BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING) EXAMINATION, 2024

(5thYear, 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-I

Answer any three questions
(Two marks are reserved for neatness
and well organized answers)

1. a) Calculate SAIFI, SAIDI, CAIDI, ASUI, ASAI, ENS AND AENS, ENS and AENS for the distribution system shown in the Fig. 1. 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

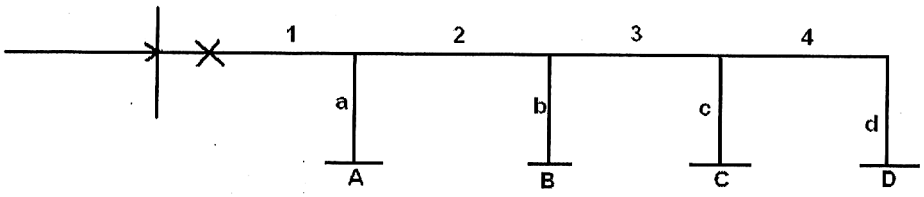

Fig. 1

Table - 1

Load Point	Number of Customer	Average Load Connected (MW)
A	350	3.5
B	550	5.0
C	700	7.7
D	300	6.4

Table - 2

Component	λ (f/yr)	r (hrs.)
1	0.25	2.5
2	0.25	2.5
3	0.3	2.5
4	0.2	2.5
a	0.2	3.5
b	0.4	3.5
c	0.2	3.5
d	0.3	3.5

2. a) *Define the following terms:*
i) Active failure ii) Passive failure and iii) Stuck condition of breaker 6

b) For the system 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 0.3 failure/year, repair time of 35 hours and switching time of 2.5 hours for each transformer. 10

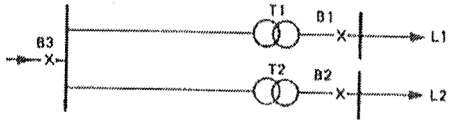

Fig. 2

3. a) Explain the method of recursion. 5

b) A generating station has four 100 MW units, each with FOR = 0.03. Construct the capacity outage probability table rounded off to 150 MW steps. Develop the cumulative probability table when another 150 MW unit is added to the system. FOR of the new unit is 0.025. Use method of recursion. 11

4. A system contains 5 × 50 MW unit with the following parameters: (a) failure rate = 0.01 failures/day and (b) repair rate = 0.49 repairs/day. Draw the state space diagram and compute the capacity outage probability table including rate of departure & frequency. 6+10

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

b) Explain with the help of suitable example why 'loss of largest unit method' is preferred to 'percentage reserve method' while computing risks in two almost similar systems. 10

Ref. No. : Ex/EE/5/T/513C/2024(S)

BACHELOR OF ENGINEERING (ELECTRICAL ENGINEERING)
FIFTH YEAR FIRST SEMESTER SUPPLEMENTARY EXAM 2024
RELIABILITY ENGINEERING

Full Marks 100

Time: Three hours **(50 marks for each part)**

Use a separate Answer-Script for each part

Question No.	PART- II	Marks
	Answer any **TWO** questions	
1. (a)	**Consider a system comprising four statistically-identical non-repairable electronic units each having an MTTF of 10 yrs. Evaluate the probability of the system surviving 0.5 yr and 5 yrs, and also the MTTF of the system, if at least two units must operate successfully. Assume that each unit is operating in its useful life period.** **Derive the expressions used.**	17
	OR	
(a)	**The life of an electric motor is exponentially distributed, with a mean of 160 hours. There are two standby motors, each of whose lifetime is independent and identically distributed as that of the original.** **(i) What is the probability of survival of the combination of these three motors for a period of 250 hours?** **(ii) What is the MTTF of the combination?** **Derive the expressions used. State clearly the assumptions made.**	17
(b)	**Derive the "Lack-of-Memory" property of exponential distribution and point out its significance from reliability point of view.**	8
2.	**Assume that the life of a roller bearing follows a Weibull distribution with shape parameter = 0.7 and scale parameter = 15000 hours.**	

Ref. No. : Ex/EE/5/T/513C/2024(S)

Question No.	PART- II	Marks
	(i) Determine the probability that a bearing lasts at least 10000 hours. (ii) Determine the probability that a bearing lasts at least a further period of 600 hours, given it has survived up to 9000 hours. (iii) Determine the mean time until failure of a bearing. Derive all the expressions used for the above computations.	25
3. (a)	Explain the importance of 'Temperature Cycle Test' for electronic components. Give the empirical expression for the acceleration factor for such tests.	5+2
(b)	What is 'Electromigration' ? How can the failure due to electromigration be accelerated in electronic devices ?	4+2
(c)	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. Also point out the relation between the shape of the hazard function and ageing of the system.	12
4.	Write notes on any two of the following. (a) Mission-oriented and continuously operated systems. (b) Reliability assessment of 'Engineering Systems' taking into consideration the effect of preventive maintenance. (c) Accelerated life testing of electronic components at enhanced current, at elevated humidity and at escalated voltage.	12 ½ +12 ½