Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

SEVENTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)
END SEMESTER EXAMINATIONS, NOV - 2017

SUBJECT: RELIABILITY AND SAFETY ENGINEERING [ICE 4029]

Duration: 3 Hour   Max. Marks:50

Instructions to Candidates:

❖ Answer **ALL** the questions.
❖ Missing data may be suitably assumed.

1A	Define the following; i. Maintainability ii. Risk iii. Availability iv. MTBF	2
1B	Derive the expression for failure rate of a continuous random variable.	4
1C	With neat diagrams, explain reliability centered maintenance.	4
2A	Evaluate the MTTF for the system depicted in Figure 2A. Components are used during the phase with an approximately constant failure rate of the bath-tube curve and $\lambda=\lambda_1=\lambda_2=\lambda_3$.	5
2C	Describe fault tree analysis with a suitable example.	5
3A	Prove that component redundancy of a product is better than the system redundancy of a product.	3
3B	The failure time (T) of an electronic circuit board follows an exponential distribution with failure rate $\lambda = 10^{-4}$ /h. What is the probability that (i) it will fail before 1000 h; (ii) it will survive at least 10,000 h; (iii) it will fail between 1000 h and 10,000 h; Determine (iv) the mean time to failure (v) the median time to failure.	4
3C	Derive the expression for mean and variance of a weibull distribution.	3
4A	To ensure proper illumination in control rooms, higher reliability of electric lamps is necessary. Let us consider that the failure times (in hours) of a population of 30 electric lamps from a control room are given in Table 4A. Calculate failure density, reliability, and hazard functions using non parametric method.	5
4B	With a neat flow chart, describe the construction of a generalized Reliability Block Diagram (RBD).	3
4C	List the design considerations of maintainability.	2
5A	Using Rasmussen's decision-making model, describe different types of human actions and associated error mechanisms.	3

5B Illustrate the basic elements required for the improvement of product safety program. 5

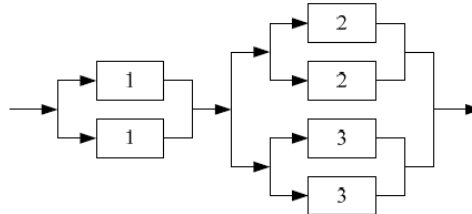**5C** Describe the focused improvement pillar of TPM. 2

Figure 2A. Reliability block diagram

Lamp	Failure time	Lamp	Failure time	Lamp	Failure time
1	5495.05	11	3511.42	21	4037.11
2	8817.71	12	6893.81	22	933.79
3	539.66	13	1853.83	23	1485.66
4	2253.02	14	3458.4	24	4158.11
5	18887	15	7710.78	25	6513.43
6	2435.62	16	324.61	26	8367.92
7	99.33	17	866.69	27	1912.24
8	3716.24	18	6311.47	28	13576.97
9	12155.56	19	3095.62	29	1843.38
10	552.75	20	927.41	30	4653.99

Table 4A

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