

SEVENTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER DEGREE EXAMINATIONS, NOVEMBER - 2018

SUBJECT: RELIABILITY AND SAFETY ENGINEERING [ICE 4029]

TIME: 3 HOURS

MAX. MARKS: 50

Instructions to candidates Answer ALL questions. • Missing data may be suitably assumed. **1**A Define the following: 2Mi. Safety Margin ii. MTTF iii. Conditional maintenance iv. Maintenance Prevention **1B** List constraints in the design of safe product and explain any one of the product safety 4Mimprovement program. **1C** Explain the conceptual frame work for product safety and liability. 4M2A State aim and explain the principles of total productive maintenance. 5M **2B** With neat diagram, explain Logic tree of reliability centered maintenance. 5M 3A Describe human behaviors and errors in reliability engineering. 3M From exponential distribution data, derive the slope of a line equation by using linear least square **3B** 3M estimation method. **3C** Derive the expression for mean and variance of an exponential distribution. 4M**4**A In designing a computer-based control system, two computers are being considered to obtain 3M higher reliability. Each computer contains four sub systems namely motherboard (MB), hard disk (HD), power supply (PS), and processor (CPU). Designer suggested redundancy at the component level. The reliabilities of four subsystems are 0.98, 0.95, 0.91, and 0.99 respectively. What is the overall system reliability for a mission of 1000 h?

4B Using Maximum Likelihood Estimator, estimate the failure rate of exponential distribution 4M whose data is given in Table 4B.

- 4C The failure time of a component follows a Weibull distribution with shape parameter is 1.5 and 3M scale parameter is 10,000 h. When should the component be replaced if the minimum recurring reliability for the component is 0.95?
- 5A A simplified emergency power supply system is shown in Figure 5A. Availability of the power 4M supply at bus A or bus B ensures the supply to loads. There is a transfer switch to connect the diesel generator DG1 to bus B or to connect DG2 to bus A. Develop the RBD and identify the combinations of failures leading to failure of power supply.
- **5B** Derive the expression for reliability of 1 out of 3 redundancy RBD model. 4M
- **5C** Given the hazard rate function λ (t) = 2×10⁻⁵ t, determine R (t) and f (t) at t = 500 h. 2M

TBF (hours)	2600	3200	4700	7400	8000	9800
R(t _i)	1	0.5	0.3	0.1	0.066	0.033

Table 4B: Experimental data.



Figure 5A: A Simplified emergency power supply system.
