

# Indian Statistical Institute

## M.S.(QMS) First Year

### Second Semester – Reliability, Maintainability and Safety - II

Mid Term Exam

Date: 21/02/2024

Time: 2 hours

Maximum Marks: 50

1. A system comprised of 5 homogeneous subsystems connected functionally in series. If a system reliability of 0.95 is desired, what is the minimum component's reliability that is needed? [2]
2. Assume that 3-wheel bolts are adequate from a design standpoint. However, the wheel attachment under consideration has 4 bolts. If the chances of losing a wheel bolt are 0.01, what is the reliability of this bolt system? [3]
3. How many homogeneous components are required in a parallel system with each component reliability 0.55 to achieve system reliability 0.99? [3]
4. Consider a series system of  $n$  independent components. Suppose,  $i^{\text{th}}$  component has reliability as  $R_i(t) = e^{-\lambda_i t^{0.2}}$ ,  $i = 1, 2, \dots, n$ . Check the hazard rate of the system is *IFR* or *DFR*. [5]
5. Define competing risks problem in terms of components of a system. Give one real life example of competing risks. Derive the likelihood function of that system assuming there are 2 independent identical components in competing risks under *type II* censoring scheme. [2+3+5=10]
6. If the minimum cut sets of a 5-component coherent system are  $S = \{(1,2), (2,3), (1,3), (4,5)\}$ , draw the reliability block diagram. Find the minimum path sets. Find the structure function of the system. [3+2+2 = 7]
7. Ten items are put on a test at time  $t = 0$  and testing is terminated as soon as the 4<sup>th</sup> failure occurs. The observed failure times are at 15.5, 19.3, 22.4 and 29.6 hours. Assuming exponential distribution with parameter  $\lambda$ , construct a point estimate and 95% confidence interval for  $\lambda$  and  $R(25)$ . [4+4 = 8]
8. Write short note on the following:
  - a. FMEA
  - b. FTA
  - c. Interval censoring
  - d. Hybrid censoring[3+3+3+3 = 12]

.....