Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

FIRST SEMESTER M.TECH (CONTROL SYSTEMS / ASTRONOMY AND SPACE ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: SYSTEM MODELING AND IDENTIFICATION [ICE 523]

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitably assumed.

1A. A homeowner has just installed 20 light bulbs in a new home. Suppose that each has a probability 0.2 of functioning more than three months. What is the probability that at least five of them function more than three months? What is the average number of bulbs the homeowner has to replace in three months? **3**

1B. In order to establish quality limits for a manufactured item, 10 independent samples are taken at random and the quality limits are established by using the lowest and highest sample values. What is the probability that at least 50% of the manufactured items will fail within these limits? **3**

1C. The time T sec for the completion of two sequential events is a continuous random variable with pdf given in Fig. Q1C. (a) What is the value of constant 'c' so that F_T (t) is the pdf (b) Find the probability that both events are completed in 3 sec or less (c) What is the probability that both the events are completed in less than or equal to 6 sec. (d) What is the probability that 't' lies between 4.99 and 5.01 sec? **4**

2A. Give a brief description on Pseudo Random Numbers. Also list the important considerations that any random number routine must satisfy. **5**

2B. Suppose that 0.17, 0.212, 0.358, 0.523, 0.238, 0.543, 0.764, 0.254, 0.103, 0.04, 0.374 and 0.419 are the random numbers generated and it is desired to perform a test for uniformity by using Kolmogorov-Smirnov test with a significance level of 0.05. Comment upon the null-hypothesis that "The given set of random numbers are not uniformly distributed". **5**

3A. Explain the techniques that can enhance and facilitate data collection procedure. **5**

3B. Describe the various steps involved in the study of simulation. **5**

4A. Give a brief note on Least Square model and properties of Mean and Variance. **4**

4B. The measurements of air-velocity and evaporation coefficient of burning fuel droplets in an impulse engine is given in Table: Q4A. Define a linear regressor for the given data by applying the method of Least Squares. Hence, estimate the evaporation coefficient of a droplet when the air velocity is 190 cm/sec. **6**

5A. Determine the type of bifurcation observed in the following equation: **5**

$\dot{x} = rx - \ln(1+x)$

Justify your answer.

5B. (i) Define chaos in nonlinear systems. **5**

(ii) Derive the describing function of relay with hysteresis.

6A. Explain SOPDT modeling with relevant examples. **3**

6B. Discuss Predictor Error model via Noise splitting. **3**

6C. Derive an MVC for a typical ARMAX model. **4**

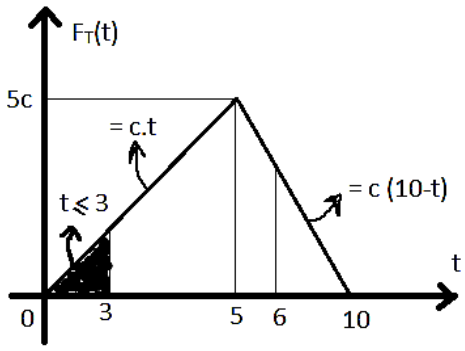

Fig. Q1C

Table Q4A.

Air Velocity (cm/sec)	Evaporation coefficient (mm^2/sec)
20	0.18
60	0.37
100	0.35
140	0.78
180	0.56
220	0.75
260	1.18
300	1.36
340	1.17
380	1.65

Kolmogorov-Smirnov Table

$n \backslash \alpha$	0.01	0.05	0.1	0.15	0.2
1	0.995	0.975	0.950	0.925	0.900
2	0.929	0.842	0.776	0.726	0.684
3	0.828	0.708	0.642	0.597	0.565
4	0.733	0.624	0.564	0.525	0.494
5	0.669	0.565	0.510	0.474	0.446
6	0.618	0.521	0.470	0.436	0.410
7	0.577	0.486	0.438	0.405	0.381
8	0.543	0.457	0.411	0.381	0.358
9	0.514	0.432	0.388	0.360	0.339
10	0.490	0.410	0.368	0.342	0.322
11	0.468	0.391	0.352	0.326	0.307
12	0.450	0.375	0.338	0.313	0.295
13	0.433	0.361	0.325	0.302	0.284
14	0.418	0.349	0.314	0.292	0.274
15	0.404	0.338	0.304	0.283	0.266
16	0.392	0.328	0.295	0.274	0.258
17	0.381	0.318	0.286	0.266	0.250
18	0.371	0.309	0.278	0.259	0.244
19	0.363	0.301	0.272	0.252	0.237
20	0.356	0.294	0.264	0.246	0.231
25	0.320	0.270	0.240	0.220	0.210
30	0.290	0.240	0.220	0.200	0.190
35	0.270	0.230	0.210	0.190	0.180
40	0.250	0.210	0.190	0.180	0.170
45	0.240	0.200	0.180	0.170	0.160
50	0.230	0.190	0.170	0.160	0.150
OVER 50	$\frac{1.63}{\sqrt{n}}$	$\frac{1.36}{\sqrt{n}}$	$\frac{1.22}{\sqrt{n}}$	$\frac{1.14}{\sqrt{n}}$	$\frac{1.07}{\sqrt{n}}$