MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIFTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (MECHANICAL ENGINEERING)

EMM 500: SYSTEM RELIABILITY AND PLANT MAINTENANCE

DATE: 16/8/2021 **TIME: 2.00-4.00 PM**

INSTRUCTIONS

Answer question ONE and any other two questions.

QUESTION ONE (30 MARKS) (COMPULSORY)

a) Explain the following terms

i. Margin of safety (2 marks)

ii. De-rating (2 marks)

iii. Redundancy (2 marks)

b) Describe four strategies Maintenance Engineer uses in optimizing maintenance (8 marks)

c) Describe three methods used in monitoring equipment condition in the industry (6 marks)

d) A system is as shown in figure 1,

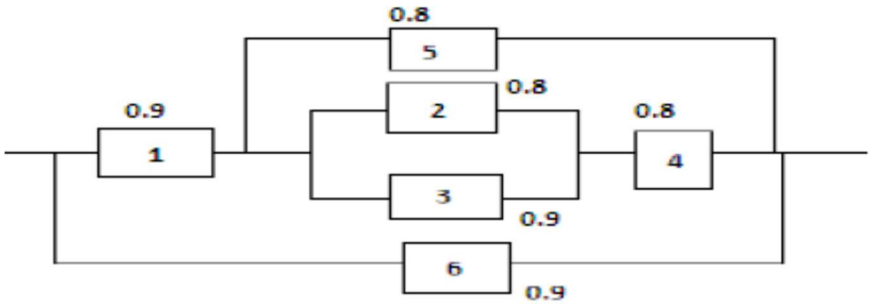

Fig 1; Set up of the system

Determine the reliability of this system (10 marks)

QUESTION TWO (20 MARKS)

a) Equipment survival distribution is shown using a Bathtub curve. Sketch and explain the curve (6 marks)

b) Explain the following terms

i. Magnified loading (3 marks)

ii. Sudden death (3 marks)

iii. Sequential testing (3 marks)

c) Two components with constant failure rates of 0.003 make up a standby redundant system. The device that transfers operation to the second component after failure of the first component has a constant failure rate of 0.0005. Determine the system reliability at time = 400 (5 marks)

QUESTION THREE (20 MARKS)

a) Explain three types of redundancy (6 marks)

b) Describe the following terms

i. Logistic time (3 marks)

ii. Active repair time (3 marks)

iii. Administrative time (3 marks)

c) Two cables support the load of a crane. The failure rate of each of the cables is constant at 0.0007 if both cables are operating properly. The failure rate increases to 0.006 after one cable fails. Determine the reliability at time = 200. (5 marks)

QUESTION FOUR (20 MARKS)

a) Explain three maintainability factors considered when designing systems (6 marks)

b) Explain any four steps in Failure Mode and Effects Analysis (4 marks)

c) A system system has three components connected in parallel from a reliability point of view having reliabilities 0.20, 0.40, 0.50, respectively, for a mission of 400 hours.

i. What is the percentage increase in the reliability of the system in each of the following cases? (2.5 marks)

ii. Reliability of the first component is increased by 0.1 and that of the second and third components remains the same. (2.5 marks)

iii. Reliability of the second component is increased by 0.1 and that of the first and third components remains the same. (2.5 marks)

iv. Reliability of the third component is increased by 0.1 and that of the first and second components remains the same. (2.5 marks)

QUESTION FIVE (20 MARKS)

a) A Mechanical Engineer is contracted to design system and installed the new equipment in shop floor. As a mechanical Engineering student, explain five design factors required if the machines are to be maintenance with ease (5 marks)

b) Explain five causes of depreciation in the equipment (5 marks)

c) A lathe is purchased for Kshs.160,000/= and the assumed life is 10 years, and scrap value is Kshs.40,000/=. If the depreciation is charged by Diminishing Balance Method, calculate the percentage by which value of the lathe is reducing every year, and depreciation fund after 2 years. (10 marks)