Ref. No.: EX/PHARM/T/125/2017

B. PHARMACEUTICAL TECHNOLOGY 1ST YEAR 2ND SEMESTER EXAMINATION-2017

Subject: Numerical Methods & Computer Programming

Time: 3 Hours **Full Marks: 100**

Note: Attempt *Q.1* and any *five* from the rest

Q.1 Answer any *ten* questions.

a) What are the respective composite errors of *Trapezoidal* and *Simpson's-1/3* rule in big 'O' notation?
b) Explain the role(s) of 'namespace' in C++.
c) Given f(0) = 1, f(1) = 2, f(3) = 34 find f(2).
d) 'Generally *Simpson's-1/3* rule gives better result than *Trapezoidal* rule' – why?
e) 'Friend functions in C++ violate security but still they are useful.' - Explain with code (if required).
f) Find the relative percentage error in approximate representation of 4/3 by 1.33.
g) 'C++ supports virtual destructor but not virtual constructor.' - Explain with suitable code.
h) Prove that, $\Delta^n x^n = n!$, where h = 1 and symbols carry their usual meaning.
i) Explain the advantage(s) of virtual member function(s) in C++.
j) Find the relative error in computation of x + y for x = 9.05 and y = 6.56 having absolute errors Δx = 0.001 and Δy = 0.003 respectively.
k) What is/are the advantage(s) of 'abstract' class?
l) What are the limitations of *Trapezoidal* and *Simpson's-1/3* rule?
m) Why explicit 'inline' notification is required in C++?

2x10

Q.2

a) Evaluate $\int_2^3 \frac{dx}{1+2x}$ taking 10 subintervals by ii) *Trapezoidal* and ii) *Simpson's 1/3* rule. Hence compare the results with the exact value.
b) Define a member function outside of the class having named 'Complex' and appropriate way of invocation whose declaration/prototype is 'Complex addition (Complex)' for adding two complex numbers.
c) What are the limitations of *Newton-Raphson's* iterative method? Can they be overcome by *Regula-Falsi* method? Justify your answer.

(3+2+1)+(5+1) +(2+2)

Q.3

a) Find a real root of $3x^3 + 5x - 40 = 0$ by *Newton-Raphson* method, correct up to 4 significant figures. Give geometrical significant of *Newton-Raphson* method.
b) Evaluate, $\Delta^{16}[(1-ax)(1-bx^2)(1-cx^3)(1-dx^4)(1-ex^5)]$ symbol carries its usual meaning and step length is 1.
c) Write a member function of a class (with a suitable name) and way of calling the function in C++ for implementing *Newton-Raphson* method.

(5+3)+3+(4+1)

Q.4

a) Using suitable interpolation formula, calculate sin(32°) and sin(58°) correct up to 4 significant figures from the following table:

x^0 :	30°	35°	40°	45°	50°	55°	60°
$\sin(x^0)$:	0.5000	0.5736	0.6420	0.7071	0.7660	0.8192	0.8660

b) Prove that, $Y_0 = 0.5(Y_1 - Y_{-1}) - 0.125\{0.5(Y_3 - Y_1) - (Y_{-1} - Y_{-3})\}$ by using *Lagrange's* interpolation formula.
c) Write a member function with appropriate function call in C++ to print the sum of prime factors of a given number.

8+4+4

Q.5

a) Solve the following system of equations by *Gauss-Jordon's* matrix inversion method:

$$4x_1 + 10x_2 + 4x_3 = -4$$
$$2x_1 + 3x_2 + 8x_3 = 20$$
$$5x_1 + 3x_2 + x_3 = 2$$

correct up to 3 significant figures.

b) Prove that i) $(1 + \Delta)(1 - \nabla) = 1$ and ii) $(\Delta - \nabla) = \Delta.\nabla$, under usual symbols.

c) Write two member functions in C++ to return HCF and LCM respectively of two numbers, given by user through constructor (LCM should not be obtained from HCF).

7+(2+2)+5

Q.6

a) Use *Gauss-Seidal* iterative method to solve the following system of equations:

$$2x_1 + 7x_2 + 10x_3 = 19$$
$$10x_1 + x_2 + x_3 = 12$$
$$2x_1 + 10x_2 + x_3 = 13$$

correct up to 3 significant figures.

b) Find $f'(1)$ and $f''(6)$, from the following table:

x :	1	2	3	4	5	6
f(x):	1	8	27	64	125	216

c) Write a member function and appropriate function call in C++ to return the sum of odd Fibonacci terms, starting from 1, from n number of terms, given by user as an argument of the function.

7+4+(4+1)

Q.7

a) Solve the following system of linear equations by *Gauss-Jordon's Inversion/Matrix Factorization* method.

$$3x_1 + 4x_2 + 2x_3 = 15$$
$$5x_1 + 2x_2 + x_3 = 18$$
$$2x_1 + 3x_2 + 2x_3 = 10$$

b) Prove that, $D = \frac{1}{h}[\nabla + \frac{\nabla^2}{2} + \frac{\nabla^3}{3} + \cdots\cdots\cdots]$, under usual symbols.

c) Write a member function in C++ which will return the frequency of a word in a sentence, where the word and sentence will be given by user through constructor.

7+3+6

Q.8

a) Compute y(0.8), by *Runge-Kutta* method of 4th order correct to five decimal places, from the equation $\frac{dy}{dx} = xy$, y(0) = 2, taking h = 0.2.

b) Describe any *two* from the followings with suitable program code in C++:
i) static vs. dynamic linking, ii) multiple vs. multi-level inheritance and iii) overloading vs. overriding.

c) Write a member function in C++ to print maximum and minimum element among principal diagonal elements of the data member, A_{nxn} matrix, where n is given by user through constructor.

6+(3+3)+4