

Reg. No.																			
Question Paper Code	14128																		

M.E. - DEGREE EXAMINATIONS, NOV / DEC 2025
 Second Semester
Industrial Safety Engineering
20PISMA101 – PROBABILITY AND STATISTICAL METHODS
 Regulations - 2020

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

Marks *K-Level* *CO*

- | | | | |
|--|---|----|-----|
| 1. A binomial distribution has parameters $n = 10$ and $p = 0.5$. What is the mean?
(a) 2.5 (b) 5 (c) 10 (d) 0.5 | 1 | K2 | CO1 |
| 2. If X and Y are independent random variables, the MGF of X + Y is
(a) $M_X(t) + M_Y(t)$ (b) $M_X(t) \cdot M_Y(t)$ (c) $M_X(t - Y)$ (d) $M_X(t) - M_Y(t)$ | 1 | K1 | CO1 |
| 3. The regression line of Y on X is given by
(a) $y = a + bx$ (b) $x = a + by$ (c) $y = bx$ (d) $y = x + a$ | 1 | K1 | CO2 |
| 4. The first population moment about the origin is
(a) $E(X^2)$ (b) $E(X)$ (c) $E(X - \bar{X})$ (d) $E(X - \mu)^2$ | 1 | K1 | CO2 |
| 5. For small samples ($n < 30$) with unknown population variance, the appropriate test statistic is
(a) Z (b) t (c) F (d) Chi-square | 1 | K1 | CO3 |
| 6. A sample of 64 items has mean 80. Population $\sigma = 16$. Z-test statistic for testing $\mu = 75$ is
(a) 1.25 (b) 2.5 (c) 5 (d) 20 | 1 | K2 | CO3 |
| 7. The error degrees of freedom in a Latin Square with p treatments is
(a) $(p - 1)(p - 2)$ (b) $p(p - 1)$ (c) $(p - 1)^2$ (d) $2(p - 1)$ | 1 | K1 | CO5 |
| 8. ANOVA is used to compare
(a) Only two population means (b) More than two population means
(c) Variances of two samples (d) Standard deviations | 1 | K1 | CO6 |
| 9. A 3-period moving average of the series (6, 9, 12, 15, 18) at time $t=4$ is
(a) 10 (b) 12 (c) 13 (d) 15 | 1 | K2 | CO4 |
| 10. A key characteristic of an Auto Regression process that it models the relationship between a variable and its:
(a) Moving averages (b) Random shocks (c) Past Values (d) Seasonal cycles | 1 | K1 | CO4 |

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

- | | | | |
|--|---|----|-----|
| 11. Define random variables. | 2 | K1 | CO1 |
| 12. If A and B are event in S such that $P(A)=1/3, P(B)=1/4$ and $P(A \cup B)=1/2$. Find $P(A \cap B)$ and $P(A/B)$. | 2 | K2 | CO1 |
| 13. Mention the properties of a good estimator. | 2 | K1 | CO2 |
| 14. What is meant by maximum likelihood estimator? | 2 | K1 | CO2 |
| 15. Define Standard error. | 2 | K1 | CO3 |
| 16. State any two applications of χ^2 -test. | 2 | K1 | CO3 |
| 17. What is the aim of design of experiments? | 2 | K2 | CO4 |
| 18. Define Randomization. | 2 | K1 | CO4 |
| 19. What are the uses of ANOVA? | 2 | K2 | CO6 |
| 20. Write any two differences between RBD and LSD. | 2 | K2 | CO6 |
| 21. Write the limitation of method of moving average. | 2 | K2 | CO4 |
| 22. State Type I & Type II error. | 2 | K1 | CO4 |

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) The probability mass function of a discrete R.V X is given in the following table: 11 K3 CO1

X	-2	-1	0	1	2	3
P(X=x)	0.1	k	0.2	2k	0.3	k

Find (i) the value of k (ii) P(X<1), (iii) P(-1≤X≤2), (iv) E(X)

OR

- b) (i) Find the MGF of Binomial distribution. 5 K3 CO1
 (ii) Messages arrive at a switch board in a Poisson manner at an average rate of 6 per hour. Find the probability that (i) exactly 2 messages arrive within one hour, 6 K3 CO1
 (ii) no messages arrives within one hour and (iii) atleast 3 messages arrive within one hour.

24. a) From the following data, 11 K3 CO2

Economics X	25	28	35	32	31	36	29	38	34	32
Statistics Y	43	46	49	41	36	32	31	30	33	39

Find (i) the two regression equations, (ii) the coefficient of correlation between the marks in economics and statistics, (iii) the most likely marks in Statistics when marks in Economics are 30.

OR

- b) Fit a straight line $y=a+bx$ to the following data, using principle of least squares 11 K3 CO2

x	1	2	3	4	6	8
y	2.4	3	3.6	4	5	6

25. a) The means of two random samples of size 9 and 7 are 196.42 and 198.92 respectively. The sum of the squares of the deviation from the mean are 26.94 and 18.73 respectively. Can the sample be considered to have been drawn from the same normal population? 11 K3 CO3

OR

- b) An sample analysis of examination results of 500 students was made. It was found that 220 students had failed. 170 had secured a third class, 90 were placed in second class and 20 got first class. Do these figures commensurate with the general examination result which is in the ratio 4:3:2:1 for the various categories respectively. 11 K3 CO3

26. a) An experiment was planned to study the effect of sulphate of potash and superphosphate on the yields of potatoes. All the combinations of 2 levels of superphosphate (p) and two levels of sulphate (k) of potash were studied in a RBD with 4 replication for each. The yields obtained are given in the following table. 11 K3 CO5

Stations	A	B	C	D
1	7	14	11	11
2	15	16	14	10
3	8	15	10	12

Analyze the data and give your conclusion (with $\alpha=1\%$)

OR

- b) The figures in the following 5x5 Latin square are the numbers of minutes, engines E1, E2, E3, E4 and E5, tuned up by mechanics M1, M2, M3, M4 and M5, ran with a gallon of fuel A, B, C, D and E. 11 K3 CO5

	E1	E2	E3	E4	E5
M1	A31	B24	C20	D20	E18
M2	B21	C27	D23	E25	A31
M3	C21	D27	E25	A29	B21
M4	D21	E25	A33	B25	C22
M5	E21	A37	B24	C24	D20

Use the level of significance $\alpha = 0.01$ to test

- The null hypothesis H_0 that there is no difference in the performance of the five engines.
- H_0 that the persons who tuned up these engines have no effect on their performance.
 H_0 that the engines perform equally well with each of the fuels.

27. a) As part of the investigation of the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected all the steel structure at three different positions on the roof. The forces required to shear each of these bolts (coded values) are as follows: 11 K3 CO6

Position1:	90	82	79	98	83	91	
Position2:	105	89	93	104	89	95	86
Position3:	83	89	80	94			

Analyze an analysis of variance to test at 0.05 level of significance whether the differences among the sample means at the three positions are significant.

OR

- b) A Latin square design was used to compare the bond strength of gold semiconductor lead wires bounded to the lead terminal by five different methods A, B, C, D & E. The bonds were made by five different operators and the devices were encapsulated using five different plastics. With the following result, expressed as pounds of force required to break the bond 11 K3 CO6

Plastics / Operator	1	2	3	4	5
1	A 3.0	B 2.4	C 1.9	D 2.2	E 1.7
2	B 2.1	C 2.7	D 2.3	E 2.5	A 3.1
3	C 2.1	D 2.6	E 2.5	A 2.9	B 2.1
4	D 2.0	E 2.5	B 3.2	B 2.5	C 2.2
5	E 2.1	A 3.6	B 2.4	C 2.4	D 2.1

28. a) With the following values for 11 years, prepare forecast by the method of exponential smoothing taking initial estimate as 100 and the value of $\alpha = 0.4$, $1-\alpha=0.6$ and $(1-\alpha)/\alpha=1.5$. 11 K3 CO4

Time period (t)	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Actual value (X)	110	105	120	116	121	123	120	125	126	124	122

OR

- b) For the following data, verify that the 5 year weighted moving average with weights 1, 2, 3, 3, 1 respectively is equivalent to 4 year centered moving average. 11 K3 CO4

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Sales (Rs.in lakhs)	5	3	7	6	4	8	9	10	8	9	9