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

$$\begin{aligned} 2x_1 + 3x_2 - x_3 &= 6 \\ x_1 + 8x_2 - 3x_3 &= 7 \\ -3x_1 + 4x_2 - 4x_3 &= -6 \end{aligned}$$

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

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

$0{\cdot}1 \le x \le 0{\cdot}5$ by taking $h = 0{\cdot}1$.

8. Write a program to solve the equation by Runge-Kutta (2nd and 4th order) methods

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

find y in the interval $0 \leq x \leq 0{\cdot}4$, taking $h = 0{\cdot}1$.

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

$$\frac{dy}{dx} = y + 2z, \frac{dz}{dx} = 3y + 2z$$

with $y(0) = 6$, $z(0) = 4$ for $x = 0{\cdot}1, 0{\cdot}2$.

10. Write a program to solve the following ODE by Milne predictor-corrector methods for $x = 0{\cdot}4, 0{\cdot}5, 0{\cdot}6$.

$$\frac{dy}{dx} = x^3 + y^2, \quad y(0) = 1.$$

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:

X	1·23	2·34	3·45	4·67	4·90	5·12	5·78	6·01
Y	1·2345	1·5678	2·4567	3·4567	3·9087	2·9876	2·1098	1·209

14. Write a program to find the multiple correlation coefficient for the sample (x_i, y_i, z_i), $i = 1, 2, ..., n$. Test your program for the following data :

X	1	2	3	4	4·5	5	5·5	6
Y	2·2345	2·5678	3·4567	4·4567	4·9087	3·9876	3·1098	2·209
Z	3·45	4·56	6·90	7·12	8·45	6·90	5·23	2·34

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

X	0·23	1·24	2·45	3·67	3·90	4·12	4·78	5·01
Y	1·235	1·678	2·567	3·456	3·087	2·976	2·198	1·209

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

X	1·25	2·25	3·25	4·25	4·50	5·00	5·25	5·50
Y	1·23	1·78	2·47	3·43	3·90	2·96	2·18	1·20

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

X	−1·23	−2·34	1·45	2·67	3·90	4·12	4·78	5·01
Y	−1·345	1·678	1·467	3·567	3·987	2·986	2·108	1·209

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

X	1	2	3	4	5	6	7	8
Y	2·3	3·4	4·5	6·7	6·9	7·1	7·5	8·1
Z	3·45	4·56	6·90	7·12	8·45	6·90	5·23	2·34