14. (a) Four machines A, B, C, D are used to produce a certain kind of cotton fabric. 4 sample with each unit of size 100 square meters are selected from the outputs of the machines at random and the number of flaws in each 100 square meters are counted, with the following results:

A	B	C	D
8	6	14	20
9	8	12	22
11	10	18	25
12	4	9	23

Do you think that there is a significant difference in the performance of the four machines? (16)

Or

(b) A variable trial was conducted on wheat with 4 varieties in a Latin Square Design. The plan of the experiment and the yield per plot are given below:

C 25	B 23	A 20	D 20
A 19	D 19	C 21	B 18
B 19	A 14	D 17	C 20
D 17	C 20	B 21	A 15

Analyze data and interpret the result. (16)

15. (a) The specifications for a certain quality characteristics are (60 ± 24) in coded values. The table given below gives the measurements obtained in 10 samples. Find the tolerance limits for the process and test if the process meets the specifications. (16)

Sample No :	1	2	3	4	5	6	7	8	9	10
	75	48	57	61	55	49	74	67	66	62
	66	79	55	71	68	98	63	70	65	68
Measurements (X)	50	53	53	66	58	65	62	68	58	66
	62	61	61	69	62	64	57	56	52	68
	52	49	72	77	75	66	62	61	58	73
	70	56	63	53	63	64	64	66	50	68

Or

(b) The following set of data covering 15 consecutive production days on the number of defectives found in daily production from a sample of 200 units. Draw a p - chart and test whether the production process was in control. (16)

Production Day :	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of defectives :	10	5	10	12	11	9	22	4	12	24	21	15	8	14	4

Reg. No. :

Question Paper Code : 90816

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third/Fourth/Seventh Semester

Agriculture Engineering

MA 8391 – PROBABILITY AND STATISTICS

(Common to : Biomedical Engineering / Electrical and Electronics Engineering / Environmental Engineering / Industrial Engineering / Industrial Engineering and Management / Manufacturing Engineering / Mechanical Engineering (Sandwich) / Petrochemical Engineering / Safety and Fire Engineering / Artificial Intelligence and Data Science / Bio Technology / Biotechnology and Biochemical Engineering / Chemical Engineering / Computer Science and Business Systems / Fashion Technology / Food Technology / Handloom and Textile Technology / Information Technology / Petrochemical Technology / Petroleum Engineering / Pharmaceutical Technology / Plastic Technology / Polymer Technology / Textile Chemistry / Textile Technology)

(Regulations 2017)

Time : Three hours   Maximum : 100 marks

Statistical Tables may be permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A red die and a blue die are rolled together. What is the probability that we obtain 4 on the red die and 2 on the blue die?

2. The time that Joe, the teaching assistant, takes to grade a paper is uniformly distributed between 5 minutes and 10 minutes. Find the mean and variance of the time he takes to grade a paper.

3. If X and Y are independent random variables with means 4 and –2 and variances 9 and 5 respectively, find variance of $(2X + Y - 5)$.

4. State central limit theorem.

5. Define Type I error and Type II error.

6. Write down the uses of χ^2– distribution.

7. Name the basic principles of experimental design.

8. What are the merits and demerits of Latin Square Design?

9. Find the lower and upper control limits for $\overline{X}$ - chart and R- chart, when each sample is of size 4 and $\overline{\overline{X}} = 10.8$ and $\overline{R} = 0.46$.

10. What do you mean by "process in control" and "process out of control"?

PART B — (5 × 16 = 80 marks)

11. (a) (i) If a random variable X has the following probability distribution,

   x: 0   1   2   3   4   5   6   7

   $p(x)$:   0 k $2k$ $2k$ $3k$ k^2 $2k^2$ $7k^2+k$

   find the value of k. Also find $P(1.5 < X < 4.5 / X > 2)$ and the smallest value of λ for which $P(X \le \lambda) > 1/2$. (8)

   (ii) Derive the moment generating function of Binomial distribution and hence find its mean and variance. (8)

Or

   (b) (i) The life of a particular brand of batteries is exponentially distributed with a mean of 4 weeks. The battery is just replaced in gadget with the particular brand. (1) What is the probability that the battery life exceeds 2 weeks? (2) Given that the battery has lasted 6 weeks, what is the probability that it will last at least another 5 weeks? (8)

   (ii) The weights in pounds of parcels arriving at a package delivery company's warehouse can be modeled by an N (5; 16) normal random variable X. What is the probability that a randomly selected parcel weighs between 1 and 10 pounds? (8)

12. (a) (i) The joint PMF of two random variables X and Y is given by $p(x,y) = \begin{cases} k(2x+y), & x=1,2; y=1,2 \\ 0 & otherwise \end{cases}$, where k is a constant. What is the value of k? Find the marginal PMFs of X and Y. Are X and Y independent? (8)

   (ii) Calculate the coefficient of correlation from the following data: (8)

X:	1	2	3	4	5	6	7	8	9
Y:	9	8	10	12	11	13	14	16	15

Or

   (b) (i) Find the PDF of W, which is the sum of X and Y that are independent random variables with the following PDFs: $f(x) = \lambda e^{-\lambda x}$, $x \ge 0$ and $f(y) = \mu e^{-\mu y}$, $y \ge 0$ where $\lambda \ne \mu$. (8)

   (ii) A random sample of size 100 is taken from a population whose mean is 60 and variance is 400. Using central limit theorem, with what probability can we assert that the mean of the sample will not differ from $\mu = 60$ by more than 4? (8)

13. (a) (i) A soap manufacturing company was distributing a particular brand of soap through a large number of retail shops. Before a heavy advertisement campaign, the mean sales per weak per shop was 140 dozens. After the campaign a sample of 26 shops was taken and mean sales was found to be 147 dozens with S.D 16. Can you consider the advertisement effective at 5% level of significance? (8)

   (ii) Test significance of the difference between the means of the samples, drawn from two normal populations with the same SD using the following data: (8)

	Size	mean	SD
Sample 1	100	61	4
Sample 2	200	63	6

Or

   (b) (i) In a industry, 200 workers employed for a specific job, were classified according to their performance and training received / not received to test independence of a specific training and performance. The data is summarized as follows: Use χ^2 test of independence at 5% level of significance and give your conclusion. (8)

	Performance		Total
	Good	Not Good	
Trained	100	50	150
untrained	20	30	50

   (ii) Two samples of sizes 9 and 8 gave the sums of squares of deviations from their respective means equal to 160 and 91 respectively. Can they be regarded as drawn from the same normal populations? (8)