



TECHNICAL UNIVERSITY OF MOMBASA

School of Engineering and Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION 2024/2025

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 4503 RELIABILITY ENGINEERING

END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

DATE: April 2025

Instructions to Candidates

You should have the following for this examination

Answer Booklet, examination pass and student ID

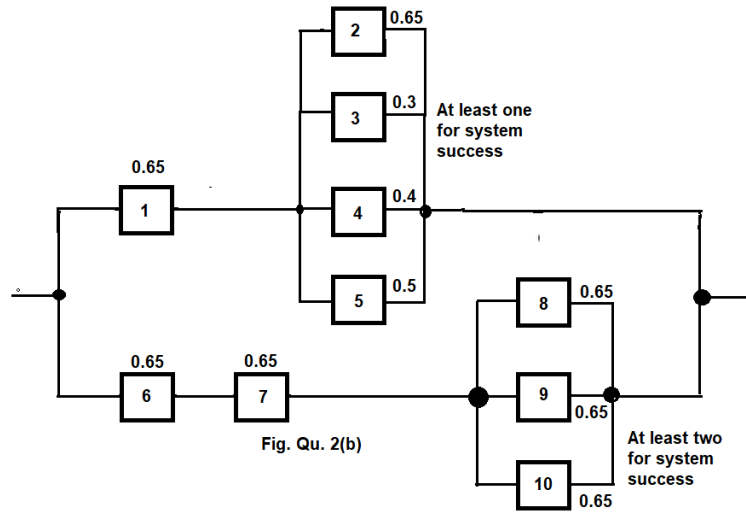
Answer Question ONE and any other TWO questions

Question ONE

- (a) Distinguish between qualitative and quantitative reliability (2 marks)
- (b) Describe using relevant examples how the following factor contribute in the achievement of high reliability in designed systems:
 - (i) Safety
 - (ii) Quality related lawsuits
 - (iii) Public pressure(9 marks)
- (c) (i) 3000 identical equipment with a constant failure rate of 1.5% per 1000 hrs are put into operation at the same time. Calculate the predicted times which will elapse before 2000 equipment have failed in service.
(ii) Convert the failure rate in c(i) into faults per 10^9 hrs. (6 marks)
- (d) Highlight how data collected from reliability studies can be used. (3 marks)

Question TWO

- (a) (i) Define the term reliability centred maintenance (RCM).
(ii) Explain any THREE goals of RCM (5 marks)
- (b) Consider Fig. Qu. 2(b).
 - (i) Determine the expression for system reliability in terms of R values given.
 - (ii) Evaluate the system reliability (15 marks)



Question THREE

- (a) Describe guideline steps that can be used to develop an effective preventive maintenance program. (6 marks)
- (b)
 - (i) Define the fault modes effects analysis (FMEA) tool
 - (ii) Using the concept of FMEA develop a troubleshooting guide to help a student troubleshoot a non-functioning project. (8 marks)
- (c) Explain THREE reasons why records are important in maintenance work. (3 marks)
- (d) The probability of a power failure in a period of one year at a particular location is 6%. Determine the probability of experiencing:

(i) No failure	(ii) At least one failure during a 10 year period.	
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 (3 marks)

Question FOUR

- (a) Distinguish between MTTF & MTBF (2 marks)
- (b) Explain how each of the following tools can be used to improve equipment reliability:

(i) Failure analysis	(ii) Failure rate	(ii) Derating
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 (6 marks)
- (c) A large generator system is designed for continuous operation and fails 10 times in a period of 5yrs. Total time for repairs during this time period is 50 days. Determine in days:
 - (i) The mean-time-to-repair
 - (ii) Mean-time-between-failure
 - (iii) Unavailability of the plant due to breakdown (6 marks)
- (d) Describe the failure mode mechanisms associated with the following environmental conditions:

(i) Temperature	(ii) Humidity	(iii) Vibrations
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 (6 marks)

Question FIVE

- (a) With the aid of a relevant sketch, explain the relationship between total life costs and reliability. (4 marks)

- (b) (i) By making appropriate assumptions show that

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

- (ii) $MTBF = \frac{1}{\lambda}$ or $MTTF = \frac{1}{\lambda}$ (12 marks)

- c) An instrumentation circuit on-board a ship ($K_E = 10$) uses 10 transistors, 20 capacitors and 10 resistors. The failure rates for each of the components are: $0.08 \times 10^{-6}/hr$ for transistors, : $0.1 \times 10^{-5}/hr$ for capacitors and : $0.03 \times 10^{-6}/hr$ for resistors. Determine: (i) MTBF of the circuit (ii) Circuit reliability for 1000 hrs. (4 marks)