ELIZADE UNIVERSITY ILARA MOKIN, ONDO STATE

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FIRST SEMESTER EXAMINATION, 2017/2018 ACADEMIC SESSION

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 DURING THE EXAMINATION.

Question 1

(a) What are the assumptions upon which the Jelinski – Moranda reliability growth model was based? **(5 marks)**

(b)   Explain the parameters of the model;

$\lambda(t) = Q(N - i + 1)$ **(2 marks)**

(c)   The estimated number of errors in a programme is 50. Using this model, calculate the failure intensity after experiencing 30 errors, given that $\varphi = 0.03$. What will be the failure intensity after experiencing 40 errors? **(7 marks)**

Comment on the results. **(1 mark)**

Question 2

A critical communication relay has a constant failure rate of 0.2 per day. Once it has failed, the mean time to repair is 2.5 days. Assuming a constant repair rate;

(a)   what are (i) the point availability at the end of two days;

(ii) the interval availability over a 2-day mission, starting from zero; and

(iii) the steady – state availability? **(6 marks)**

(b)   If two communication relays operate in series, compute the availability at the end of two days. **(3 marks)**

(c)   If they operate in parallel, compute the steady state availability of the system. **(3 marks)**

(d)   If one communication relay operates in a standby mode with no failure in standby, what is the steady-state availability? **(3 marks)**

Question 3

(a) A system has **n** subsystem with equal reliabilities connected in series, what is the system reliability R_s? **(2 marks)**

(b) What will be the system reliability if the **n** subsystems are connected in redundant configuration?   **(3 marks)**

(c) The reliability block diagram (RBD) of a system is shown below. The reliabilities of all the subsystems A, B, C, D, E, F, G and H are equal to 0.9. Determine the system reliability R_s. **(10 marks)**
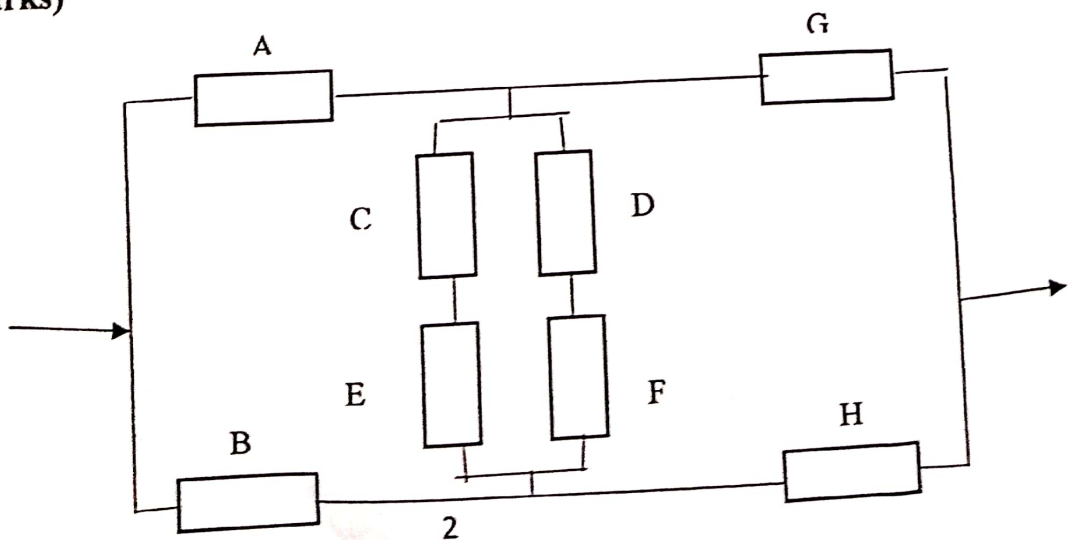
Question 4

(a) Define the following terms
  (i) maintainability;
  (ii) availability; and
  (iii) reparability. **(3 marks)**
(b) What factors are considered when taking a decision on maintenance policy? **(7 marks)**
(c) Explain briefly the relationship between reliability and cost. **(5 marks)**

Question 5

(a) An electronic circuit consists of 5 silicon transistors, 6 silicon diodes, 7 resistors, and 7 ceramic capacitors connected in series configuration. The hourly failure rate of each component is given below;

Silicon transistor $\lambda_t = 2 \times 10^{-5}$
Silicon diode $\lambda_d = 3 \times 10^{-5}$
Resistor $\lambda_r = 4 \times 10^{-5}$
Ceramic capacitor $\lambda_c = 5 \times 10^{-5}$

Assuming an exponential distribution, calculate the reliability of the circuit for 10 hours. **(5 marks)**

(b) The density function f (t) of the time to failure of an electrical appliance is given by

$$f(t) = \frac{32}{(t+3)^3} \quad t > 0 \text{ is in years}$$

Find (i) the reliability function R (t);
  (ii) the failure rate λ(t); and
  (iii) the mean time to failure. **(10 marks)**

Question 6

(a) The distribution system is said to contribute over 90% of all outages in the electric power system. What reasons have been given for this? **(5 marks)**
(b) Suggest ways to improve the availability of typical Nigerian power distribution network. **(5 marks)**
(c) List five reliability indices associated with the power distribution system and explain each one. **(5 marks)**