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Question Paper Code :R3M21

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Third Semester

Mechanical Engineering

R21UMA321-PROBABILITY, STATISTICS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to Chemical Engineering)

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. Which of the following discrete distribution has equal mean and variance? CO6-U
(a) Binomial (b) Poisson (c) Normal (d) None of the above
2. The limiting form of a Poisson distribution is CO6-U
(a) Geometric (b) Binomial (c) Normal (d) None of the above
3. Small sample size is _____ CO6-U
(a) 30 (b) > 30 (c) < 30 (d) None of these
4. F – test is used to test for equality of _____ CO6-U
(a) Mean (b) Variance (c) Both (a) & (b) (d) None of these
5. Factors in a factorial design are the _____. CO6-U
(a) The dependent variables (b) The organismic variables
(c) Means (d) All of the above
6. What statistical procedure is used to assess the statistical significance of the main effects and the interaction(s) in a factorial design? CO6-U
(a) Analysis of covariance (b) Correlation (c) T – test (d) Analysis of variance
7. The complementary function of $(D^2 - 2DD' + D'^2)z = 0$ is _____ CO4-App
(a) $f_1(y+x) + f_2(y-x)$ (b) $f_1(y+x) + xf_2(y+x)$

(c) $f_1(y+x) + x^2 f_2(y+x)$

(d) none of these

8. The particular integral of $(D^2 + 3DD' - 4D'^2)z = \sin y$ is CO4-App

(a) $\frac{1}{2} \sin y$

(b) $\frac{1}{4} \sin y$

(c) $\sin y$

(d) $-\sin y$

9. The P.d.e of one dimensional heat flow CO6 – U

(a) $\frac{\partial u}{\partial t} = \alpha^2 \frac{\partial^2 u}{\partial x^2}$

(b) $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$

(c) $\frac{\partial^2 u}{\partial t^2} = \alpha^2 \frac{\partial^2 u}{\partial x^2}$

(d) None of these

10. $2u_{xx} + 3u_x u_y + u_{yy} = x$ is a type of CO6 – U

(a) Hyperbolic

(b) Parabolic

(c) elliptic

(d) None of these

PART – B (5 x 2= 10 Marks)

11. Find the mean for the discrete RV X with probability distribution CO1-App

x	-2	-1	0	1
P(X)	0.2	3k	0.2	0.3

12. State any two applications of t –test CO6-U

13. What is the aim of design of experiments? CO6-U

14. Form the PDE by eliminating arbitrary constants from $z = (x+a)^2 + (y+b)^2$ CO4-App

15. Classify the differential equation $3 \frac{\partial^2 u}{\partial x^2} + 4 \frac{\partial^2 u}{\partial x \partial y} + 6 \frac{\partial^2 u}{\partial y^2} - 2 \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} - u = 0$ CO5-App

PART – C (5 x 16= 80 Marks)

16. (a) The probability distribution function of a random variable X is CO1-App (16)

$$f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 1 < x < 2 \\ 0, & x > 2 \end{cases}$$

Calculate the cumulative distribution, mean and variance

Or

- (b) Obtain the Correlation coefficient for the following data CO1-App (16)

X	12	15	17	18	23	16	25	27
Y	110	120	124	130	136	122	140	143

17. (a) Two independent samples of sizes 9 and 7 from a normal population CO2-App (16)
had the following values of the variables.

Sample I	18	13	12	15	12	14	16	14	15
Sample II	16	19	13	16	18	13	15	-	-

Investigate the estimates of the population variance differ significantly at 5% level?

Or

- (b) The table below gives the number of aircraft accidents that occurred CO2-App (16)
during the various days of the week. Test whether the accidents are uniformly distributed over the week.

Days	M on	Tue	Wed	Thu	Fri	Sat
No. of Accidents	14	18	12	11	15	14

18. (a) A completely randomized design experiment with 10 plots and 3 CO3-Ana (16)
treatments gave the following results:.

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

Or

- (b) The following data represent the number of units production per day CO3-Ana (16)
turned out by different workers using 4 different types of machines.

		Machine Type			
Workers		A	B	C	D
	1	44	38	47	36
	2	46	40	52	43
	3	34	36	44	32
	4	43	38	46	33
	5	38	42	49	39

Test whether the five men differ with respect to mean productivity and test whether the mean productivity is the same for the four different machine types.

19. (a) (i) Solve $(D^2 - 5DD' + 6D'^2)z = e^{x+y} + \sin(x-y)$ CO4-App (8)
- (ii) Form a PDE by eliminating ϕ from $\phi(x^2 + y^2 + z^2, x + y + z) = 0$ CO4-App (8)
- Or
- (b) (i) Solve $(mz - ny)p + (nx - lz)q = ly - mx$ CO4-App (8)
- (ii) Solve $z = px + qy + p^2q^2$ CO4-App (8)
20. (a) A String is stretched and fastened to two points 1 apart .Motion is started by displacing the string into the form $y=\lambda x(1-x)$ from which it is released at $t=0$.Find the displacement of any point at a distance 'x' at any time 't'. CO5-App (16)
- Or
- (b) A rod 20cm long has its ends A and B kept at 30oc and 80oc respectively until steady state conditions prevails. Then the Temperature at the ends A and B are changed to 40oc and 60oc respectively. Find $u(x,t)$. CO5-App (16)