Ref. No. : Ex/EE/5/T/513B/2018(S) (OLD)

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) FIFTH YEAR FIRST SEMESTER (OLD) SUPPLEMENTARY EXAM - 2018

RELIABILITY ENGINEERING

Full Marks 100

Time: Three hours (50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART- I	Marks
	Answer any *TWO* questions	
1. (a)	Define 'hazard function' in the context of reliability assessment of engineering items. Derive the relation between the hazard function and the survival function.	8
(b)	For non-repairable systems, derive expressions for *a posteriori* reliability function, and *a posteriori* failure distribution function in terms of the *a priori* failure density function *f(t)*.	10
(c)	How is the shape of the hazard function related to the ageing of the engineering item under consideration?	7
2. (a)	The life of a pump is exponentially distributed, with a mean of 2000 hours. There is a standby pump whose lifetime is independent and identically distributed as that of the original. (i) What is the probability of survival of the combination for a period of 1500 hours? (ii) What is the "Mean-time-to-failure" (MTTF) of the combination? Derive the expressions used. State clearly the assumptions made.	12
(b)	An engineer thinks that the best "model" for time between breakdowns of an engine is the exponential distribution with a mean of 200 days. (i) If the generator has just broken down, what is the probability that it will breakdown in the next 210 days? (ii) What is the probability that the generator will operate for 300 days without a breakdown? Derive the expressions used	13

[Turn over

No. of Questions	PART I	Marks
3. (a)	It is desired to determine the MTTF of a logarithmic amplifier module at 20°C. For this purpose, *M* number of s-identical log modules are operated for τ hours at 90°C, and another batch of such *M* modules for τ hours at 80°C. At 90°C, the MTTF was obtained as 6.0×10^3 hours. At 80°C, this was 2.5×10^4 hours. What is the MTTF of this log-module at 20°C ? Consider Arrhenius model for acceleration of failure due to elevated temperature.	15
(b)	Explain the importance of *'Temperature Cycle Test'* for electronic components. Give the empirical expression for the acceleration factor for such tests. What is 'Electromigration' ? How can the failure due to electromigration be accelerated in electronic devices ?	10
4.	Write <u>short</u> notes on *any two* of the following. (i) Application of Binomial distribution in reliability assessment of engineering systems. (ii) Mission-oriented and continuously operated systems. (iii) Survival function, hazard function and MTTF of engineering items with time-to-failure with Weibull distribution.	12 ½ + 12 ½

Ex/EE/5/T/513B/2018(S) (Old)

BACHELOR OF ELECTRICAL ENGINEERING (EVENING)EXAMINATION, 2018

(5^{th}Year, 1st Semester, Supplementary)

RELIABILITY ENGINEERING

Time: Three Hours Full Marks: 100

(50 marks for each part)

Use a separate Answer-script for each Part

PART-II

Answer any three questions

(Two marks are reserved for neatness and well organized answers)

1. a) Deduce the expression for basic exponential reliability function. Comment on the shape of bath-tub characteristic. 6

   b) A system contains five 100 MW units, each having a failure rate of 0.01 per day and 0.49 repairs per day. Construct the capacity outage probability table. Neglect probability values less than 10^{-6}. 10

2.. a) Explain why 'loss of largest unit' is preferred to 'percentage reserve' while computing risks in two almost similar systems. 8

   a) A system contains three 50 MW units and one 80 MW units each having F.O.R. = 0.02. Construct the capacity outage probability table rounded off to 100 MW steps. 8

3. Calculate SAIFI, SAIDI, CAIDI, ASUI, ASAI, ENS AND AENS, ENS and AENS for the distribution system shown in the Fig. 1, below. The number of customers and average load connected to each load point are shown in Table-1. The reliability parameters are given in Table-2 16

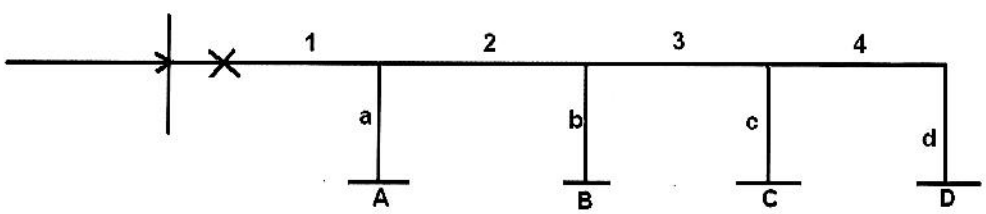

Fig.1

Table 1

Load Point	Number of Customer	Average Load Connected (MW)
A	400	3
B	300	4
C	600	5
D	500	4

Table2

Component	λ (f/yr)	r (hrs.)
1	0.3	2
2	0.1	2
3	0.1	2
4	0.2	2
a	0.2	2.5
b	0.5	3
c	0.2	2.5
d	0.3	3

4. a) Show that for a two component repairable parallel system, the total annual outage time is given by - $\lambda_1\lambda_2 r_1 r_2/8760$ hours. 5

b) Show that the frequency of encountering a state can be expressed as: $f = A.\lambda$ or as: $f = U.\mu$ with usual nomenclature. 5

b) A system contains 5 × 50 MW unit with the following parameters: failure rate = 0.02 failures/day and repair rate = 0.48 repairs/day. Draw the state space diagram and find out the F.O.R. 6

5. a) Define the following terms:

i) Active failure ii) Passive failure and iii) Stuck condition of breaker 6

b) For the system as shown in Fig. 2, compute the average repair time, annual outage duration and failure rate of load point L1 and L2 with the following condition.
   i) isolation of failed component not possible
   ii) isolation of failed component is possible

Considering the failure rate of 0.2 failures /yr, repair time of 30 hours and switching time of 2 hours for each transformer. 10

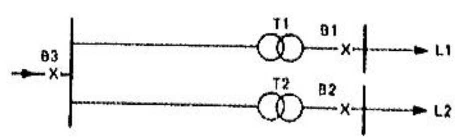

Fig. 2

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