

Enrollment No.....



Faculty of Engineering
End Sem (Odd) Examination Dec-2018
EE3EL08/EX3EL08 Reliability Engineering
Programme: B.Tech. Branch/Specialisation: EE/EX

Duration: 3 Hrs.**Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. Which among the following exhibits inversely proportional relationship with the reliability? 1
- (a) Production cost
(b) Design and development cost
(c) Maintenance and repair cost
(d) All of these
- ii. What is /are the major purpose/s of using a bath tub curve? 1
- (a) To determine the capital maintenance in defense equipments
(b) To compute lifts in the distillation column
(c) To decide the maintenance of equipment
(d) All of these
- iii. How is the reliability of a product specified? 1
- (a) Always less than 1 (b) Always greater than 1
(c) Always equal to 1 (d) None of these
- iv. According to exponential law of reliability, the relationship between the reliability and the system failure due to consistency in occurrence of failure rate, can be generally expressed as _____ 1
- (a) $R = \lambda t$ (b) $R = -\lambda t$ (c) $R = e^{\lambda t}$ (d) $R = e^{-\lambda t}$
- v. Which one of the following relationships is incorrect? 1
- (a) $F(t) = 1 - R(t)$ (b) $R(t) = \exp\left[-\int_0^t \lambda(x) dx\right]$
(c) $f(t) = \frac{-dF(t)}{dt}$ (d) $\lambda(t) = \frac{f(t)}{1 - F(t)}$

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- vi. What is the failure cost of a product possessing reliability $R=1$? **1**
 (a) Zero (b) Unity (c) Infinity (d) None of these
- vii. Which of the following is not considered a reliability design method? **1**
 (a) Monte Carlo (b) Derating
 (c) Accessibility (d) Use of redundancy
- viii. A system composed of two active redundant components each having an availability equal to "A" has an availability equal to: **1**
 (a) A^2 (b) $1-A^2$ (c) $1-(1-A^2)$ (d) $1-(1-A)^2$
- ix. Life tables are used to estimate the reliability of: **1**
 (a) Ungrouped complete data (b) Grouped censored data
 (c) Ungrouped censored data (d) A minimal repair component
- x. What would happen, if equipment possesses reliability and maintainability to the maximum extent in accordance to MTTR? **1**
 (a) Failure rate is higher & downtime is longer
 (b) Failure rate is lower & downtime is longer
 (c) Failure rate is higher & downtime is shorter
 (d) Failure rate is lower & downtime is shorter
- Q.2 i. Define reliability considering adequacy and security. **2**
 ii. State any three reliability indices with it's formula. **3**
 iii. Explain probability distribution function with neat sketch. **5**
 OR iv. Explain discrete random variables and probability distributions **5**
- Q.3 i. Define reliability based hazard function. **2**
 ii. Explain failure law in series system with mathematical treatment. **8**
 OR iii. Explain effect of preventive maintenance on reliability. **8**
- Q.4 i. Explain cut-set method used in reliability evaluation. **3**
 ii. A two component series system contains identical components each having a reliability of 0.99. Evaluate the unreliability of the system. **7**
 OR iii. A system consists of four components in parallel. System success requires that at least three of these components must function. What is the probability of system success if the component

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reliability is 0.9? What is the system reliability if five components are placed in parallel to perform the same function?

- Q.5 i. Differentiate between discrete and continuous Markov process. **4**
 ii. Write a short note on frequency balance approach. **6**
 OR iii. What do you mean by failure frequency? Hence calculate system average interruption frequency index for the following. **6**

Duration (min)	Number of customers	Interruption type
20	200	<i>Sustained</i>
1	400	<i>Momentary</i>
513.5	700	<i>Sustained</i>

- Q.6 Attempt any two:
 i. What is the mean time to failure (MTTF) for the transmission system? **5**
 ii. Find mean time to failure (MTTF) for system which is composed of three elements. Component 1 is in series with the parallel redundant combination of components 2 and 3, which are identical. **5**
 $\lambda_1 = 1$ f/yr, $\lambda_2 = \lambda_3 = 3$ f/yr
 $\mu_1 = 98$ r/yr, $\mu_2 = \mu_3 = 50$ r/yr
 iii. Explain parametric estimation using least square estimates. **5**

Marking Scheme

EE3EL08/EX3EL08 Reliability Engineering

Q.1	i.	Which among the following exhibits inversely proportional relationship with the reliability? (d) All of these	1
	ii.	What is /are the major purpose/s of using a bath tub curve? (c) To decide the maintenance of equipment	1
	iii.	How is the reliability of a product specified? (a) Always less than 1	1
	iv.	According to exponential law of reliability, the relationship between the reliability and the system failure due to consistency in occurrence of failure rate, can be generally expressed as _____ (d) $R = e^{-\lambda t}$	1
	v.	Which one of the following relationships is incorrect? (c) $f(t) = \frac{-dF(t)}{dt}$	1
	vi.	What is the failure cost of a product possessing reliability R=1? (a) Zero	1
	vii.	Which of the following is not considered a reliability design method: (a) Monte Carlo	1
	viii.	A system composed of two active redundant components each having an availability equal to "A" has an availability equal to: (d) $1-(1-A)^2$	1
	ix.	Life tables are used to estimate the reliability of: (b) Grouped censored data	1
	x.	What would happen, if equipment possesses reliability and maintainability to the maximum extent in accordance to MTTR? (d) Failure rate is lower & downtime is shorter	1
Q.2	i.	Reliability	1 mark
		Adequacy and security	1 mark
	ii.	Any three reliability indices with it's formula 1 mark for each	3 (1 mark *3)
	iii.	Probability distribution function Sketch	3 marks 2 marks
OR	iv.	Discrete random variables	2marks

		Probability distributions	3 marks
Q.3	i.	Reliability based hazard function Sketch	1 mark 1 mark
	ii.	Failure law in series system Mathematical treatment.	4 marks 4 marks
OR	iii.	Effect of preventive maintenance on reliability. Derivation	4 marks 4 marks
Q.4	i.	Cut-set method definition Method	1 mark 2 marks
	ii.	Reliability calculation Unreliability calculation	4 marks 3 marks
OR	iii.	Partially redundant system Fully redundant system	4 marks 3 marks
Q.5	i.	Discrete Markov process Continuous Markov process.	2 marks 2 marks
	ii.	Frequency balance approach. Illustration/Example	3 marks 3 marks
OR	iii.	Failure frequency System average interruption frequency index Calculation	5 marks 1 mark
Q.6		Attempt any two:	
	i.	MTTF for the transmission system	5
	ii.	State transition diagram MTTF calculation	2 marks 3 marks
	iii.	Least square estimates. Example	3 marks 2 marks
