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ME (mech) Sem II (Machine Design) PTDC.

Con/3326–07. BB–1669

8/6/07 Engg. Experimentation & Reliability Engg. start

(4 Hours) [Total Marks : 100

N.B. : (1) Question No. 1 is **compulsory**.
(2) Attempt any **four** questions from **Q. No. 2 to 7**.
(3) Standard Statistical data tables **permitted**.
(4) Justify any assumption made.

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1. (a) A farmer wishes to test the effect of four different fertilizers A, B, C, and D on the yield of wheat. To eliminate the success of error due to variable soil fertility; he uses the Latin square arrangement as shown in table, where the numbers indicate yields in kg / unit area. Perform an analysis of variance to determine if there is significant difference between the fertilizers at the – (i) 0.05 and (ii) 0.01 level of significance. Clearly state the conclusions drawn from the analysis: 20

Latin Square Table

A_{20}	B_{12}	C_{21}	D_{25}
B_{15}	C_{22}	D_{24}	A_{15}
C_{23}	D_{22}	A_{16}	B_{11}
D_{21}	A_{25}	B_{10}	C_{19}

2. (a) Measurement of the diameter of random samples of 150 ball bearings made by a machine during one week, showed a mean of 29.9 mm and standard deviation of 1.05 mm. Find (i) 95% and (ii) 99% confidence limit for the mean diameter of all the bearings.

(b) Mean life of an electric bulb is 1200 hours with a standard deviation of 25 hours. Determine how many bulbs will have life of
(i) more than 1250 hours and (ii) between 1150 hours and 1225 hours.

(c) Six shafts (all similar) were tested for fatigue test. They were tested to failure on accelerated life test. The results are as follows:
8500; 39,500; 54,000; 80,000; 1,50,000; 2,05,000.

3. Eight specimen of an alloy steel were evaluated for hardness. Each was then tested for tensile strength. 20
The result are tabulated below:

Sample No.	Tensile Strength (MPa)	Brinell Hardness number (BHN)
1	260	110
2	263	113
3	232	100
4	237	102
5	245	105
6	284	122
7	276	118
8	272	116

(a) Determine the regression between hardness and tensile strength. Conform the regression by analysis a variance at 1% significance level.

(b) Determine the co-efficient of co-relation, and offer your comments on regression between hardness and tensile strength.

4. (a) What do you understand by Robust Design? 6

(b) Clearly state and explain signal to noise (S / N) ratio. Explain the use of S / N ratio in obtaining Robust Design. 8

(c) How orthogonal array help in economizing the run in design of experiments? 6

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5. (a) An automobile company buys its requirements of axles from four manufacturers. Manufacturer M_1 supplies 40% of the requirements, while M_2, M_3, and M_4 supply 20% each. The axles from M_1 pass the acceptance test 95% of the times, whereas the figures for other manufacturers are 90%, 85% and 80%. If in a given installation, an axle is found defective, what is the probability that the axle was supplied by M_1, M_2, M_3 or M_4? 8

(b) If the component has failure rate of 5×10^{-6} failures/hour, what is its reliability for an operating period of 100 hours? If there are 10,000 components in the test, how many failures are expected in 100 hours? 6

(c) Explain failure RATE time Curve in brief. 6

6. (a) In a factory 1000 machine components were tested for failure data analysis. The result of the test is as shown in table. 8

Time	0	1	2	3	4	5	6	7	8	9
Cumulative Failure	0	130	213	288	356	418	474	525	571	612
Time	10	11	12	13	14	15	16	17	18	19
Cumulative Failure	649	683	714	742	806	882	944	984	996	100

(b) Explain what do you understand by MTTF and MTBF for a component. 5

(c) Find the reliability of the system shown in Figure 1 using conditional probability (Bayes Theorem) Method. 7

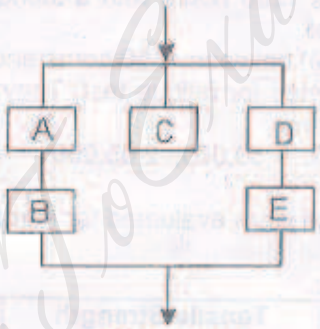

Figure 1

7. (a) Determine the reliability of system shown in Figure 2 by using Enumeration Method. 12

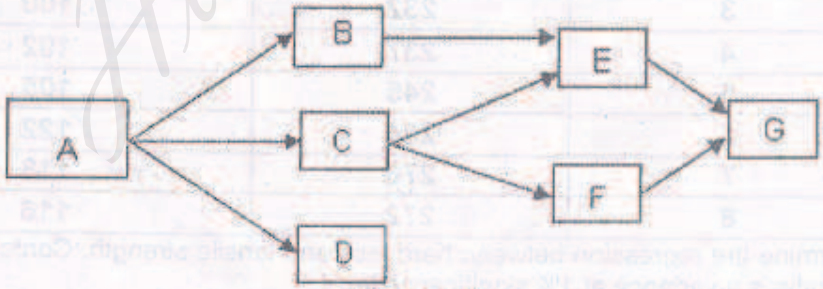

Figure 2

The reliability of the components are as follows:

$R_A=R_G=0.9$, $R_B=R_C=R_D=R_E=R_F=0.8$

(b) 8

The failure distribution of a component is defined by $F(t) = \frac{3t^2}{10^9}$ where $0 \le t \le 1000$ hrs.

(i) What is the probability of failure within 150 hour warranty period?

(ii) Calculate MTTF.

(iii) Find the design life for a reliability of 0.99.

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