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**Question Paper Code :R3M21**

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

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)

- Probability of sure event is CO6-U  
(a) 0 (b) 1 (c) 2 (d) 10
- The limiting form a Poisson distribution is CO6-U  
(a) Geometric (b) Binomial (c) Normal (d) None of the above
- Small sample size is \_\_\_\_\_ CO6-U  
(a) 30 (b) > 30 (c) < 30 (d) None of these
- F – test is used to test for equality of \_\_\_\_\_ CO6-U  
(a) Mean (b) Variance (c) Both (a) & (b) (d) None of these
- Factors in a factorial design are the \_\_\_\_\_. CO6-U  
(a) The dependent variables (b) The organismic variables  
(c) Means (d) All of the above
- What statistical procedure is used to assess the statistical CO6-U  
significance of the main effects and the interaction(s) in a factorial  
design?  
(a) Analysis of covariance (b) Correlation (c) T – test (d) Analysis of variance
- 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. The one dimensional heat equation is \_\_\_\_\_ CO6 – U
- (a) Hyperbolic                      (b) Parabolic                      (c) cyclic                      (d) None of these

PART – B (5 x 2= 10Marks)

11. If Correlation coefficient  $r = 0.4$ ,  $\sigma_x = 5$ ,  $\sigma_y = 2$ , find the Covariance of x and y. CO1-App
12. Write the formula for the chi- square test of goodness of fit of a random sample to a hypothetical distribution CO6-U
13. Is a 2 X 2 Latin Square Design possible? Why? CO6-U
14. Form the PDE by eliminating the arbitrary function f from  $z = f(x^2-y^2)$  CO4-App
15. The ends A and B of a rod of length 10cm long have their temperature kept at 20°c & 70°c. Find the steady state temperature distribution on the rod. CO5-App

PART – C (5 x 16= 80Marks)

16. (a) A RV X has the following distribution CO1-App (16)

|      |   |    |    |    |    |     |     |     |     |
|------|---|----|----|----|----|-----|-----|-----|-----|
| X    | 0 | 1  | 2  | 3  | 4  | 5   | 6   | 7   | 8   |
| P(X) | a | 3a | 5a | 7a | 9a | 11a | 13a | 15a | 17a |

- i) Find 'a'    ii)  $P(X < 3)$     iii)  $E(X)$     iv)  $Var(X)$

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 had the following values of the variables. CO2-App (16)

|           |        |    |    |    |        |        |        |        |        |
|-----------|--------|----|----|----|--------|--------|--------|--------|--------|
| Sample I  | 1<br>8 | 13 | 12 | 15 | 1<br>2 | 1<br>4 | 1<br>6 | 1<br>4 | 1<br>5 |
| Sample II | 1<br>6 | 19 | 13 | 16 | 1<br>8 | 1<br>3 | 1<br>5 | -      | -      |

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

Or

- (b) Two independent samples are chosen from two schools A and B, a common test is given in a subject. The scores of the students as follows: CO2-App (16)

|           |    |    |    |    |    |    |    |    |
|-----------|----|----|----|----|----|----|----|----|
| Section A | 76 | 68 | 70 | 43 | 94 | 68 | 33 | -  |
| Section B | 40 | 48 | 92 | 85 | 70 | 76 | 68 | 22 |

Can we conclude that students of school A performed better than students of section B?

18. (a) Analyze the following is a Latin square of a design. CO3-Ana (16)

|          |          |          |          |
|----------|----------|----------|----------|
| A<br>105 | B 95     | C 125    | D<br>115 |
| C115     | D<br>125 | A<br>105 | B 105    |
| D<br>115 | C 95     | B 105    | A<br>115 |
| B 95     | A<br>135 | D 95     | C 115    |

Or

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

|         |   | Machine Type |    |    |    |
|---------|---|--------------|----|----|----|
|         |   | A            | B  | C  | D  |
| Workers | 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  $\phi$  from CO4-App (8)
- $$\phi(x^2 + y^2 + z^2, x + y + z) = 0$$
- 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 l 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 bar of 10cm long with insulated sides has its ends A and B kept at  $50^\circ\text{c}$  and  $100^\circ\text{c}$  respectively until steady state condition prevail. The temperature at A is then suddenly raised to  $90^\circ\text{c}$  and at the same instant B is lower to  $60^\circ\text{c}$  and maintained thereafter. Find the subsequent temperature distribution in the bar. CO5-App (16)