M.Sc. 3rd Semester Examination, 2012

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

( Practical on Advanced Numerical and Statistical Lab. )

( Practical )

PAPER—MTM-307

Full Marks : 25

Time : 2 hours

Answer one question

The figures in the right-hand margin indicate marks

[ Problem : 20 Marks; Lab. note book and Viva : 5 Marks ]

Question will be selected by Lottery

1. Write a program to evaluate a determinant by Gauss elimination method, using partial pivoting. Test your program for the following determinant.

\[
\begin{bmatrix}
2 & 5 & 2 & 1 \\
2 & 0 & 2 & -1 \\
1 & 5 & 7 & 0 \\
4 & 1 & 3 & 1
\end{bmatrix}
\]
2. Write a program to find the inverse of a matrix of partial pivoting. Write a program to solve a system of linear equations by Gauss Seidal iteration method. Test your program for the following equations:

\[ 12x_1 + 3x_2 - x_3 = 15 \]
\[ x_1 + 8x_2 - 3x_3 = -9 \]
\[ -3x_1 + 4x_2 - 10x_3 = 18 \]

3. Write a program to solve a system of linear equations by matrix inverse method. Test your program for the following equations:

\[ 2x_1 + 3x_2 - x_3 = 4 \]
\[ x_1 + 8x_2 - 3x_3 = 6 \]
\[ -3x_1 + 4x_2 - 4x_3 = -3 \]

4. Write a program to solve a system of linear equations by LU decomposition method. Test your program for the following equations:

\[ 2x_1 + 3x_2 - x_3 = 6 \]
\[ x_1 + 8x_2 - 3x_3 = 7 \]
\[ -3x_1 + 4x_2 - 4x_3 = -6 \]
5. Write a program to solve a system of linear equations by Gauss elimination method. Test your program for the following equations

\[\begin{align*}
2x_1 + 3x_2 - x_3 &= 6 \\
x_1 + 8x_2 - 3x_3 &= 7 \\
-3x_1 + 4x_2 - 4x_3 &= -6
\end{align*}\]

6. Write a program to solve a system of tri-diagonal equations.

7. (a) Write a program to find the following integration by Gauss-Legendre quadrature (6-point) formula.

\[\int_0^2 (1 + e^{-x} \sin 4x) \, dx.\]

(b) Write a program to solve the equation

\[\frac{dy}{dx} = 3x^2 + y, \quad y(0) = 4\]

\[0.1 \leq x \leq 0.5\] by taking \( h = 0.1 \).
8. Write a program to solve the equation by Runge-Kutta (2\textsuperscript{nd} and 4\textsuperscript{th} order) methods

\[ 5 \frac{dy}{dx} = x^2 + y^2, \quad y(0) = 1, \]

find \( y \) in the interval \( 0 \leq x \leq 0.4 \), taking \( h = 0.1 \).

9. Write a program to solve the following pair of first order first degree ODEs by 4\textsuperscript{th} order Runge-Kutta method.

\[ \frac{dy}{dx} = y + 2z, \quad \frac{dz}{dx} = 3y + 2z \]

with \( y(0) = 6, \quad z(0) = 4 \) for \( x = 0.1, 0.2 \).

10. Write a program to solve the following ODE by Milne predictor-corrector methods for \( x = 0.4, 0.5, 0.6 \).

\[ \frac{dy}{dx} = x^3 + y^2, \quad y(0) = 1. \]
11. Write a program to solve a second order PDE by finite difference method.

12. Write a program to find the largest eigenvalue of a square matrix by power method. Using your program find the eigenvalues of the following matrix:

\[
\begin{bmatrix}
2 & 5 & 2 & 1 \\
2 & 0 & 2 & -1 \\
1 & 5 & 7 & 0 \\
4 & 1 & 3 & 1 \\
\end{bmatrix}
\]

13. Write a program to find the correlation coefficient for a bivariate sample. Test your program for the following data:

<table>
<thead>
<tr>
<th>X</th>
<th>1.23</th>
<th>2.34</th>
<th>3.45</th>
<th>4.67</th>
<th>4.90</th>
<th>5.12</th>
<th>5.78</th>
<th>6.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.2345</td>
<td>1.5678</td>
<td>2.4567</td>
<td>3.4567</td>
<td>3.9087</td>
<td>2.9876</td>
<td>2.1098</td>
<td>1.209</td>
</tr>
</tbody>
</table>

PGIIIS/MTM-307/12(Pr.)
14. Write a program to find the multiple correlation coefficient for the sample \((x_i, y_i, z_i), \ i = 1, 2, \ldots, n\). Test your program for the following data:

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>4.5</th>
<th>5</th>
<th>5.5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>2.2345</td>
<td>2.5678</td>
<td>3.4567</td>
<td>4.4567</td>
<td>4.9087</td>
<td>3.9876</td>
<td>3.1098</td>
<td>2.209</td>
</tr>
<tr>
<td>Z</td>
<td>3.45</td>
<td>4.56</td>
<td>6.90</td>
<td>7.12</td>
<td>8.45</td>
<td>6.90</td>
<td>5.23</td>
<td>2.34</td>
</tr>
</tbody>
</table>

15. Write a program to find the regression lines for a bivariate sample. Test your program for the following data:

<table>
<thead>
<tr>
<th>X</th>
<th>0.23</th>
<th>1.24</th>
<th>2.45</th>
<th>3.67</th>
<th>3.90</th>
<th>4.12</th>
<th>4.78</th>
<th>5.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.235</td>
<td>1.678</td>
<td>2.567</td>
<td>3.456</td>
<td>3.087</td>
<td>2.976</td>
<td>2.198</td>
<td>1.209</td>
</tr>
</tbody>
</table>

16. Write a program to fit a linear curve for a bivariate sample. Test your program for the following data:

<table>
<thead>
<tr>
<th>X</th>
<th>1.25</th>
<th>2.25</th>
<th>3.25</th>
<th>4.25</th>
<th>4.50</th>
<th>5.00</th>
<th>5.25</th>
<th>5.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>1.23</td>
<td>1.78</td>
<td>2.47</td>
<td>3.43</td>
<td>3.90</td>
<td>2.96</td>
<td>2.18</td>
<td>1.20</td>
</tr>
</tbody>
</table>
17. Write a program to fit a quadratic curve for a bivariate sample. Test your program for the following data:

<table>
<thead>
<tr>
<th>X</th>
<th>-1.23</th>
<th>-2.34</th>
<th>1.45</th>
<th>2.67</th>
<th>3.90</th>
<th>4.12</th>
<th>4.78</th>
<th>5.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>-1.345</td>
<td>1.678</td>
<td>1.467</td>
<td>3.567</td>
<td>3.987</td>
<td>2.986</td>
<td>2.108</td>
<td>1.209</td>
</tr>
</tbody>
</table>

18. Write a program to find two partial correlation coefficient for the sample \( (x_i, y_i, z_i), i = 1, 2, \ldots, n \). Test your program for the following data:

<table>
<thead>
<tr>
<th>X</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>2.3</td>
<td>3.4</td>
<td>4.5</td>
<td>6.7</td>
<td>6.9</td>
<td>7.1</td>
<td>7.5</td>
<td>8.1</td>
</tr>
<tr>
<td>Z</td>
<td>3.45</td>
<td>4.56</td>
<td>6.90</td>
<td>7.12</td>
<td>8.45</td>
<td>6.90</td>
<td>5.23</td>
<td>2.34</td>
</tr>
</tbody>
</table>