

Reg. No. :

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

**Question Paper Code : 60811**

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

First Semester

Construction Engineering and Management

MA 5165 — STATISTICAL METHODS FOR ENGINEERS

(Common to : Environmental Engineering/Infrastructure Engineering and Management/Remote Sensing)

(Regulations 2017)

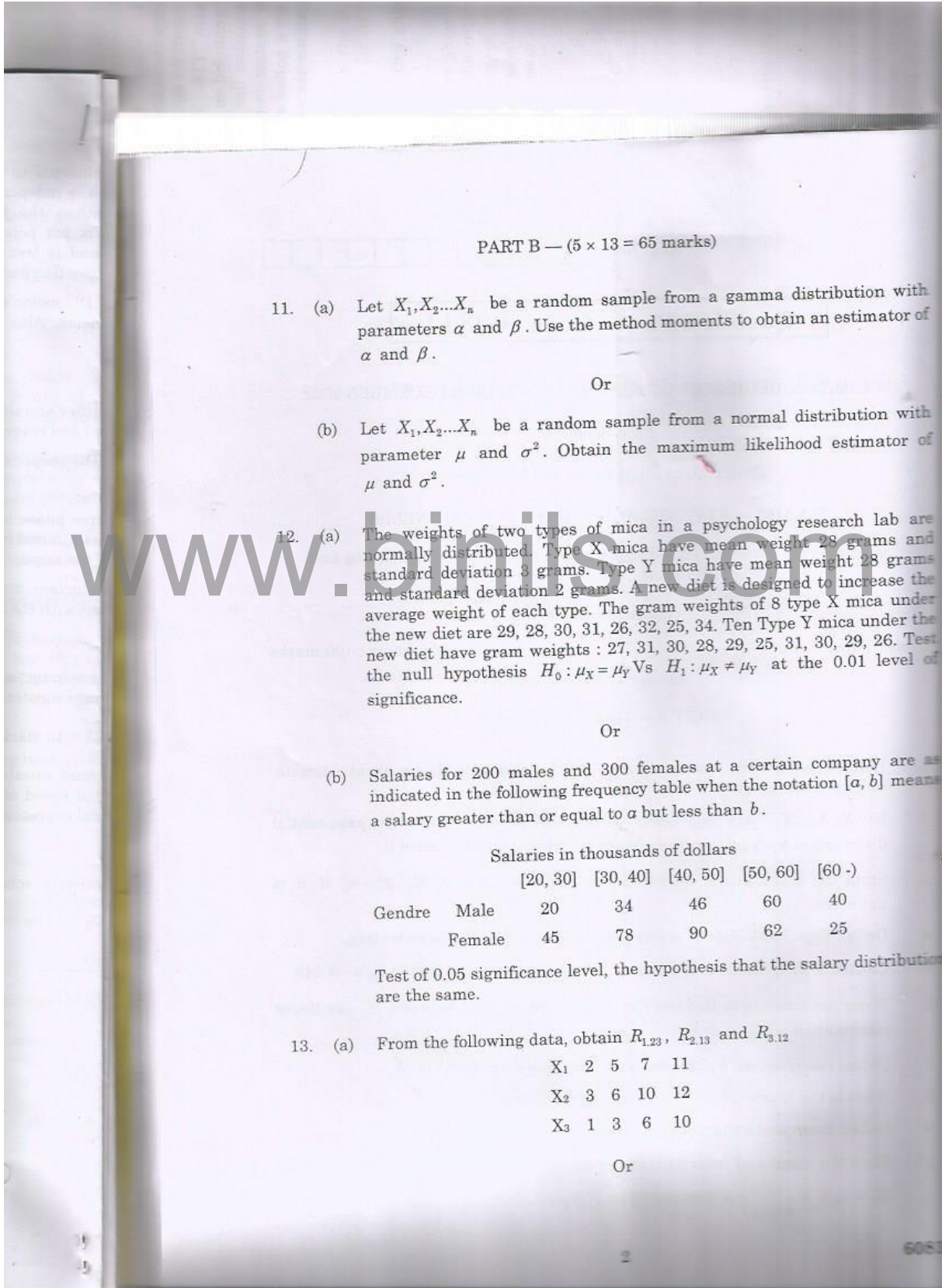
Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

- Define the following terms with reference to estimation theory. Print estimate, unbiased estimator.
- If  $X_1, X_2, \dots, X_n$  are independent random sample from an exponential distribution with parameter  $\lambda$ , write the likelihood function of it.
- State the test statistic for testing the null hypothesis  $H_0 : \sigma^2 = \sigma_0^2$  if  $\mu$  is unknown.
- Define Type I and Type II errors with reference to Hypothesis testing.
- Calculate the partial correlation  $r_{12.3}$  if  $r_{12} = -0.369$ ,  $r_{13} = 0.918$ ,  $r_{23} = -0.245$ .
- Write the formula to find out the multiple correlation between  $X_1$  are linear combination of  $X_2$  and  $X_3$ .
- Define mean square for treatments in the Single-factor ANOVA.
- What is the characteristics of a Latin square design?
- Define mean and covariance of the  $b \times 1$  random vector.
- State the mean and covariance of the conditional distribution of  $X$ , given that  $X_2 = x_2$  if  $X = \begin{pmatrix} X_1 \\ X_2 \end{pmatrix}$  is distributed as  $N_p(\mu, \Sigma)$ .



39. From the given data in the following table, find out least square regression equation of  $X_1$  on  $X_2$  and  $X_3$  and hence estimate the value of  $X_1$  for  $X_2 = 45$  and  $X_3 = 8$ .

$X_1$	1	2	3	4	5
$X_2$	3	4	5	6	7
$X_3$	4	5	6	7	8

40. The following are the cholesterol contents in milligrams per package which four laboratories obtained for 6 ounce packages of these very similar diet foods. Perform a two way analysis of variance and test the null hypothesis concerning the diet food and the laboratories at the 5% level of significance.

	Lab	A	B	C
Diet food				
1		3.4	2.6	2.8
2		3	2.7	3.1
3		3.3	3.0	3.4
4		3.5	3.1	3.7

Or

41. Analyse the following results of Latin square experiment.

	1	2	3	4
1	A(12)	D(20)	C(16)	B(10)
2	D(18)	A(14)	B(11)	C(14)
3	B(12)	C(15)	D(19)	A(13)
4	C(16)	B(11)	A(15)	D(20)

Where the letters A, B, C and D denote the treatments and the figures in brackets denote the observation value.

42. Find the mean vector and covariance matrix for the linear combinations.

$$Z_1 = X_1 - 2X_2 + X_3$$

$$Z_2 = 2X_1 - X_2 + X_3$$

$$Z_3 = X_1 + X_2 - 2X_3$$

Or

43. Let  $\Sigma = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ , determine the principal components  $Y_1, Y_2$  and  $Y_3$ .

## PART C — (1 × 15 = 15 marks)

16. (a) A research article reports the following data on the number of borers in each of 120 groups of borers. Does the Poisson probability mass function provide a plausible model for the distribution of the number of borers in a group?

Number of borers : 0 1 2 3 4 5 6 7 8 9 10 11 12

Frequency : 24 16 16 18 15 9 6 5 3 4 3 0 1

Or

- (b) (i) A random sample of five values of a normal random variable  $X$  is : 10, 12, 18, 27, 13 and a random sample of 6 values of a normal random variable  $Y$  is : 23, 24, 31, 26, 28, 30. Test the null hypothesis  $H_0: \sigma_x^2 = \sigma_y^2$  against the alternative hypothesis  $H_1: \sigma_x^2 > \sigma_y^2$  at the 0.01 significance level. (8)

- (ii) Given the following data :

$x$  0 1 2 3 4  
 $y$  1 5 10 22 38

Find the parabola of best fit by the method of moments. (7)