MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

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

END SEMESTER EXAMINATIONS, DEC - 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. Random variable ii. Predictive maintenance iii. MTTF iv. Reliability	2
1B	Derive the expression for unreliability of a continuous random variable.	4
1C	In designing a computer-based control system, two computers are being considered to obtain 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?	4
2A	Derive the expressions for mean and variance of an exponential distribution.	4
2B	The failure time of a component follows a Weibull distribution with shape parameter is 1.5 and scale parameter is 10,000 h. When should the component be replaced if the minimum recurring reliability for the component is 0.95?	3
2C	Derive the expression for reliability of 2 out of 3 redundancy RBD model.	3
3A	With a neat flow chart, explain the conceptual framework of design for safety and liability.	5
3B	Explain safety margin of a critical device.	2
3C	Illustrate different types of maintenance techniques used in reliability and safety engineering.	3
4A	Describe different types of human errors.	2
4B	Using Maximum Likelihood Estimator, estimate the failure rate of exponential distribution whose data is given in table 4B	5
4C	With neat diagram, explain life characteristic curve.	3

5A   List all Pillars of Total Productive Maintenance (TPM).   2

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

5C   Prove that Mean Time To Failure (MTTF) of an exponential distribution is inversely proportional   3
to the failure rate.

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

<div align="center">Table 4B</div>

<div align="center">********************</div>