Aliah University

Autumn Semester Examination - 2020

Paper Name: Open Elective – I [Numerical Methods] **Full Marks: 80**

Paper Code: MATUGOE01 **Time: 3 hrs**

Answer any **Eight (8)** questions

1. State the General Newton's- Raphson Method with the criteria for convergence. Find the roots of the equation: $f(x)=4x^2-2x-3$ using Newton's- Raphson methods upto three decimal places. Can we apply iteration method to find the root of the equation? [4+5+1]

2. What are iterative and non-iterative methods for the solution of system of linear equations. Where have they been used and why? Solve the below questions using Gauss Elimination and Gauss Seidel methods and compare the results. [2+2+3+3]

$$3x - y + 7z = 1$$
$$5x - 2y + z = 3$$
$$x - 4y + 2z = 2$$

3. State Newton's forward and backward interpolation formulae. Where these methods are different from Langrange and Newton divided difference interpolation formulae. Find the function f(x) using any these methods, where interpolating points are given by [2+2+2+4]

x	1.5	3	4.5	6	7.5	9	10.5	12
y	1	2	3	4	5	6	7	8

4. Discuss some numerical integration methods. Where these methods are applied. Using Simpsons3/8 and Weddle's rules, solve the following integration problem with step value=1.5 and compare the results. [2+2+6]

$$\int_1^5 (1 + x.sin(x))dx$$

5. Discuss numerical solution of differential equations. How Euler's method is derived from Taylor's series expansion method. Solve [2+3+5]

$$\frac{dy}{dx} = 6 - 2\frac{y}{x} \qquad y(3) = 1$$

6. State Runge-Kutta 4th Order Method. Where it has been used? What are transcendental equations? Explain LU factorization method for system of solutions of linear equations. [4+1+2+3]

7. If $\Delta f(x) = f(x+h) - f(x)$, then a constant k, Δk equals? What is the order of the truncation error of the trapezoidal rule as function of n, the number of trapezoids? Show that Gaussian quadrature using n + 1 points is exact for polynomials of degree $k \leq 2n + 1$. [2+4+4]

8. Two numbers A and B are approximated as C and D , respectively. Find the relative error of C × D. What is significant digits for 0.0185×10^4. Let xA = 3.14 and yA = 2.651 be correctly rounded from xT and yT , to the number of decimal digits shown. Find the smallest interval that contains (i) xT , (ii) yT , (iii) xT + yT , (iv) xT − yT , (v) xT × yT and (vi) xT /yT . [2+2+6]

9. For the given real numbers x0, x1 and x2, define the divided difference f[x0, x1, x2] of a real valued function f(x). Find the value of f[1, 0.5, 1] when f(x) = sin(x). Estimate the effect of data inaccuracy on results computed by Trapezoidal and Simpson's rule. Find the approximate solution of the equation x sin x−1 = 0 (sine is calculated in radians) in the interval [0, 2] using Bisection method. Obtain the number of iterations to be performed to obtain a solution whose absolute error is less than 10−3. [3+1+6]