DPP-1413
M. Sc. (Sem. II) Examination
March/April – 2016
Physics : PH-424
(Numerical Analysis & Computer Programming)
Time : 3 Hours] [Total Marks : 70

Instructions : (1)

(2) Attempt all questions.
(3) Symbols used have their usual meaning.
(4) Figures to the right indicate marks.
(5) Scientific calculator may be used.

1 Attempt any two questions.

(a) (i) Derive Simpson’s 1/3 rule for integration. 3

(ii) Find all the eigen values and eigen vectors of the matrix given below using 4

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

Jacobi method

(b) (i) Explain the matrix inverse method for solution of simultaneous linear equations. 3

Explain a method for finding the inverse of a matrix.

(ii) Given \(dy/dx = x^2y\) and \(y(0)=1\). Find \(y(0.2)\) using second order Runge-Kutta method and taking \(h=0.1\). 4

(c) (i) Explain the 4th order Runge-Kutta method for solution of ordinary differential equations. What is the geometric significance of this method? 3

(ii) Compute the integral \(\int_{1}^{4} dx\) using Simpson 1/3 rule. Also find the inherent error in your calculation. 4
2 Attempt any two questions.

(a) (i) Discuss the Householder method for solution of eigen value problem.

(ii) Two computations of a definite integral are made using Simpson's 1/3\textsuperscript{rd} rule giving $R_1$ and $R_2$ as corresponding results. Show that the inherent error in the second computation ($E_2$) is given by $E_2 = (R_2 - R_1)/15$. When the number of subintervals used in the second computation is twice that used in the first.

(b) (i) Explain the importance of numerical analysis in solving problems in physics with the help of some examples.

(ii) Using the linear regression, find the straight line $y = mx + c$ that fits the following data:

<table>
<thead>
<tr>
<th>x</th>
<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>15</td>
<td>17</td>
<td>19</td>
<td>14</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

(c) (i) Define the terms: (i) Operating system (ii) Higher level language (iii) Compiler.

(ii) What are the steps involved in writing a program in a high level language to get output from it? Explain each of them in brief.

3 Attempt any two questions.

(a) (i) Discuss the general syntax of DO-loop with examples.

(ii) What is the first line of every FORTRAN program and what does it tell the compiler?

(iii) Write a FORTRAN expression corresponding to the following algebraic expression:

$$\sqrt{x^2 - y^2} + \sqrt{2xy}$$

(b) (i) Discuss any two Format specifications used in FORTRAN with examples.

(ii) Write down syntax for IF-THEN-ELSE statement.

(iii) Write a FORTRAN program to arrange 'N' given numbers in ascending order.

(c) (i) What are the relational operators in FORTRAN?

(ii) Write down general syntax for WRITE statement with examples.

(iii) Explain any two file processing statements in FORTRAN.

4 Attempt any two questions.

(a) (i) Explain the different types of loops in C with syntax and example.

(ii) Write C program to find the largest of the three numbers.

(b) (i) Write a C program to read and display a text from the file.

(ii) Write a Program in C to reverse the digits of a given number.

(c) (i) Write a C Program to print prime numbers between 1 and 100.

(ii) Explain Recursive function with an example program.
5 Attempt any two questions.

(a) (i) Evaluate the following expression:  
\[ A=1.5; B=3.0 \]
\[ I=B/2.0+B^4/4.0/A-B+A^{**3} \]
(ii) Write a FORTRAN program to read all the elements of a \( N \times N \) real matrix given row-wise and find the sum of squares of the diagonal elements.

(b) (i) What is the hierarchy of the arithmetic operators in FORTRAN?  
(ii) Write a C program to evaluate \[ \int_{1.0}^{1.4} 7 \log x \, dx \] using Simpson's 1/3 rule.

(c) (i) Find errors, if any, in the following assignment statements and rectify them:  
(i) \( p^*=x/y \)  
(ii) \( a=b+c*2 \)
(ii) Write a C or FORTRAN program to find a real root of a transcendental equation \[ x - 2\sin x = 1 \] using *Newton Raphson method* assuming \( x_0 \) and \( x_1 \) where \( f(x_0) < 0 < f(x_1) \).