| Reg. No. | | | | | | | | | | | | | | | |
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**B.Tech. DEGREE EXAMINATION, NOVEMBER 2023**
Fifth Semester

18MAB301T – PROBABILITY AND STATISTICS
*(For the candidates admitted from the academic year 2018-2019 to 2021-2022)*

**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 & Part - C** should be answered in answer booklet.

Time: 3 hours Max. Marks: 100

**PART – A (20 × 1 = 20 Marks)** Marks BL CO
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 traveling by train or plane? 1 1 1
   (A) 2/15 (B) 11/15
   (C) 13/15 (D) 7/15

2. If Var(X) = 4, then find the value of Var(4X+5) where X is a random variable. 1 1 1
   (A) 16 (B) 64
   (C) 4 (D) 32

3. The density function of a random variable X is given by $f(x)=kx(2-x), 0\le x\le 1$ then the value of k is 1 3 1
   (A) 4/3 (B) 1/3
   (C) 2/3 (D) 3/2

4. A number is chosen at random among the first 120 natural numbers. The probability of the number chosen to be a multiple of 5 is 1 2 1
   (A) 1/5 (B) 1/8
   (C) 1/16 (D) 1/9

5. The mean of the Poisson distribution is 1 1 2
   (A) $\lambda$ (B) $\lambda^2$
   (C) $1-\lambda$ (D) $\lambda+\lambda^2$

6. The moment generating function of binomial distribution is 1 1 2
   (A) $\left(q+pe^t\right)^{-n}$ (B) $\left(q-pe^t\right)^{n}$
   (C) $\left(q+pe^t\right)^{n}$ (D) $\left(q-pe^t\right)^{-n}$

7. If the probability that an applicant for a driver's license will pass the road test on any given trial is 0.8, What is the probability that he will finally pass the test on the fourth trial? 1 3 2
   (A) 2.735 (B) 0.532
   (C) 1.283 (D) 0.0064

8. If the random variable X is uniformly distributed over (0, 10) then the value of (P(3<X<9) is 1 3 2

(A) 1.3 (B) 0.2
(C) 0.6 (D) 2.1

9. The range of F-distribution is 1 1 3

(A) –1 to 1 (B) 1 to ∞
(C) 0 to ∞ (D) 0 to 1

10. If the estimated two population variances are 3.96 and 4.79, then the test statistic value of F is 1 2 3

(A) 1.65 (B) 1.98
(C) 2.39 (D) 1.21

11. Which one of the following small sample tests is used to test the difference between two sample means? 1 1 3

(A) t-test (B) Chi-square test
(C) F-test (D) z-test

12. A type II error occurs when 1 4 3

(A) the null hypothesis is incorrectly rejected when it is true (B) the null hypothesis is incorrectly accepted when it is false
(C) the sample mean differs from the population mean (D) the test is biased

13. The range of simple correlation coefficient is 1 1 4

(A) –∞ to +∞ (B) –1 to +1
(C) 0 to 1 (D) 0 to ∞

14. The coefficient of correlation between x and y is 0.48, and their covariance is 36. If the variance of x is 16, then the standard deviation of y is. The coefficient of correlation between x and y is 0.48, and their covariance is 36. If the variance of x is 16, then the standard deviation of y is. 1 5 4

(A) 18.75 (B) 187.5
(C) 1.875 (D) 0.1875

15. If two lines of regression are $x+2y-5=0$, *and* $2x+3y-8=0$ respectively, then the means of x and y are respectively. 1 2 4

(A) 3, 3 (B) 2, 3
(C) 1, 2 (D) 5, 3

16. In two-way classification, the data are classified according to_____ different factors. 1 2 4

(A) One (B) Three
(C) Two (D) Four

17. A typical control chart consists of _____ horizontal lines. 1 1 5

(A) 4 (B) 2
(C) 1 (D) 3

18. The control chart for the fraction of defective is 1 1 5

(A) np-chart (B) p-chart
(C) c-chart (D) Range chart

19. The upper control limit of np-chart if $\overline{np}=6$ *and* $n=100$ is — 1 5 5

(A) 1.313 (B) 131.3
(C) 13.13 (D) 0.1313

20. If the calculated value of the lower control limit is negative, then we consider it as — 1 2 5

(A) Negative (B) Positive
(C) Zero (D) One

## PART – B (5 × 4 = 20 Marks)

Marks BL CO

Answer **ANY FIVE** Questions

21. A continuous random variable X has a probability density function $f(x)=kx^2e^{-x}, x\geq 0$. Find the value of k. — 4 3 1

22. Let X be a random variable following a Poisson distribution such that P(X=2)=9P(X=4)+90P(X=6). Find the mean and standard deviation of X. — 4 1 2

23. The fatality rate of typhoid patients is believed to be 17.26 percent. In a certain year, 640 patients suffering from typhoid were treated in a metropolitan hospital, and only 63 patients died. Can you consider the hospital efficient? — 4 2 3

24. Write down the format of the ANOVA table for one factor of classification. — 4 1 4

25. The number of defects in 10 carpets is 3, 4, 5, 6, 3, 3, 5, 3, 6, and 2. Find the UCL and LCL for the c-chart. — 4 1 5

26. The distribution function of a random variable X is given by $F(x)=1-(1+x)e^{-x}, x\geq 0$. Find the density function and mean of X. — 4 4 1

27. The time (in hours) required to repair a machine is exponentially distributed with the parameter $\lambda=\frac{1}{2}$. What is the probability that the repair time exceeds 2 hours? — 4 3 2

## PART – C (5 × 12 = 60 Marks)

Marks BL CO

Answer **ALL** Questions

28. a. The contents of urns I, II, and III are as follows: 2 white, 3 black, and 4 red balls; 3 white, 2 black, and 2 red balls; and 4 white, 1 black, and 3 red balls. An urn is chosen at random, and two balls are drawn. They happen to be white and red. What is the probability that they come from urns I, II, and III? — 12 4 1

**(OR)**

b. A discrete random variable X has the following probability distribution — 12 4 1

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

Find (i) k (ii) P(X<2) (iii) P(–2<X<2) (iv) the cdf of X (v) the mean of X.

29. a. Out of 800 families with 4 children each, how many families would be expected to have (i) 2 boys and 2 girls, (ii) at least 1 boy, (iii) at most 2 girls, and (iv) children of both sexes. Assume equal probabilities for boys and girls. — 12 2 2

**(OR)**

b. Fit a Poisson distribution for the following data. 12 2 2

| $x$: | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| $f$: | 142 | 156 | 69 | 27 | 5 | 1 |

30. a. Two independent samples of 8 and 7 items respectively had the following values of the variable. 12 5 3

| Sample 1: | 9 | 11 | 13 | 11 | 15 | 9 | 12 | 14 |
|---|---|---|---|---|---|---|---|---|
| Sample 2: | 10 | 12 | 10 | 14 | 9 | 8 | 10 | |

**(OR)**

b. The following table shows the distribution of digits in the numbers chosen at random from a telephone directory: 12 5 3

| Digit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 1026 | 1107 | 997 | 966 | 1075 | 933 | 1107 | 972 | 964 | 853 |

Test whether the digits may be taken to occur equally frequently in the directory.

31. a. Calculate the Karl Pearson's co-efficient of correlation to the following data. 12 3 4

| $x$: | 65 | 66 | 67 | 67 | 68 | 69 | 70 | 72 |
|---|---|---|---|---|---|---|---|---|
| $y$: | 67 | 68 | 65 | 68 | 72 | 72 | 69 | 71 |

**(OR)**

b. The sales of 4 salesmen in 3 seasons are tabulated here. Carry out an analysis of variance. 12 3 4

| | Salesmen | | | |
|---|---|---|---|---|
| Seasons | A | B | C | D |
| Summer | 45 | 40 | 38 | 37 |
| Winter | 43 | 41 | 45 | 38 |
| Monsoon | 39 | 39 | 41 | 41 |

32. a. The following are the sample means $\overline{X}$ and sample ranges R for 10 samples, each of size 5. Construct the control chart for mean and range and comment on the state of control. 12 4 5

| Sample | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean ($\overline{X}$) | 12.8 | 13.1 | 13.5 | 12.9 | 13.2 | 14.1 | 12.1 | 15.5 | 13.9 | 14.2 |
| Range | 2.1 | 3.1 | 3.9 | 2.1 | 1.9 | 3.0 | 2.5 | 2.8 | 2.5 | 2.0 |

**(OR)**

b. 15 samples of 200 items each were drawn from the output of a process. The number of defective items in the samples are given below, prepare a control chart for the fraction defective and comment on the state of control. 12 4 5

| Sample | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of defective | 12 | 15 | 10 | 8 | 19 | 15 | 17 | 11 | 13 | 20 | 10 | 8 | 9 | 5 | 8 |

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