2020

ELECTRONICS — HONOURS

Paper : DSE-A-1

(Numerical Techniques)

Full Marks : 50

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question no.* 1** and ***any four*** questions from the rest. 1×10

1. (a) What are programming errors?

(b) What is floating point representation?

(c) Which of the two methods, namely Bisection method and Newton Raphson method, converges faster?

(d) Write Taylor series of a function $f(x)$.

(e) What is meant by extrapolation?

(f) What is the difference between a difference table and a divided-difference table?

(g) What is meant by backward differecne?

(h) What is least-squares fitting?

(i) What is Spline interpolation?

(j) What is meant by a system of linear algebraic equations?

2. (a) What is roundoff error? What is truncation error?

(b) What is meant by absolute and relative errors? The height of a building is measured to be 10 meters, while its true height is 10.27 meters. Calculate the absolute and relative errors in the measurement.

(c) What is error-propagation? (2+2)+(1+1+2)+2

3. (a) What is a transcendental equation? What is a polynomial equation?

(b) What is meant by obtaining the roots of an equation? What is an iterative method and what is the importance of the rate of convergence in such a method?

(c) Name a few iterative methods of solving polynomial equations. (2+2)+(2+1+1)+2

4. (a) Explain with the help of a graph, the procedure of finding a root of the equation $f(x) = 0$ using Newton-Raphson method.

(b) Write the algorithm for the Newton-Raphson method.

(c) What are the pitfalls or limitations in Newton-Raphson method? 4+4+2

5. (a) Explain with the help of a graph, the procedure of finding a root of the equation $f(x) = 0$ using Bisection method.

(b) Write the algorithm for the Bisection method.

(c) What is the drawback of the Bisection method? 4+4+2

6. (a) What is interpolation? How is it different from curve-fitting?

(b) Write down Lagrange's interpolation polynomial of 2nd degree. Use it to interpolate the value of $f(x)$ at $x = 2.0$, from the given values of x and $f(x)$ tabulated below :

x	1	4	6
$f(x)$	–0.2	2	10

(2+1)+(2+5)

7. (a) Use Newton's forward difference interpolation formula to interpolate the value of $f(x)$ at $x = 0.15$, from the forward difference table below :

x	$f(x)$	Δf	$\Delta^2 f$	$\Delta^3 f$
0.1	1.005			
		0.015		
0.2	1.020		0.010	
		0.025		0.001
0.3	1.045		0.011	
		0.036		
0.4	1.081			

(b) Write the expressions for the linear regression coefficients a_0 and a_1 in the linear best-fit equation $y = a_1 x + a_0$ in terms of the set of n data points $\{x_i, y_i\}$.

(c) Name two numerical techniques to solve a system of linear algebraic equations. 5+3+2

8. (a) Integrate the function $f(x) = 2x^3$ from $x = 0$ to $x = 1$ using composite Simpson's 1/3rd rule. Take $\Delta x = h = 0.25$.

(b) Name a few numerical methods used to solve first order ordinary differential equations.

(c) Explain Euler's method of solving the differential equation $\frac{dy}{dx} - f(x, y)$ subject to the initial condition $y(x_1) = y_1$. 4+2+4

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