMS

COURSE CODE: EEE 511

EXAMINATION DATE:

COURSE LECTURER: DR K. O. TEMIKOTAN

HOD's Signature

TIME ALLOWED: 2 HOURS

INSTRUCTIONS

1. ANSWER ANY **FOUR** QUESTIONS.
2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING, POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.
3. YOU ARE NOT ALLOWED TO BORROW ANY WRITING MATERIALS, AND CALCULATORS DURING THE EXAMINATION.
4. SMART WATCHES OR SIMILAR DEVICES ARE NOT ALLOWED IN THE EXAMINATION VENUE.

QUESTION ONE

According to the Jelinski-Moranda Growth Model, the program failure rate at the ith failure interval is given by,

$$\lambda(t_i) = \phi[N - (i - 1)], i = 1, 2, ..., N`$$

a) State five assumptions about the fault detection and correction processes made by the proponents of this model?

   5 marks

b) Find the Mean Time Between Failure (MTBF) at time t for the model. 2 marks

c) Derive the reliability function R(t) of the model. 4 marks

d) Sixty (60) errors are estimated to be present in a program. Given that $\phi = 0.02$, compute the failure intensity after (i) 30 errors (ii) after 40 errors. 4 marks

QUESTION TWO

a) Explain briefly five (5) approaches to reducing equipment failure. 5 marks

b) Write a mathematical expression for Arrhenius' Law and describe each of the parameters involved. 3 marks

c) State the expression for (i) constant voltage and (ii) constant temperature 2 marks

d) In a test to determine failure rate, the following conditions were recorded;

   Failure rate for V and T

   Failure rate for V and 2T

   Failure rate for 0.5 V and T

If the failure rates for these three conditions are 0.025, 0.1000, and 0.00125, respectively, and the rated temperature T is 30 C, calculate the probable failure rate at one-third rated voltage V and two-third rated temperature T. 5 marks

QUESTION THREE

a) Compare some of the key characteristics of ISO9126and the Software Engineering Institute Capability Maturity Model (SEI-CMM).   5 marks

b) Why is it necessary to conduct an analysis of the cost of software quality?   2 marks

c) State four components of the cost of quality?   4 marks

d) Using a flow chart, describe the software engineering process   4 marks

QUESTION FOUR

a) For the reliability block diagram shown in Figure Q 4, draw (i) an equivalent minimal-tie diagram and (ii) an equivalent minimal-cut diagram.
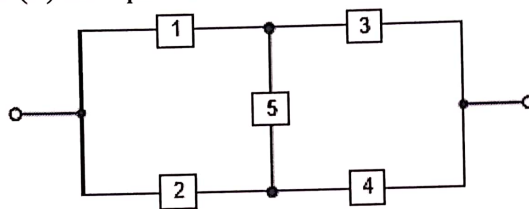

4 marks

Figure Q 4

b) If a device has a failure rate of

$$\lambda(t) = (0.015 + 0.02t)per\ year, where\ t\ is\ in\ years$$

i. Calculate the reliability for a five-year design life, assuming that annual preventive maintenance is performed.   6 marks

ii. Calculate the reliability for a five-year design life, assuming that annual preventive maintenance restores the device to an as good as new condition

5 marks

QUESTION FIVE

a) State and briefly explain five causes of outages on the power distribution system in Nigeria? 5 marks

b) How can reliability improvements be achieved in the distribution system?   5 marks

c) Figure Q5 shows a 4 km long distribution express feeder that is used to provide electric energy to Akure Industrial Park from Akure Sub-transmission Station. Approximately 1 km of the feeder has been built underground due to aesthetic considerations while the rest of the feeder is overhead. The underground feeder has two termination points. On the average, two faults per circuit-kilometre for the overhead section and one fault per

circuit- kilometre for the underground section of the feeder have been recorded in the last 10 years. The annual cable termination fault rate is given as 0.3% per cable termination. Furthermore, based on past experience, it is known that, on the average, the repair times for the overhead section, underground section, and each cable termination are 3, 28, and 3 h, respectively. Using the given information, determine the following:

   i.   Total annual fault rate of the feeder

   ii.   Average annual fault restoration time of the feeder in hours

   iii. Unavailability of the feeder

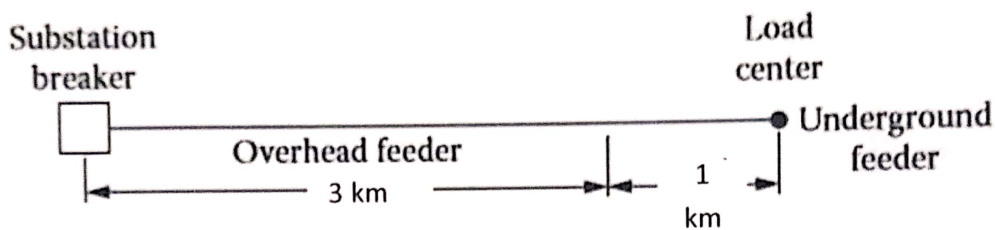   iv.   Availability of the feeder   5 marks

Figure Q 5: A 4 km long distribution Industrial Park feeder

QUESTION SIX

a) State six (6) challenges affecting the performance of quality of service in communication system?   (6 marks)

b) State and five (5) ways to improve the quality of service in communication systems. (5 marks)

c) Ten (10) routers were tested for 1000 hours and 3 failures occurred during this time. Estimate (i) the failure rate and (ii) the MTTF of the routers.(2 marks)

d) What will be the result if 20 routers were used for the test?(2 marks)