

22/8/13

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B.E. (Full Time) DEGREE END SEMESTER EXAMINATIONS, MAY 2013

INDUSTRIAL ENGINEERING

(Semester VI)

IE9353 RELIABILITY ENGINEERING

(Regulation-R2008)

Duration: 3 hours

Answer ALL questions.

Max. marks =100

(Use of Statistical Tables is permitted)

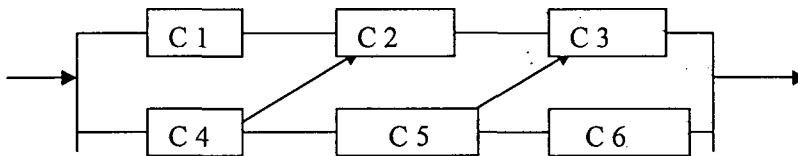
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PART A (10x2=20 marks)

1. Write the probability density function of Weibull distribution and name the parameters of this distribution.
2. Compare the Mean Time Between Failures of a two unit parallel redundant system with that of a two unit standby redundant system.
3. What are the classifications of Singly Censored failure data?
4. A rocket needs two out of its four engines to function so as to achieve orbit. Determine the reliability of achieving the orbit if the reliability of each engine is 0.96.
5. Draw the idealized reliability growth curve.
6. State the methods used for reliability improvement.
7. If MTTR of a component is 15 hours and its MTBF is 33 hours, compute the inherent availability of the component.
8. What are the elements of maintenance downtime?
9. The repair time of a mechanical valve is known to be lognormal with $t_{med}=2.4$ hr and $s=0.41$. If the valve has to be repaired within 3 hours 90 percent of the time, compute MTTR.
10. Define maintainability.

PART B (5x16=80 marks)

11. Determine the reliability of the following linked system using the decomposition method. Take C_4 as the pivot unit.



Compute the system reliability when all the units have a reliability of 0.86.

- 12.A. i) A test was conducted in a fixed population of 105 items over a 7 hour period and the frequency of failure is as given below.

Hours	0-1	1-2	2-3	3-4	4-5	5-6	6-7
Failures	30	25	16	12	7	4	3

Determine the probability of survival and plot the survival curve. (8 marks)

- ii) Write about the significance of useful life phase of a product in reliability studies. (8 marks)

[OR]

12B. Reliability of a pump used in cooling the nuclear reactor is defined by the equation, $R(t) = \{t_0 - t/t_0\}^4$ $0 \leq t \leq t_0$
Compute the failure rate and the MTTF. (8+8 marks)

13.A i) Give the stepwise procedure of constructing the exponential graph paper which can be used to know the MTBF and the Reliability given a set of failure data. (6 marks)

ii) Twenty units were placed on test until 15 failures were recorded. The following failure times in hours were observed. Test whether the data fits exponential with 90% confidence using Bartlett's test.

33.2, 20.5, 3.8, 14.3, 7.7, 79.4, 88.3, 10.6, 54.4, 33.2, 16.9,
47.1, 23.7, 11.0, 62.2. (10 marks)

[OR]

13.B. i) Write a short note on the application of Kolmogorov-Smirnov test. (10 marks)

ii) A large number of identical relays have times to first failure that follow a Weibull distribution with shape parameter=0.5 and characteristic life of 10 years. What is the probability that a relay will survive 1 year, 5 years and 10 years without failure? (6 marks)

14.A i) List out the steps adopted in the construction and the use of Ebel and Lang graphs. (6 marks)

ii) State and explain the various models available for predicting the human reliability. (10 marks)

[OR]

14.B Write short notes on:

i) RCM

ii) Reliability allocation in series system

15.A. Discuss about the development and the application of the replacement model to determine the optimal replacement times for equipment whose operating costs increases with use.

[OR]

15.B. A product in the design stage undergoes reliability growth testing. The test-fix-test-fix cycle consists of 75 hours of monitoring. The numbers of failures per cycle observed are in the order: 22, 18, 11, 7, 5, 3 and 1. Determine the current MTTF and the additional time required to obtain an MTTF goal of 30 hours.