**B.Tech. / M.Tech (Integrated) DEGREE EXAMINATION, MAY 2023**
Fourth Semester

**21MAB301T – PROBABILITY AND STATISTICS**
*(For the candidates admitted from the academic year 2021 - 2022 & 2022 - 2023)*
(Statistical table, control chart constant table and graph sheets to be provided)

**Note:**
(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
(ii) **Part – B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours                                                                 Max. Marks: 75

### PART – A (20 × 1 = 20Marks)

Marks BL CO PO

Answer **ALL** Questions

1. The probability that a company director will travel by train is 1/5 and by plane is 2/3. What is the probability of his travelling by train or plane?   [1 2 1 1]
(A) 2/15          (B) 13/15
(C) 11/15         (D) 1/5

2. Let F(x) be a CDF of a random variable X, then $\lim_{x \to \infty} F(x)$ is   [1 1 1 2]
(A) 0             (B) 1/4
(C) 1/2           (D) 1

3. The probability density function of X is $f(x) = kx^2; 0 < x < 3$, then the value of k=_____   [1 2 1 2]
(A) 1/9           (B) 1/2
(C) 1/3           (D) 1

4. If A and B are independent events and $P(A) = P(B), P(A \cap B) = \alpha$, then $P(B) =$   [1 1 1 2]
(A) $\alpha^2$        (B) $2\alpha$
(C) $\sqrt{\alpha}$   (D) $\alpha/2$

5. If a coin is tossed 50 times, then the average number of times head appears is   [1 2 2 2]
(A) 50            (B) 25
(C) 2             (D) 1

6. If the standard deviation of the Poisson distribution is 2, then the probability mass function (pmf) of the probability distribution is   [1 2 2 2]
(A) $\dfrac{e^{-2}2^x}{x!}$        (B) $\dfrac{e^{2}2^x}{x!}$
(C) $\dfrac{e^{-4}4^x}{x!}$        (D) $\dfrac{e^{4}4^x}{x!}$

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b. The following table gives the number of air-craft accidents that occurred during the various days of a week. Test whether the accidents are uniformly distributed over the week.   [8 4 3 2]

| Day: | Mon | Tues | Wed | Thu | Fri | Sat |
|---|---|---|---|---|---|---|
| No. of accidents: | 15 | 19 | 13 | 12 | 16 | 15 |

24. a. Compute the Karl-Pearson correlation co-efficient between X and Y using the following data.   [8 3 4 2]

| X: | 1 | 3 | 5 | 7 | 8 | 10 |
|---|---|---|---|---|---|---|
| Y: | 8 | 12 | 15 | 17 | 18 | 20 |

**(OR)**

b. A completely randomized design experiment with 10 plots and 3 treatments gave the following results:   [8 4 4 2]

| Plot No: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment: | A | B | C | A | C | C | A | B | A | B |
| Yield: | 5 | 4 | 3 | 7 | 5 | 1 | 3 | 4 | 1 | 7 |

Analyze the results for treatment effects.

25. a. 10 samples each of size 50 were inspected and the number of defectives in the inspection were:   [8 3 5 2]
2, 1, 1, 2, 3, 5, 5, 1, 2, 3.
Draw the appropriate control chart for defectives.

**(OR)**

b. 15 tape-recorders were examined for quality control test. The number of defects in each tape-recorder is recorded below. Draw the appropriate control chart and comment on the state of control.   [8 3 5 2]

| Unit No: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of defects (c): | 2 | 4 | 3 | 1 | 1 | 2 | 5 | 3 | 6 | 7 | 3 | 1 | 4 | 2 | 1 |

### PART – C (1 × 15 = 15 Marks)

Marks BL CO PO

Answer **ANY ONE** Question

26. The nicotine contents in two random samples of tobacco are given below:   [15 4 3 2]

| Sample I  : | 21 | 24 | 25 | 26 | 27 | - |
|---|---|---|---|---|---|---|
| Sample II : | 22 | 27 | 28 | 30 | 31 | 36 |

Can you say that the two samples came from the same normal population?

27. Given below are the values of sample mean $\overline{X}$ and sample range R for 10 samples, each of size 5. Draw the mean and range charts and comment on the state of control of the process.   [15 3 5 2]

| Sample No: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean: | 43 | 49 | 37 | 44 | 45 | 37 | 51 | 46 | 43 | 47 |
| Range: | 5 | 6 | 5 | 7 | 7 | 4 | 8 | 6 | 4 | 6 |

* * * * *

7. If X is uniformly distributed over (0,3), then the mean is          1  2  2  2
   (A)  3/2                          (B)  2/3
   (C)  2                            (D)  3

8. If the parameter of the exponential distribution is 3, then the MGF is          1  2  2  2
   (A)  $\dfrac{1}{3-t}$             (B)  $\dfrac{3}{3-t}$
   (C)  $\dfrac{3-t}{3}$             (D)  $3-t$

9. The value set for $\alpha$ is known as          1  1  3  2
   (A)  The rejection level          (B)  The acceptance level
   (C)  The significance level       (D)  The error in the hypothesis test

10. In Chi-square test          1  1  3  2
    (A)  $\sum O_i \neq \sum E_i$    (B)  $\sum O_i = \sum E_i$
    (C)  $\sum O_i > \sum E_i$       (D)  $\sum O_i < \sum E_i$

11. If the estimated population variances are 4.80 and 3.96, then the test statistic for F is          1  2  3  2
    (A)  1.54                        (B)  1.31
    (C)  2.0                         (D)  1.21

12. Degree of freedom is related to          1  1  3  2
    (A)  No. of observations in a set          (B)  Hypothesis under test
    (C)  No. of independent variables in a set          (D)  No. of dependent variables in a set

13. The value of correlation co-efficient lies between          1  1  4  2
    (A)  $\pm 1$                     (B)  $\pm\infty$
    (C)  $\pm 3$                     (D)  $\pm 6$

14. If $b_{xy}=1.6$ and $b_{yx}=0.4$, then $r_{xy}$ will be          1  2  4  2
    (A)  0.4                         (B)  0.64
    (C)  0.8                         (D)  $-0.8$

15. The basic purpose of ANOVA is to test the _____ of several means.          1  1  4  2
    (A)  Proportions                 (B)  Heterogeneity
    (C)  Homogeneity                 (D)  Variations

16. In ANOVA table SSC=73.2, SSR=17.87, SSE=62.13, C=5 and r=4, then $F_R$ is          1  2  4  2
    (A)  1.1505                      (B)  0.8691
    (C)  1.9185                      (D)  0.6714

17. Control chart for variable is          1  1  5  2
    (A)  s-chart                     (B)  p-chart
    (C)  np-chart                    (D)  c-chart

18. Which of the following control chart would be used to monitor the quality of product if the proportion of defectives are known          1  1  5  2
    (A)  h-chart                     (B)  np-chart
    (C)  c-chart                     (D)  p-chart

19. In c-chart $\overline{c}=11$, then LCL value is          1  2  5  2
    (A)  1.05                        (B)  11
    (C)  20.95                       (D)  7.68

20. The upper control limit for the sample mean chart if $A_2=0.729$, $\overline{R}=1.33, \overline{\overline{X}}=11.56$          1  2  5  2
    (A)  3.04                        (B)  10.59
    (C)  2.282                       (D)  12.53

## PART – B (5 × 8 = 40 Marks)
### Answer ALL Questions          Marks  BL  CO  PO

21. a. In a bolt factory machines A, B, C manufacture respectively 25%, 35% and 40% of the total. Of their output 5%, 4% and 2% are defective bolts. A bolt is drawn at random from the product and is found to be defective. What are the probabilities that it was manufactured by machines A, B?          8  3  1  2

**(OR)**

   b. A random variable X has the following probability distribution.          8  3  1  2

| $x$    | -2  | -1 | 0   | 1   | 2   | 3   |
|--------|-----|----|-----|-----|-----|-----|
| $P(x)$ | 0.1 | k  | 0.2 | 2k  | 0.3 | 3k  |

   (i)   Find the value of k
   (ii)  Evaluate $P(X<2)$ and $P(-2<X<2)$
   (iii) Find the C.D.F of X
   (iv)  Find the mean of X

22. a. It is known that the probability of an item produced by a certain machine will be defective is 0.05. If the produced items are sent to the market in packets of 20, find the number of packets containing at least, exactly and at most 2 defective item in a consignment of 1000 packets using Binomial distribution.          8  3  2  2

**(OR)**

   b. If X is normally distributed and the mean of x is 12, standard deviation is 4. Find out the probability of the following.          8  3  2  2
      (i)    $X \geq 20$  (ii)  $X \leq 20$  (iii) $0 \leq X \leq 20$

23. a. A simple sample of heights of 6400 English men has a mean of 170 cm and a S.D of 6.4 cm, while a simple sample of heights of 1600 American's has a mean of 172 cm and a S.D of 6.3 cm. Do the data indicate that Americans are, on the average, taller than the English men?          8  4  3  2

**(OR)**