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Question Paper Code : 41313

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Fourth/Fifth Semester
Mechanical Engineering
MA 6452 – STATISTICS AND NUMERICAL METHODS
(Common to Mechanical Engineering (Sandwich)/Automobile Engineering/ Mechatronics Engineering)
(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Define the following terms : Statistic, Parameter, Standard Error and Random Sampling.
2. For the following cases, specify which probability distribution to use in a hypothesis test.
   a) $H_0 : \mu = 27, H_1 : \mu \neq 27, \bar{X} = 20.1, \sigma = 5, n = 12$
   b) $H_0 : \mu = 98.6, H_1 : \mu > 98.6, \bar{X} = 65, s = 12, n = 42$
3. What are the basic elements of an ANOVA table for one way classification ?
4. What are the Basic designs of Experiment ?
5. State the Newton-Raphson method formula and the criteria for convergence.
6. Write a sufficient condition for Gauss-Seidel method to converge.
7. Find the divided difference table for the following data.

x	2	5	10
y	5	29	109

8. Obtain Lagrangian interpolation polynomial from the data.

x	0	1	3
f(x)	5	6	14

9. Using Euler's method, find y of x = 0.1 if $\frac{dy}{dx} = 1 + xy$, y(0) = 2.

10. Write down the finite difference scheme for solving y" + x + y = 0, y(0) = y(1) = 0.

PART – B (5×16=80 Marks)

11. a) i) The nicotine content in milligram of 2 samples of tobacco were found to be as follows :

Sample A	24	27	26	21	25	
Sample B	27	30	28	31	22	36

Can it be said that these samples were from normal population with the same mean. **(6)**

ii) Five coins are tossed 320 times. The number of heads observed is given below :

Number of Heads	0	1	2	3	4	5
Frequency	15	45	85	95	60	20

Examine whether the coin is unbiased. Use 5% level of significance. **(10)**

(OR)

b) i) Mechanical engineers testing a new arc welding technique, classified welds both with respect to appearance and an X-ray inspection.

		Appearance		
X-ray		**Bad**	**Normal**	**Good**
	Bad	20	7	3
	Normal	13	51	16
	Good	7	12	21

Test for independence using 0.05 level of significance. **(10)**

ii) Given a sample mean of 83, a sample standard deviation of 12.5 and a sample size of 22, test the hypothesis that the value of the population mean is 70 against the alternative that it is more than 70. Use the 0.025 significance level. **(6)**

12. a) A chemist wishes to test the effect of four chemical agents on the strength of a particular type of cloth. Because there might be variability from one bolt to another, the chemist decides to use a randomised Block design, with the bolts of cloth consider as blocks, she selects five bolts and applies all four chemicals in random order to each bolt. The resulting tensile strengths follows :

	Bolt				
Chemical	1	2	3	4	5
1	73	68	74	71	67
2	73	67	75	72	70
3	75	68	78	73	68
4	73	71	75	75	69

Does the tensile strength depend on chemical ? Test at $\alpha = 0.10$. (16)

(OR)

b) A Latin square design was used to compare the bond strengths of gold semi conductor lead wires bounded to the lead terminal by 5 different methods, A, B, C, D and E. The bonds were made by 5 different operators and the devices were encapsulated using 5 different plastics. With the following results, expressed as pounds of force required to break the bond.

	Operator				
Plastics	1	2	3	4	5
1	A 3	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

Analyse these results and test with 0.01 level of significance. (16)

13. a) i) Solve the following system of equations by Gauss-Seidel method correct to three decimal places.

$$x + y + 54z = 110$$
$$27x + 6y - z = 85$$
$$6x + 15y + 2z = 72$$

(8)

ii) Solve the following system of equations by Gauss Jordan method.

$$2x + y + 4z = 12$$
$$8x - 3y + 2z = 20$$
$$4x + 11y - z = 33$$

(8)

(OR)

b) i) Solve the following system of equations by Gauss Elimination Method.

$2y - 3z = -5$

$x + 4y - 7z + t = -8$

$2x - y - t = -4$

$x + y + z = 6$ **(8)**

ii) Using the power method, find the largest Eigenvalue and the corresponding eigenvector for the matrix

$A = \begin{pmatrix} 1 & 4 \\ 3 & 2 \end{pmatrix}$. Let $X_0 = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$ **(8)**

14. a) i) Find the first derivative of f(x) at x = 0.4 from the following table :

x	0.1	0.2	0.3	0.4
f(x)	1.10517	1.22140	1.34986	1.49182

(8)

ii) Using Simpson's ⅓ rule, to evaluate $\int_0^1 \int_0^1 \frac{dxdy}{1+xy}$ with $\Delta x = \Delta y = 0.25$. **(8)**

(OR)

b) i) Find the first two derivatives of $x^{1/3}$ at x = 56, given the table below :

x	50	51	52	53	54	55	56
$y = x^{1/3}$	3.6840	3.7084	3.7325	3.7563	3.7798	3.8030	3.8259

(8)

ii) Evaluate $\int_0^2 e^x dx$ by using trapezoidal rule taking 6 sub intervals. **(8)**

15. a) i) Given $\frac{dy}{dx} = y - x^2 + 1$, y(0) = 0.5. Find y(0.2) by modified Euler's Method. **(6)**

ii) Given $5x \frac{dy}{dx} + y^2 - 2 = 0$, y(4) = 1, y(4.1) = 1.0049 y (4.2) = 1.0097, y (4.3) = 1.0143. Compute y(4.4) by Milne's Predictor-Corrector Method. **(10)**

(OR)

b) i) Solve $y^1 = y^2 + x$, y(0) = 1 using Taylor Series Method for y(0.1) and y(0.2). **(6)**

ii) Using Runge-Kutta Method of Order four, solve $y^1 = x + y$, y(0) = 1 to find y(0.1). **(10)**