
Fourth Semester

Mechanical Engineering

MA 2266/MA 42/MA 1254/080120014/10177 SN 401 — STATISTICS AND
NUMERICAL METHODS

(Common to Automobile Engineering and Production Engineering)

(Regulations 2008/2010)

(Common to PTMA 2266 – Statistics and Numerical Methods for B.E. (Part-Time)
Second Semester – Production Engineering – Regulations 2009)

Time : Three hours  
Maximum : 100 marks

Statistical tables may be permitted.

Answer ALL questions.

PART A — (10 x 2 = 20 marks)

1. Write any two applications of \( \chi^2 \) test.

2. What are Type–I and Type–II errors?

3. Present the ANOVA table for a completely randomized design.

4. Explain 2\(^2\) factorial design.


6. Write the formula and order of convergence for Newton-Raphson method.

7. Construct the Newton's forward difference table for \( y = x^2 - 3x + 1 \), \( x = 0 \) to \( 4 \).

8. Write the difference between Trapezoidal and Simpson's \( \frac{1}{3} \) rule.

9. Using Euler's method find \( y(0.1) \) for \( y' = x + y \), \( y(0) = 1 \).

10. Classify the equation : \( f_x - 2f_{xy} + f_{yy} = 0 \).
PART B — (5 × 16 = 80 marks)

11. (a) (i) Do the following sample variances vary significantly at 5% level? (8)

- Sample I: 39 41 43 41 45 39
- Sample II: 40 42 40 44 39 38 40

(ii) Test whether the following attributes are independent at 5% level. (8)

<table>
<thead>
<tr>
<th>Small pox</th>
<th>Given</th>
<th>Not given</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attacked</td>
<td>35</td>
<td>333</td>
<td>368</td>
</tr>
<tr>
<td>Not attacked</td>
<td>308</td>
<td>806</td>
<td>1114</td>
</tr>
<tr>
<td>Total</td>
<td>343</td>
<td>1139</td>
<td>1482</td>
</tr>
</tbody>
</table>

Or

(b) (i) Test if the difference in means is significant for the following at 5% level. (8)

- $\bar{x}_1 = 1190$, $\bar{x}_2 = 1230$, $S_1 = 90$, $S_2 = 120$, $n_1 = 100$, $n_2 = 75$.

(ii) Is there any significant difference in means, in the following at 5% level? (8)

- $\bar{x}_1 = 107$, $\bar{x}_2 = 112$, $S_1 = 10$, $S_2 = 8$, $n_1 = 16$, $n_2 = 14$.

12. (a) A farmer wishes to test the effects of 4 different fertilizers (A, B, C, D) on the yield of wheat. In order to eliminate sources of error due to variability in soil fertility, he uses the fertilizers in a latin square arrangement as shown in the following table, where the number indicated yields in bushels/unit area. Perform an analysis of variance to determine whether there is a difference between the fertilizers at significant levels of

(i) .05
(ii) .01. (16)

- A18  C21  D25  B11
- D22  B12  A15  C19
- B15  A20  C23  D24
- C22  D21  B10  A17

Or

(b) Five doctors each test five treatments for a certain disease and observe the number of days each patient takes to recover. Discuss the difference between

(i) The doctors and
(ii) The treatments for the following data at 5% level. (16)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Doctors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
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<tr>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
</tr>
</tbody>
</table>

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13. (a) (i) Find the inverse of the matrix, by Gauss elimination.
\[
A = \begin{pmatrix}
4 & 1 & 2 \\
2 & 3 & -1 \\
1 & -2 & 2
\end{pmatrix}
\]

(ii) Using Gauss-Seidel method, solve:
\[
\begin{align*}
20x + y - 2z &= 17 \\
3x + 20y - z &= -18 \\
2x - 3y + 20z &= 25.
\end{align*}
\]

Or

(b) Find the eigen value of \( A = \begin{pmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{pmatrix} \) using power method.

14. (a) (i) Using Newton's divided difference formula find the value of \( f(8) \) for the following:
\[
x : \quad 4 \quad 5 \quad 7 \quad 10 \quad 11 \quad 13 \\
f(x) : \quad 48 \quad 100 \quad 294 \quad 900 \quad 1210 \quad 2028
\]

(ii) Evaluate \( \int_0^1 e^x \, dx \) using Simpson's \( \frac{1}{3} \) rule correct to five decimal places, taking \( h = 0.1 \). Verify your answer.

Or

(b) (i) Find \( \left( \frac{dy}{dx} \right)_{11} \) and \( \left( \frac{d^2y}{dx^2} \right)_{11} \) for the following:
\[
x : \quad 1.0 \quad 1.1 \quad 1.2 \quad 1.3 \quad 1.4 \quad 1.5 \quad 1.6 \\
y : \quad 7.989 \quad 8.103 \quad 8.781 \quad 9.129 \quad 9.451 \quad 9.750 \quad 10.031
\]

(ii) Using Lagrange's method find \( y(10) \) from the following:
\[
x : \quad 5 \quad 6 \quad 9 \quad 11 \\
y : \quad 12 \quad 13 \quad 14 \quad 16
\]

15. (a) Use Runge-Kutta method of order 4 to find \( y \) at \( x = 0.1, 0.2, 0.3 \) given that \( y' = x + y^2, \quad y(0) = 1 \).

Or

(b) Given: \( y' = x^2 + y^2 - 2, \quad y(0) = 1 \), use Taylor's method to find \( y \) at \( x = -0.1, 0.1, 0.2 \) and Milne's method to find \( y \) at \( x = 0.3 \).