Name:
Enrollment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2021

Programme Name: B.Tech GSE **Semester : VI**
Course Name : Statistical Methods in GeoSciences **Time : 03 hrs**
Course Code: PEGS 3005 **Max. Marks : 100**

<table>
<tr><th colspan="4">Section A
(All questions are compulsory.)</th></tr>
<tr><td>1.</td><td>Two marbles are drawn in succession from a box containing 10 red, 30 white, 20 blue and 15 green marbles, with replacement after each drawing. Find the probability that both are white.</td><td>[5]</td><td>CO1</td></tr>
<tr><td>2.</td><td>The time in hours required to repair a machine is exponentially distributed with parameter$\lambda = {}^{1}/_{3}$. What is the probability that the repair time exceeds 3 hours?</td><td>[5]</td><td>CO2</td></tr>
<tr><td>3.</td><td>If X is a random variable with mean μ and variance σ^2, then $\frac{2x_1-x_6+x_4}{6}$ is an unbiased estimator of
a) $\frac{\sigma}{\sqrt{6}}$
b) $\sigma\sqrt{{}^{1}/_{3}}$
c) $\mu/3$
d) σ^2</td><td>[5]</td><td>CO3</td></tr>
<tr><td>4.</td><td>The number of messages sent per hour over a computer network has a following probability distribution:
<table>
<tr><td>x</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td>$P(X=x)$</td><td>0.08</td><td>0.15</td><td>0.30</td><td>0.20</td><td>0.20</td><td>0.07</td></tr>
</table>
Determine the mean of the number of messages sent per hour.</td><td>[5]</td><td>CO4</td></tr>
<tr><td>5.</td><td>Assuming second order stationary condition and intrinsic hypothesis, write relation between semivariogram and covariance functions.</td><td>[5]</td><td>CO5</td></tr>
<tr><td>6.</td><td>In which kriging E[Z(x)] is assumed constant and known</td><td>[5]</td><td>CO5</td></tr>
</table>

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SECTION B
(Q1-Q5 are compulsory and Q5 has internal choices.)

1. Consider sequences of coin flips. Each flip in a sequence is independent of other flips in the sequence. Head and tail are equally likely in each flip. Let X be a random variable denoting the number of flips before a head appear for the first time. Find the probability mass function of the random variable $X-1$.

[10] **CO1**

2. If X and Y are two random variables with joint probability density function given by

$$f(x,y)=\left\{\begin{matrix}2, & 0<y<x<1\\ 0, & otherwise\end{matrix}\right\}$$

Obtain

(a) The marginal and conditional probability density functions.
(b) The conditional means $E(X|Y)\ and\ E(Y|X)$

[10] **CO2**

3. Two samples of sizes 9 and 8 give the sum of squares of deviations from their respective means equals to 160 sq. inches and 91 sq. inches. Can these be regarded as drawn from same normal population?

[10] **CO3**

4. The following are data on the number of twists required to break a certain kind of forged alloy bar and the percentages of two alloying elements present in the metal:

Number of twists Y	Percent of element A x_1	Percent of element B x_2
41	1	5
49	2	5
69	3	5
65	4	5
40	1	10
50	2	10
58	3	10
57	4	10
31	1	15
36	2	15
44	3	15
57	4	15
19	1	20
31	2	20
33	3	20
43	4	20

Fit a least square regression plane and use its equations to estimate the number of twists required to break one of the bars when $x_1=2.5$ and $x_2=12$

[10] **CO4**

5.

A geologist claims that mean temperature in certain region inside the Earth in kelvin is 345K. To verify the claim, following temperatures are obtained at randomly selected locations in the region: 340, 356, 332, 362, 318, 344, 386, 402, 322, 360, 362, 354, 340, 372, 338, 375, 364, 355, 324, 370. Do the data contradict the geologist's claim?

OR

With equal probability, the observations 5, 10, 8, 2 1nd 7 show the number of defective units found during five inspections in a laboratory. Find the first four central moments,

[10] **CO4**

SECTION C

(Q1 is compulsory and has internal choices.)

1A

Define semi- variogram and explain semi-variogram model.

OR

Mathematically, define the ordinary kriging error variance, and express it as a function of variogram function.

[10]

1B

Use simple kriging to estimate the value of $Z(x_0)$ at $x_0 = (180, 120)$. Given $E[Z(x)] = 110$ and the covariance function $2000 * \exp(\frac{-h}{250})$.

	X	Y	Z
x_1	387	72	50
x_2	392	81	56
x_3	388	56	a

here a=$52 + \frac{3}{250}d$, where d is the three digit number formed by last three digits of your roll number. For example if your roll number is R870218125, then d=125.

OR

Use ordinary kriging to estimate the value of $Z(x_0)$ at $x_0 = (180, 120)$. Given, covariance function as $2000 * \exp(\frac{-h}{250})$.

[10] **CO5**

	X	Y	Z
x_1	387	72	50
x_2	392	81	a

here a=$55+\frac{3}{250}d$, where d is the three digit number formed by last three digits of your roll number. For example if your roll number is R870218125, then d=125.