13/05/2025 SE CHEMICAL SEM-IV C-SCHEME EM-IV QP CODE: 10082313

(3 Hours) **[Total Marks: 80]**

N.B. : 1) Question No. **1** is **Compulsory**.
2) Answer **any THREE** questions from Q.2 to Q.6.
3) Figures to the right indicate full marks.

Q.1 (a) Fit a straight line to the following data **(5)**

X	1	2	3	4	5	6
Y	49	54	60	73	80	86

(b) Calculate Correlation coefficient between the variables x and y for the following data **(5)**

X	12	15	18	21	27
Y	2	4	6	8	12

(c) Let X be a continuous random variable with probability density function $f(x) = \frac{x}{6} + k,\ 0 \le x \le 3$ Find k and $(1 \le x \le 2)$. **(5)**

(d) Find the line integral of $\bar{F} = x^2 i + xyj$ along line OP where, $O = (0,0)\ and\ P = (1,1)$. **(5)**

Q.2 (a) A random variable x has the following probability function **(6)**

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) E(X)

(b) Prove that $\bar{F} = (x + 2y + az)i + (bx - 3y - z)j + (4x + cy + 2z)k$ is solenoidal and find the constants a,b,c if $\bar{F}$ is irrotational. **(6)**

(c) Evaluate $\int_c \frac{z+6}{z^2-4} dz$ where c is (i) $|z| = 1$ (ii) $|z - 2| = 1$ (iii) $|z + 2| = 1$. **(8)**

Q.3 (a) The average breaking strength of steel rods is specified to be 17.5 (in units of 1000 kg) to test this sample of 14 rods tested & gave the following results: 15, 18, 16, 21, 19, 21, 17, 17, 15, 17, 20, 19, 17, 18. Is the result of the experiment significant? **(6)**

(b) Use Green's theorem to evaluate $\int_c (2x^2 - y^2)\, dx + (x^2 + y^2) dy$ where c is the boundary of the region enclosed by the lines $x = 0, y = 0, x = 2, y = 2$. **(6)**

(c) If height of 500 students are normally distributed with mean 68 inches and standard deviation 4 inches, Find the number of students having heights (i) greater than 72 inches (ii) between 65 and 71 inches (iii) less than 62 inches. **(8)**

Q.4 **(a)** Use Gauss Divergence theorem to evaluate $\iint_s \bar{F}.\hat{n}ds$ where $\bar{F} = 4xz\hat{i} - y^2\hat{j} + yz\hat{k}$ and s is the surface of the cube bounded by $x = 0,\ x = 1,\ y = 0,\ y = 1, z = 0, z = 1$. **(6)**

(b) Find the lines of regression for the following data to estimate y corresponding to $x = 155$ **(6)**

X	100	110	120	130	140	150	160	170	180	190
Y	45	51	54	61	66	70	74	78	85	89

(c) Find all possible Laurent's series expansion of the function $f(z) = \frac{5z+7}{(z+3)(z+2)}$ about $z = 0$ indicating region of convergence. **(8)**

Q.5 **(a)** The standard deviation from two random samples of sizes 9 and 13 are 1.99 and 1.9. Can the samples be regard as drawn from normal population with same standard deviation?$(F_{(8,12)}(0.025) = 3.51, F_{(12,8)}(0.025) = 4.20)$ **(6)**

(b) Using Stoke's Theorem to evaluate $\int_c \bar{F}.d\bar{r}$ where $\bar{F} = yi + zj + xk$ and c is the boundary of surface $x^2 + y^2 = 1 - z,\ z > 0$. **(6)**

(c) In an experiment on immunization of cattle from tuberculosis the following results were obtained (use 5% LOS) **(8)**

	Affected	Not Affected	Total
Inoculated	267	27	294
Not Inoculated	757	155	912
Total	1024	182	1206

Use Chi Square test to determine the efficiency of vaccine in preventing tuberculosis.

Q.6 **(a)** A bag contains 7 red balls and 3 black balls and another bag contains 4 red balls and 5 black balls. One ball is transferred from the first bag to the second bag then a ball is drawn from the second bag. If this ball happens to be red, Use Bayes' theorem to find the probability that a black ball was transferred. **(6)**

(b) A car hire firm has 2 cars which it hires out day by day. The number of demands for a car on each day is distributed as Poisson variate with mean 1.5. Calculate the probability of days on which some demand is refused. **(6)**

(c) Show that $\bar{F} = (2xy + z)i + (x^2 + 2yz^3)j + (3y^2z^2 + x)k$ is conservative. Find scalar potential such that $\bar{F} = \nabla\emptyset$ and hence, find the work done by $\bar{F}$ in displacing a particle from (1,2,0) to (2,2,1). **(8)**

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