MECH 2013

Reg. No. : | | | | | | | | | | | | |

**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 $\begin{array}{|c|c|}\hline a & b \\ \hline c & d \\ \hline \end{array}$ ?

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 — ($5 \times 16 = 80$ 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)

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$
$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$
$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$
$$-x_1 - x_2 - 2x_3 + 10x_4 = -9.$$

(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)

$$2x_1 + 2x_2 - x_3 + x_4 = 4$$
$$4x_1 + 3x_2 - x_3 + 2x_4 = 6$$
$$8x_1 + 5x_2 - 3x_3 + 4x_4 = 12$$
$$3x_1 + 3x_2 - 2x_3 + 2x_4 = 6.$$

(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 it's 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 $\theta$ with respect to time '$t$' seconds.

| $t$: | 0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 |
|---|---|---|---|---|---|---|
| $\theta$: | 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)

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