



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017**

COURSE NAME : INDUSTRIAL RELIABILITY
COURSE CODE : BWB 32003
PROGRAMME CODE : BWQ
EXAMINATION DATE : JUNE 2017
DURATION : 3 HOURS
INSTRUCTION : ANSWER ALL QUESTIONS

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THIS EXAMINATION PAPER CONSISTS OF **THREE (3)** PAGES

- Q1** (a) Explain the reasons how the failure time of an item on test is not recorded. Relate it with different types of data censoring. (8 marks)
- (b) Determine the purposes of reliability engineering. (2 marks)
- (c) Interpret **ONE (1)** similarity and **FOUR (4)** differences between Type I and Type II Censoring (10 marks)
- Q2** Based on the given lifetime functions, define their meaning. Then, compare the properties of the lifetime functions.
- (a) Reliability function, $R(t)$ and cumulative distribution function, $F(t)$. (12 marks)
- (b) Failure time density function, $f(t)$ and hazard function $h(t)$. (10 marks)
- Q3** Given an item is exponentially distributed with mean time to failure is 2000 hours.
- (a) Calculate the probability that it will fail between 500 hours and 800 hours of functioning. Given that it still functioning at 500 hours. (5 marks)
- (b) From your answer in (a), prove that the exponential distribution has memoryless property. (7 marks)
- Q4** Twenty five independent exponential electronic components, each with exponential times to failure, were placed on test at the beginning of observation. Then, the observation was stop at 10th failure. The recorded failure times are given in **Table Q4**.

Table Q4

142	165	188	188	295	605	630	720	720	720
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- (a) Calculate the point estimate of the failure rate for the component. (6 marks)
- (b) From your answer in Q4(a), construct 95% confidence interval for the failure rate. (10 marks)

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- (c) Assume that the underline distribution for the electronic component is unknown, suggest an appropriate estimation method for the survivor function. Justify your answer.

(3 marks)

Q5 Failure time data from a product that has lifetime function independent and identically distributed as exponential distribution. For Type II censoring case, answer the following questions.

- (a) Compute the likelihood function for Type I censoring case.

(7 marks)

- (b) Compute the likelihood function for Type II censoring case.

(7 marks)

Q6 (a) Repair time, $R(t)$ is being modelled as a single random variable. However, it can be partitioned into different components. State **FIVE (5)** components of the repair time of an item.

(5 marks)

- (b) A system that has failure and repair sequence is modelled by an alternating renewal process. The time to failure being exponentially distributed with a mean of 500 hours and the repair time being exponentially distributed with a mean of 20 hours. Compute:

- (i) the limiting availability.
(ii) the limiting unavailability.

(8 marks)

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- END OF QUESTIONS -