MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ……

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

…… YEAR **……..** SEMESTER EXAMINATION FOR BACHELOR OF ……

EET 411 – SYSTEM RELIABILITY & MAINTENANCE

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a. Reliability can be understood differently depending on different contexts. Describe the term reliability in the context of:
   i. Equipment health (1.5marks)
   ii. Production (1.5marks)
   iii. Measurement, inspection and quality control. (2marks)

b. Define the concept of probability of failure. (1mark)

c. The cumulative operating time is found to be 50hours in a system consisting of 100 components each having mean time between failures (MTBF) of 5000 hours. Find the reliability of the system. (5marks)

d. The probability of functioning of each elements in a series system of four components is given as $R_1 = 0.6$ $R_2 = 0.7$, $R_3 = 0.8$, $R_4 = 0.9$. Find the overall reliability of the system. What will be the change in the system reliability if the reliability of the third component is
   i. Increased to 0.9 (7marks)
   ii. Decreased to 0.1

e. Consider a system with combined system as shown. Find the overall reliability of the total system. (6marks)

f. An old electronic system consists of five vacuum tubes whose MTBF is 10,000 hours. When the system is filled with 20 lbs., the MTBF increased to 80,000 hours. Find the effects of the Ks on reliability of the system. If the transistors are used instead of lbs we require 40 transistors.
   Evaluate if the transistors can be used. (7marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a. What are the causes of equipment failures? (4marks)

b. State the objectives of applying maintainability engineering. What are the results that will be expected when maintainability engineering principles have been applied effectively to any product? (6marks)

c. List the methods used to improve equipment maintainability. (5marks)

d. Briefly discuss any five important design characteristics of maintainability. (5marks)

QUESTION THREE (20 MARKS)

a. By aid of an illustration, explain how the minimum cost of producing an item can be arrived by comparing reliability and maintenance cost. (4marks)
b. Explain what you understand by failure mode and effect analysis (FMEA). Stat the major steps used in performing FMEA.Where is FMEA used and state its advantages. (8marks)
c. Discuss the relationship between product reliability and maintainability and state how they are related to MTTR and MTBF. (8marks)

QUESTION FOUR (20 MARKS)

a. Five presses of certain workshop are planned in three shifts per day. Any machine kept idle during lunch hour (1hr) and in tea breaks (15min) x two times per shift). The machines are found to be under breakdown for 50, 20, 28, 40 and 45 hours respectively in a certain month from the logbooks of Plant Engineering. The production department observes the cycle times of operations are 12, 10, 9, 12 and 10 seconds while these are 10, 10, 8, 9 and 8 from the record books of the Industrial Engineering Department. The quality Department reported that the numbers of defective parts produced by these machines are 150, 220, 125, 140 and 145 respectively. Among the quantities 2000, 1500, 1500, 1800 and 1500 produced. The plant manager has to predict and decide the order of these machines for maintenance.
b. He assumes that the machine is to be taken for maintenance immediately if overall equipment Effectiveness (OEE) fall below 65% and 5 days hence for every increment of 1% above 65%,
   Schedule the machines for maintenance, consider 25 working days in a month. (20marks)