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Question Paper Code : 72071

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Fourth Semester

Mechanical Engineering

MA 6452 — STATISTICS AND NUMERICAL METHODS

(Common to Fourth Semester Automobile Engineering, Mechatronics Engineering
and Fifth Semester for Mechanical Engineering (Sandwich))

(Regulations 2013)

Time : Three hours

Maximum : 100 marks

Use of Statistical table is permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the expected frequencies of 2×2 contingency table

a	b
c	d

?
2. A standard sample of 200 tins of coconut oil gave an average weight of 4.95 kgs with a standard deviation of 0.21 kg. Do we accept that the net weight is 5 kgs per tin at 5% level of significance?
3. What are the uses of ANOVA?
4. What are the basic principles in the design of experiment?
5. Find the smallest positive root of $x^3 - 2x + 0.5 = 0$.
6. Evaluate $\Delta[x(x+1)(x+2)(x+3)]$.
7. Solve the following by Gauss Elimination method $10x + y = 18.141$;
 $x + 10y = 28.140$.
8. Apply Newton's backward formula to find a polynomial of degree 3.

$x:$	3	4	5	6
$y:$	6	24	60	120

9. Compute $y(0.1)$ correct to 4 decimal places if $y(x)$ satisfies $y' = x + y$, $y(0) = 1$, by Taylor's series method.
10. Write down the modified Euler formulae for $y' = f(x, y)$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) The sales manager of a large company conducted a sample survey in states A and B taking 400 samples in each case. The results were

	State A	State B
Average Sales	Rs. 2,500	Rs. 2,200
S.D.	Rs. 400	Rs. 550

Test whether the average sales is the same in the 2 states at 1% level of significance. (8)

- (ii) A certain medicine administered to each of 10 patients resulted in the following increases in the B.P. 8, 8, 7, 5, 4, 1, 0, 0, -1, -1. Can it be concluded that the medicine was responsible for the increase in B.P. 5% level of significance. (8)

Or

- (b) (i) It is believed that the precision of an instrument is no more than 0.16. Write down the null and alternative hypotheses for testing this belief. Carry out the test at 1% level of significance, given 11 measurements of the same subject on the instrument.

2.5, 2.3, 2.4, 2.3, 2.5, 2.7, 2.5, 2.6, 2.6, 2.7, 2.5. (8)

- (ii) Two independent samples of sizes 9 and 7 from a normal population had the following values of the variables.

Sample 1	18	13	12	15	12	14	16	14	15
Sample 2	16	19	13	16	18	13	15		

Do the estimates of the population variance differ significantly at 5% level of significance? (8)

12. (a) (i) The accompanying data resulted from an experiment comparing the degree of soiling for fabric copolymerized with the 3 different mixtures of methacrylic acid. Analyse the classification. (6)

Mixture 1	0.56	1.12	0.90	1.07	0.94
Mixture 2	0.72	0.69	0.87	0.78	0.91
Mixture 3	0.62	1.08	1.07	0.99	0.93

- (ii) A variable trial was conducted on wheat with 4 varieties in a Latin square design. The plan of the experiment is given below. Analyse data and interpret the result. (10)

C	25	B	23	A	20	D	20
A	19	D	19	C	21	B	18
B	19	A	14	D	17	C	20
D	17	C	20	B	21	A	15

Or

- (b) (i) A set of data involving 4 tropical food stuffs A, B, C, D tried on 20 chicks is given below. All the 20 chicks are treated alike in all respects except the feeding treatments and each feeding treatment is given to 5 chicks. Analyse the data : (7)

A 55 49 42 21 52

B 61 112 30 89 63

C 42 97 81 95 92

D 169 137 169 85 154

- (ii) Perform a 2-way ANOVA on the data given below : (9)

		Treatment 1			
		1	2	3	
Treatment 2	1	30	26	38	
	2	24	29	28	
	3	33	24	35	
	4	36	31	30	
	5	27	35	33	

Use the coding method subtracting 30 from the given number.

13. (a) (i) Using Gauss-Seidel method solve the system of the following equations correct to a decimal places. (10)

$$\begin{aligned} 10x_1 - 2x_2 - x_3 - x_4 &= 3 \\ -2x_1 + 10x_2 - x_3 - x_4 &= 15 \\ -x_1 - x_2 + 10x_3 - 2x_4 &= 27 \\ -x_1 - x_2 - 2x_3 + 10x_4 &= -9. \end{aligned}$$

- (ii) Find the inverse of the matrix $\begin{pmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{pmatrix}$ using Gauss Jordan method. (6)

Or

- (b) (i) Solve the system of the following equations using Gauss Jordan method correct to two decimal places. (8)

$$\begin{aligned} 2x_1 + 2x_2 - x_3 + x_4 &= 4 \\ 4x_1 + 3x_2 - x_3 + 2x_4 &= 6 \\ 8x_1 + 5x_2 - 3x_3 + 4x_4 &= 12 \\ 3x_1 + 3x_2 - 2x_3 + 2x_4 &= 6. \end{aligned}$$

- (ii) Determine by Power method the largest eigenvalue and the corresponding eigenvector of the matrix $\begin{pmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{pmatrix}$. (8)

14. (a) (i) Given $\log_{10} 654 = 2.8156$, $\log_{10} 658 = 2.8182$, $\log_{10} 659 = 2.8189$ and $\log_{10} 661 = 2.8202$. Find the value of $\log_{10} 656$ using Newton's divided difference formula. (8)

(ii) Find the first, second and third derivatives of the function $f(x)$ at $x = 1.5$. (8)

x :	1.5	2.0	2.5	3.0	3.5	4.0
$f(x)$:	3.375	7.0	13.625	24.0	38.875	59.0

Or

(b) (i) The velocity V of a particle at distances from a point on its path is given by the table

T feet:	0	10	20	30	40	50	60
V feet/s:	47	58	64	65	61	52	38

Estimate the time taken to travel 60 feet by using Trapezoidal and Simpson's 1/3 rule. Compare the result with Simpson's 3/8 rule. (9)

(ii) A rod is rotating a plane. The following table gives the angle θ with respect to time ' t ' seconds.

t :	0	0.2	0.4	0.6	0.8	1.0
θ :	0	0.12	0.49	1.12	2.02	3.20

Calculate the angular velocity and angular acceleration of the rod when $t = 0.6$ seconds. (7)

15. (a) (i) By fourth order Runge-Kutta method find $y(0.2)$ from $\frac{dy}{dx} = y - x$, $y(0) = 2$ taking $h = 0.1$. (8)

(ii) Solve the differential equation $\frac{d^2y}{dx^2} - y = x$ with $y(0) = 0$, $y(1) = 0$ and $h = \frac{1}{4}$ by finite difference method. (8)

Or

(b) Using Taylor's series method, solve $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$ at $x = 0.1, 0.2, 0.3$. Continue the solution at $x = 0.4$ by Milne's Predictor-Corrector method. (16)