



MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

**FIFTH YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING**

EEE 543: RELIABILITY ENGINEERING

DATE: 13/12/2017

TIME: 8.30-10.30 AM

INSTRUCTIONS:

Answer Question one and any other two

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Define the following terms and abbreviations as used in reliability (5 marks)
 - i. Failure
 - ii. Failure Rate.
 - iii. MTBF
 - iv. Risk
 - v. Hazard
- b) For an item with a constant failure rate of one occurrence per operating year and a required time of operation of six month, determine the reliability of the item (4 marks)
- c) For 10 non-repaired items with a constant failure rate, the observed total operating time to failures of all the items is 2 years. Determine the failure rate. (4 marks)
- d) Explain four objectives of maintainability (8 marks)
- e) Failure of an item is caused by two different failure mechanisms A and B. The time-to-failure distribution of the item due to failure mechanism A can be represented by

exponential distribution with parameter $\lambda_A = 0.003$ hours. The time-to-failure distribution of the item due to failure mechanism B can be represented by exponential distribution with parameter $\lambda_B = 0.004$ hours. Find the probability that the item will fail before 500 hours of operation. (9 marks)

QUESTION TWO (20 MARKS)

- a) Discuss what reliability is and the concept of reliability engineering? (5 marks)
- b) Identify and explain four objectives of reliability engineering? (8 marks)
- c) Time to failure distribution of a gas turbine system can be represented using Weibull distribution with scale parameter $h = 1000$ hours and shape parameter $b = 1.7$. Find the hazard rate of the gas turbine at time $t = 800$ hours and $t = 1200$ hours. (7 marks)

QUESTION THREE (20 MARKS)

- a) Discuss the main reasons why failure occurs (7 marks)
- b) Explain any six repercussions of poor reliability (6 marks)
- c) A system has two items A and B connected in series. The time-to-failure of item A follows exponential distribution with parameter $\lambda = 0.002$. The time to-failure of item B follows Weibull distribution with parameter $h = 760$ and $b = 1.7$. Find the hazard rate of this system at time $t = 100$ and $t = 500$. (7 marks)

QUESTION FOUR (20 MARKS)

- a) Draw and describe the life cycle of a system (10 marks)
- b) Explain the concept of failure (3 marks)
- c) Explain the Hazard function (3 marks)
- d) Discuss the Poisson Distribution (4 marks)

QUESTION FIVE (20 MARKS)

Explain the following terms:

- a) Mean Time To Failure (MTTF) (3 marks)
- b) System redundancy (3 marks)
- c) Maintenance and Maintainability (4 marks)
- d) Maintenance Elapsed-Time (3 marks)
- e) Factors to consider when designing for reliability: (7 marks)