



- Notes :
1. All questions carry marks as indicated.
  2. Solve Question 1 OR Questions No. 2.
  3. Solve Question 3 OR Questions No. 4.
  4. Solve Question 5 OR Questions No. 6.
  5. Solve Question 7 OR Questions No. 8.
  6. Solve Question 9 OR Questions No. 10.
  7. Solve Question 11 OR Questions No. 12.
  8. Due credit will be given to neatness and adequate dimensions.
  9. Assume suitable data whenever necessary.
  10. Diagrams and chemical equations should be given whenever necessary.
  11. Illustrate your answers whenever necessary with the help of neat sketches.
  12. Use of non programmable calculator is permitted.

1. Explain following terms

- a) i) Reliability 6  
 ii) MTTF  
 iii) MTBF
- b) 100 Components are put under test. After every hour number of failures are recorded. 8  
 Find failure density, hazard rate and reliability from given data.

Time Interval (Hrs)	1	2	3	4	5	6	7	8	9	10
No. of Failures	21	13	9	7	6	6	5	7	11	15

**OR**

2. a) The results of test conducted under severe adverse condition on 250 safety valves are tabulated below calculate failure density (fd) & hazard rate  $z(t)$  when the time interval is four hours instead of one hour. Also calculate No. of survivors. 7

Time Interval (Hrs)	0-0	0-4	4-8	8-12	12-16	16-20	20-24
No. of Failures	0	135	35	32	22	15	11

- b) In the life testing of 200 specimens of a particular device the No. of failures during each time interval of 20 hrs is shown in table. Estimate MTTF of these specimens. 7

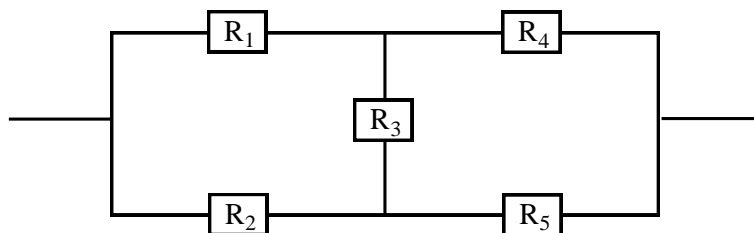
Time Interval (Hrs)	No. of Failures during the intervals
$T \leq 1000$	0
$1000 \leq T \leq 1020$	30
$1020 \leq T \leq 1040$	40
$1040 \leq T \leq 1060$	35
$1060 \leq T \leq 1080$	40
$1080 \leq T \leq 1100$	20
$1100 \leq T \leq 1120$	25
$1120 \leq 1140$	5
$1140 \leq 1160$	5

3. a) Draw and explain the three regions of 'Bathtub' curve. 7  
 b) Explain series and parallel configuration of reliability evaluation. 7

**OR**

4. Explain 7  
 a) i) Infant Mortality. 7  
 ii) Useful life.  
 iii) Wearout region.  
 b) Explain series – parallel and parallel – series configuration of reliability evaluation. 7

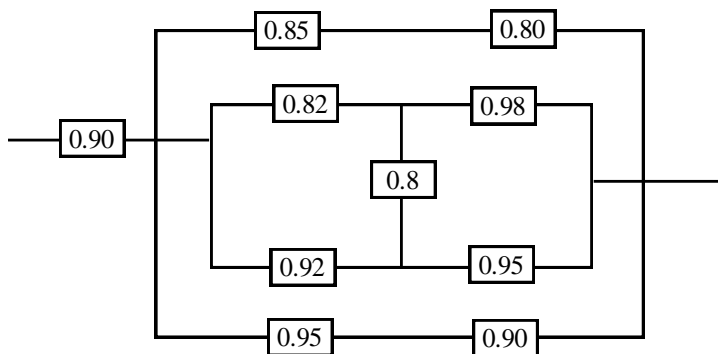
5. Explain 9  
 i) a) Network reduction method. 9  
 b) Fault Tree Analysis (FTA).  
 c) Decomposition method.  
 ii) Solve [Where 'R<sub>i</sub>' = Reliability, i = 1, 2, 3, 4, 5] 4



$R_1 = R_2 = R_3 = R_4 = R_5 = 0.8$

**OR**

6. Determine reliability of given systems. 6  
 a) 6



- b) 7
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7. Explain in detail about [FMEA]. (FMEA – Failure modes and effects analysis.) **13**
- OR**
8. What is failure & functional failures? Describe about failure modes and necessity of analysis of failure modes and failure mode categories. **13**
9. Define maintenance and explain in detail about. **13**  
i) Proactive maintenance – Predictive task  
ii) Proactive maintenance – Preventive task
- OR**
10. Distinguish between Proactive maintenance – Predictive task & Proactive maintenance – Preventive task. **13**
11. a) Describe brief history of RCM. **6**  
b) Application of RCM in airlines. **7**
- OR**
12. a) What do you mean by RCM? **3**  
b) Application of RCM in  
i) Nuclear facility. **10**  
ii) Military.

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