Name : ....
Roll No. : ....
Invigilator's Signature : ....

CS/M. TECH (MT)/SEM-2/MTI-201/2012

2012

QUALITY & RELIABILITY ENGINEERING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions taking at least *two* from each Group.

GROUP – A

1. a) Define 'fitness for purpose'. 3

   b) What are the eight dimensions of Quality ? Explain any four of them briefly. 4 + 4

   c) Explain cost of Quality. 3

2. a) Briefly discuss the contributions of E. W Deming in Quality. 6

   b) As per P.B. Crosby what are 'the absolute' in Quality Management ? 4

   c) Briefly discuss the evolution of Quality. 4

3. a) Define Statistical Quality Control (SQC). 3

   b) Explain 'Assignable causes' of variations with examples. 2

c) Explain with examples different characteristics that can be measured by control chart. 3

d) A quality control inspector of a soft drink company has taken 19 samples with four observations each of the volume of bottles filled. The relevant data is given below. If the standard deviation of the bottling operations is 0·14 ounces by using this information, develop control limits of three standard deviation for the bottling operations and develop a control chart. 6

Sample No.	Observation (Volume in ounces)			
	1	2	3	4
1	15·85	16·02	15·83	15·93
2	16·12	16·00	15·85	16·01
3	16·00	15·91	15·94	15·83
4	16·20	15·85	15·74	15·93
5	15·74	15·86	16·21	16·10
6	15·94	16·01	16·14	16·03
7	15·75	16·21	16·01	15·86
8	15·82	15·94	16·02	15·94
9	16·04	15·98	15·83	15·98
10	15·64	15·86	15·94	15·89
11	16·11	16·00	16·01	15·82
12	15·72	15·85	16·12	16·15
13	15·85	15·76	15·74	15·98
14	15·73	15·84	15·96	16·10
15	16·20	16·01	16·10	15·89
16	16·12	16·08	15·83	15·94
17	16·01	15·93	15·81	15·68
18	15·78	16·04	16·11	16·12
19	15·84	15·92	16·05	16·12

4. An analysis of failure of the output from a UPS manufacturing company unit produced the following results :

UPS capacity	No of failures
5	67
6	08
7·5	07
10	56
15	15
20	22
30	13
45	05
60	04
80	03

a) Construct a Pareto diagram. 6

b) Explain Cause and Effect diagram with neat sketch. 5

c) Define process capability. 3

GROUP – B

5. a) "Bath tub curve is the true indicator of expressing life cycle of a device." – Justify the statement. 3

b) Consider a system composed of 4 identical elements each with reliability R = 0·7. What is the system reliability of 2 of the 4 active elements are required ? 4

c) A receiver has an estimated failure rate of 200×10^{-6} failures per hour. Assuming constant failure rate, what are its MTBF and reliabity for a 1000 hour mission ? 3

d) "Severity class and criticality distinguishes the FMECA from FMEA." – Justify the statement. State various classes of severity class. 2 + 2

6. a) Define 'State margin'. 2

b) Distinguish between 'ABC Classification' and 'VED Classification'. 3

c) How does Material Requirements Planning (MRP) useful for Material Resource Planning and Control ? Discuss with suitable flow chart. 5

d) Calculate the reliability and MTBF of the system shown (Fig.1) : 4

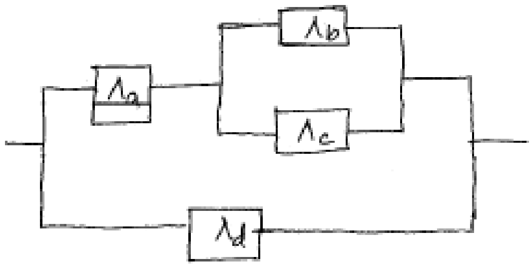

Fig. 1

7. a) Describe the system success states and transition rate tables for the block diagram (Fig 2) : 4

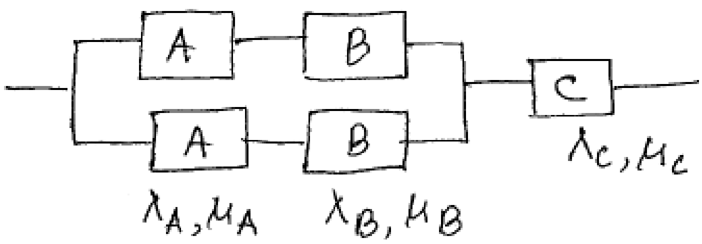

Fig. 2

b) Determine the probability of event *A* in the Fault Tree of Fig. 3 if all basic events assumed to be statistically independent and mutually exclusive of one another. Also find the minimum cut sets and determine the probability of event A with the help of minimum cutsets.

The probabilities of events are

P (D) = 20%, P (E) = 12%, P(F) = 5%,

P (H) = 15%, P (I) = 10%, P (J) = 5 % 7

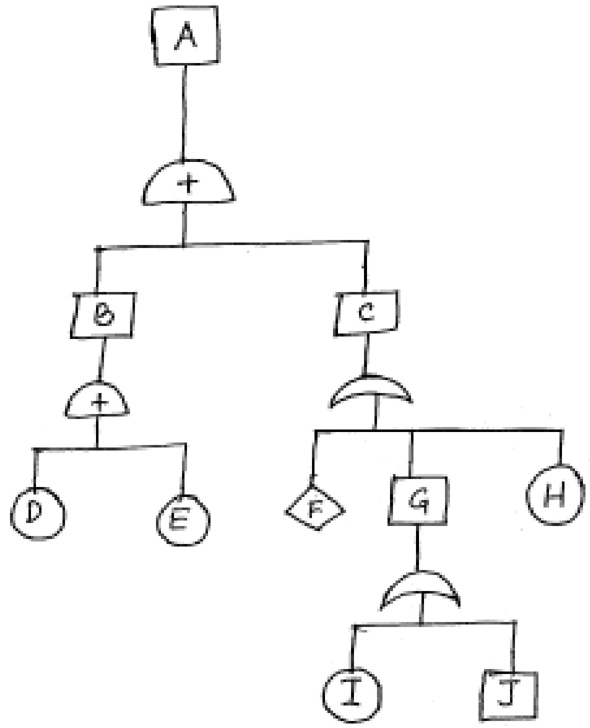

Fig. 3

c) Transform the fault tree diagram of Fig. 3 into petrinet. 3

8. a) Discuss Arrhenions model for accelerated testing. 3

   b) Determine upper and lower 90% confidence estimates for a device that experienced 11 failures in 485,000 device operating hours in the field test. Assume constant failure rate. Also determine 80% confidence band. 4

   c) Write short notes on the following : 3 + 4

      i) Duty Cycling

      ii) The Chi-square test of Goodness of fit.

TABLE B.2
Chi-square distribution.

Value χ^2 such that $P(x < \chi^2) = \alpha$

Degrees of Freedom μ:	α: 0.005	0.010	0.025	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95	0.975	0.990	0.995
1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.3	0.5	0.7	1.1	1.6	2.7	3.8	5.0	6.6	7.9
2	0.0	0.0	0.1	0.1	0.2	0.4	0.7	1.0	1.4	1.8	2.4	3.2	4.6	6.0	7.4	9.2	10.6
3	0.1	0.1	0.2	0.4	0.6	1.0	1.4	1.9	2.4	3.0	3.7	4.6	6.3	7.8	9.4	11.3	12.8
4	0.2	0.3	0.5	0.7	1.1	1.7	2.2	2.8	3.4	4.0	4.9	6.0	7.8	9.5	11.1	13.3	14.9
5	0.4	0.6	0.8	1.2	1.6	2.3	3.0	3.7	4.4	5.1	6.1	7.3	9.2	11.1	12.8	15.1	16.7
6	0.7	0.9	1.2	1.6	2.2	3.1	3.8	4.6	5.4	6.2	7.2	8.6	10.6	12.6	14.4	16.8	18.5
7	1.0	1.2	1.7	2.2	2.8	3.8	4.7	5.5	6.4	7.3	8.4	9.8	12.0	14.1	16.0	18.5	20.3
8	1.3	1.7	2.2	2.7	3.5	4.6	5.5	6.4	7.3	8.4	9.5	11.0	13.4	15.5	17.5	20.1	22.0
9	1.7	2.1	2.7	3.3	4.2	5.4	6.4	7.4	8.3	9.4	10.7	12.2	14.7	16.9	19.0	21.7	23.6
10	2.2	2.6	3.3	3.9	4.9	6.2	7.3	8.3	9.3	10.5	11.8	13.4	16.0	18.3	20.5	23.2	25.2
11	2.6	3.1	3.8	4.6	5.6	7.0	8.2	9.2	10.3	11.5	12.9	14.6	17.3	19.7	21.9	24.7	26.8
12	3.1	3.6	4.4	5.2	6.3	7.8	9.0	10.2	11.3	12.6	14.0	15.8	18.5	21.0	23.3	26.2	28.3
13	3.6	4.1	5.0	5.9	7.0	8.6	9.9	11.1	12.3	13.6	15.1	17.0	19.8	22.4	24.7	27.7	29.8
14	4.1	4.7	5.6	6.6	7.8	9.5	10.8	12.1	13.3	14.7	16.2	18.2	21.1	23.7	26.1	29.1	31.3
15	4.6	5.2	6.3	7.3	8.6	10.3	11.7	13.0	14.3	15.7	17.3	19.3	22.3	25.0	27.5	30.6	32.8
16	5.1	5.8	6.9	8.0	9.3	11.2	12.6	14.0	15.3	16.8	18.4	20.5	23.5	26.3	28.8	32.0	34.3
17	5.7	6.4	7.6	8.7	10.1	12.0	13.5	14.9	16.3	17.8	19.5	21.6	24.8	27.6	30.2	33.4	35.7
18	6.3	7.0	8.2	9.4	10.9	12.9	14.4	15.9	17.3	18.9	20.6	22.8	26.0	28.9	31.5	34.8	37.2
19	6.8	7.6	8.9	10.1	11.7	13.7	15.4	16.9	18.3	19.9	21.7	23.9	27.2	30.1	32.9	36.2	38.6
20	7.4	8.3	9.6	10.9	12.4	14.6	16.3	17.8	19.3	21.0	22.8	25.0	28.4	31.4	34.2	37.6	40.0
21	8.0	8.9	10.3	11.6	13.2	15.4	17.2	18.8	20.3	22.0	23.9	26.2	29.6	32.7	35.5	38.9	41.4
22	8.6	9.5	11.0	12.3	14.0	16.3	18.1	19.7	21.3	23.0	24.9	27.3	30.8	33.9	36.8	40.3	42.8
23	9.3	10.2	11.7	13.1	14.8	17.2	19.0	20.7	22.3	24.1	26.0	28.4	32.0	35.2	38.1	41.6	44.2
24	9.9	10.9	12.4	13.8	15.7	18.1	19.9	21.7	23.3	25.1	27.1	29.6	33.2	36.4	39.4	43.0	45.6
25	10.5	11.5	13.1	14.6	16.5	18.9	20.9	22.6	24.3	26.1	28.2	30.7	34.4	37.7	40.6	44.3	46.9
26	11.2	12.2	13.8	15.4	17.3	19.8	21.8	23.6	25.3	27.2	29.2	31.8	35.6	38.9	41.9	45.6	48.3
27	11.8	12.9	14.6	16.2	18.1	20.7	22.7	24.5	26.3	28.2	30.3	32.9	36.7	40.1	43.2	47.0	49.6
28	12.5	13.6	15.3	16.9	18.9	21.6	23.6	25.5	27.3	29.2	31.4	34.0	37.9	41.3	44.5	48.3	51.0
29	13.1	14.3	16.0	17.7	19.8	22.5	24.6	26.5	28.3	30.3	32.5	35.1	39.1	42.6	45.7	49.6	52.3
30	13.8	15.0	16.8	18.5	20.6	23.4	25.5	27.4	29.3	31.3	33.5	36.3	40.3	43.8	47.0	50.9	53.7
35	17.2	18.5	20.6	22.5	24.8	27.8	30.2	32.3	34.3	36.5	38.9	41.8	46.1	49.8	53.2	57.3	60.3
40	20.7	22.2	24.4	26.5	29.1	32.3	34.9	37.1	39.3	41.6	44.2	47.3	51.8	55.8	59.3	63.7	66.8
45	24.3	25.9	28.4	30.6	33.4	36.9	39.6	42.0	44.3	46.8	49.5	52.7	57.5	61.7	65.4	70.0	73.2
50	28.0	29.7	32.4	34.8	37.7	41.4	44.3	46.9	49.3	51.9	54.7	58.2	63.2	67.5	71.4	76.2	79.5
75	47.2	49.5	52.9	56.1	59.8	64.5	68.1	71.3	74.3	77.5	80.9	85.1	91.1	96.2	101	106	110
100	67.3	70.1	74.2	77.9	82.4	87.9	92.1	95.8	99.3	103	107	112	119	124	130	136	140