

9. The relation between the friction factor f and Reynold's number Re is of the form, $f = aRe^m$.
From the set of following data determine the values of a and m by regression method.

Re	4230	5030	5780	9600	12600	15600
f	0.0098	0.0095	0.0092	0.0081	0.0075	0.0071

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**STATISTICAL ANALYSIS
(REEN 5146)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The 95% confidence interval means _____ % level of significance.
(a) 100 (b) 5 (c) 1 (d) 95
- (ii) The degrees of freedom means
(a) the total number variables
(b) the number of constant parameter but not the variables
(c) the number independent variables
(d) the number which is one less the number independent variables.
- (iii) The binomial distribution is a
(a) discrete distribution (b) synonym of normal distribution
(c) skewed distribution (d) virtual distribution.
- (iv) The Poisson distribution is a
(a) discrete distribution (b) synonym of normal distribution
(c) skewed distribution (d) virtual distribution.
- (v) The design of experiments can accrue useless results if it has
(a) randomized variables (b) replicates
(c) confounding variables (d) error.
- (vi) Spearman's rank correlation coefficient varies from
(a) $-\infty$ to $+\infty$ (b) 0 to $+\infty$
(c) 0 to +1 (d) -1 to +1.
- (vii) Chi square distribution is a _____ distribution.
(a) discrete (b) continuous
(c) virtual (d) none of the above

- (viii) The Statement "The sampling distribution of the sample means approaches a normal distribution as the sample size gets larger — no matter what the shape of the population distribution" is known as
 - (a) Thevenin's theorem
 - (b) Central Limit theorem
 - (c) Sampling theorem
 - (d) de Moivre–Laplace theorem.
- (ix) The first order model of Response Surface Methods is known as
 - (a) Method of Steepest Ascent
 - (b) Method of Constrained Optimization
 - (c) Method of Quadratic Programming
 - (d) Method of LPP.
- (x) If X is a random variable, then P(X) is the _____ of X.
 - (a) Shewart's normal distribution
 - (b) Density Function
 - (c) Probability Distribution
 - (d) de Moivre–Laplace theorem.

Group – B

- 2. If $\mu_x = E(x) = \int_{-\infty}^{+\infty} xf(x)dx$ where, x is continuous and $\sum xP(x)$, where, x is discrete, then prove that $\mu_{np} = E(r) = np$ and $\sigma_{np} = E(r^2) = \sqrt{np(1-p)}$ (symbols stand for usual notations). 12
- 3. A random variable X is distributed at random between the values 0 and 1 so that its probability density function is $f(x) = kx^2(1-x^3)$, where, k is a constant. Find the value of k, the mean and standard deviation of the distribution. (4 × 3) = 12

Group – C

- 4. An engineer has studied the formulation of a Portland cement mortar, by adding a polymer latex emulsion during mixing to determine if this impacts the curing time and tension bond strength of the mortar. The investigation data are given below:

Sl. No.	Modified Mortar (y _{1j})	Unmodified mortar (y _{2j})
1	16.85	17.50
2	16.40	17.63
3	17.21	18.25
4	16.35	18.00
5	16.52	17.86
6	17.04	17.75
7	16.96	18.22
8	17.15	17.90
9	16.59	17.96
10	16.57	18.15

Conduct a t-test and draw your conclusions.

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- 5. When the first proof of 322 pages of a book of 1100 pages were read, the distribution of printing mistakes were found as follows:

No. of mistakes in a page (x)	0	1	2	3	4	5	6
No. of pages (f)	275	72	30	7	5	2	1

Fit a Poisson distribution to the above data and test the goodness of fit.

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Group – D

- 6. A textile company weaves a fabric on a large number of looms. They would like the looms to be homogeneous so that they can obtain a fabric of uniform strength. The process engineer suspect that, in addition to the usual variation in strength within samples of fabric from the same loom, there may also be significant variations in the strength between looms. To investigate this she selects four looms at random and makes four strength determinations on the fabric manufactured on each loom. This experiment is run in random order, and data obtained are shown in the following table.

Observation					
Looms	1	2	3	4	y _i
1	98	97	99	96	390
2	91	90	93	92	366
3	96	95	97	95	383
4	95	96	99	98	388
Total					1527

Formulate the Design Experiment model for this problem. Stating suitable hypothesis formulate the ANOVA table and compute the values of degrees of freedom for the problem.

(6 + 6) = 12

- 7. Using data given in Question No. 6 carry out analysis of variance and draw your conclusion.

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Group – E

- 8. Discuss the step by step procedure of carrying out Multiple Linear Regression process, explaining the symbols used.

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