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Question Paper Code : 20783

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2020
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 tables 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 do you understand by design of an experiment ?
4. What are the basic principles of the design of experiments ?
5. Mention the order and condition for the convergence of Newton-Raphson method.
6. What is the procedure of Gauss-Jordan method ?
7. Give the Newton's backward difference table for
x : 0 1 2 3
y : -1 -2 -1 2
8. Compare Trapezoidal rule with Simpson's $\frac{1}{3}$ rule.



9. Find $y(0.01)$ by using Euler's method, given that $\frac{dy}{dx} = -y$, $y(0) = 1$.
10. Write the finite difference approximation for the equation $\frac{d^2y}{dx^2} = x + y$.

PART – B

(5×16=80 Marks)

11. a) i) Fit a binomial distribution for the following data and also test the goodness of fit.

| | | | | | | | | |
|---------------|---|----|----|----|---|---|---|-------|
| X : | 0 | 1 | 2 | 3 | 4 | 5 | 6 | Total |
| F(X) : | 5 | 18 | 28 | 12 | 7 | 6 | 4 | 80 |

(8)

- ii) The mean value of a random sample of 60 items was found to be 145, with a standard deviation of 40. Find the 95% confidence limits for the population mean. What size of the sample is required to estimate the population mean within 5 of its actual value with 95% or more confidence, using the sample mean ?

(8)

(OR)

- b) i) Test made on the breaking strength of 10 pieces of a metal gave the following results 578, 572, 570, 568, 572, 570, 570, 572, 596 and 584 kg. Test if the mean breaking strength of the wire can be assumed as 577 kg.

(8)

- ii) A group of 10 rats fed on diet A and another group of 8 rats fed on diet B recorded the following increase in weight :

| | | | | | | | | | | |
|----------|---|---|---|---|----|---|---|---|---|----|
| Diet A : | 5 | 6 | 8 | 1 | 12 | 4 | 3 | 9 | 6 | 10 |
| Diet B : | 2 | 3 | 6 | 8 | 10 | 1 | 2 | 8 | | |

Show that the estimates of the population variance from the samples are not significantly different.

(8)

12. a) Three varieties of coal were analysed by 4 chemists and the ash content is tabulated here, perform an analysis of variance.

| | | Chemists | | | |
|------|-----|----------|---|---|---|
| | | A | B | C | D |
| Coal | I | 8 | 5 | 5 | 7 |
| | II | 7 | 6 | 4 | 4 |
| | III | 3 | 6 | 5 | 4 |

(OR)



b) The result of an RBD experiment on 3 blocks with 4 treatments A, B, C, D are tabulated here. Carry out an analysis of variance.

| Blocks | Treatment effects | | | |
|--------|-------------------|-----|-----|-----|
| I | A36 | D35 | C21 | B36 |
| II | D32 | B29 | A28 | C31 |
| III | B28 | C29 | D29 | A26 |

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 eigen value and the

corresponding eigen vector of the matrix $\begin{pmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{pmatrix}$. (8)

14. a) i) Given :

$$x : 0 \quad 2 \quad 3 \quad 4 \quad 7 \quad 9$$

$$y : 4 \quad 26 \quad 58 \quad 112 \quad 466 \quad 922$$

Find $y(10)$, $y'(6)$ using Newton's divided difference formula. (8)

ii) Evaluate the integral $I = \int_0^1 \frac{dx}{1+x^2}$ using Simpson's $\frac{1}{3}$ rule by taking $h = \frac{1}{4}$. (8)

(OR)



b) i) Evaluate $\int_1^2 \frac{dx}{1+x^2}$ taking $h = .2$ using trapezoidal rule. (8)

ii) Given :

$$x : 140 \quad 150 \quad 160 \quad 170 \quad 180$$

$$y : 3.685 \quad 4.854 \quad 6.302 \quad 8.076 \quad 10.225$$

Find $y(175)$.

(8)

15. a) Given $\frac{dy}{dx} = xy + y^2$, $y(0) = 1$, $y(0.1) = 1.1169$, $y(0.2) = 1.2773$, find

i) $y(0.3)$ by Runge-Kutta method of fourth order and

ii) $y(0.4)$ by Milne's method.

(16)

(OR)

(b)(i) If $\frac{dy}{dx} = x^2 - y$, $y(0) = 1$, find $y(0.1)$ using Taylor series method. (8)

(ii) If $\frac{dy}{dx} = x + y$, $y(0) = 1$, find $y(0.2)$ using modified Euler method taking $h = 0.1$. (8)