

**Department of Computer Science & Engineering**  
**University of Asia Pacific (UAP)**

**Final Examination      Spring 2022      3<sup>rd</sup> Year 2<sup>nd</sup> Semester**

**Course Code: CSE 313**

**Course Title: Numerical Methods**

**Credits.: 3**

**Full Marks: 150**

**Duration: 3 Hours**

**Instructions:**

- There are Six (6) Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
- Non-programmable calculators are allowed.

1. a. What are the basic procedures of the Gauss-Seidel method? Explain the benefits of using Gauss-Seidel method over other simultaneous linear equations. [7] CO2
- b. Using  $[x,y,z] = [1,0,0]$  as the initial guess, find the values of  $[x,y,z]$  after two iterations in the Gauss-Seidel method for the following equations. [18] CO3
- $$\begin{aligned} 20x + y - 2z &= 17 \\ 3x + 20y - z &= -18 \\ 2x - 3y + 20z &= 25 \end{aligned}$$

**OR**

- a. With the initial guess of  $[a,b,c] = [1,0,1]$  and the matrix  $[A] =$  [7] CO2

12	2	5
-11	5	2
-3	-6	13

Will the solution converge using the Gauss-Seidel method? Explain your answer?

- b. Find the lower triangular matrix  $[L]$  and the upper triangular  $[U]$  in the  $[L][U]$  decomposition of the matrix given below: [18] CO3

20	15	8
10	5	4
5	1	2

2. a. Briefly state the algorithm of the Bisection method step-by-step. [10] CO1
- b. Assuming an initial interval of [6, 7], what would be the second (at the end of 2 iterations) iterative value of the root of the function  $f(x) = x^{2.5} - 60$  using the Bisection method. Find the absolute relative approximate error at the end of each iteration. [15] CO3

OR

- a. State the basis of Simpson's one-third rule. [10] CO1
- b. Given the velocity function with respect to time,  $v(t) = 5t^2 + 7$ , where  $t$  is in seconds and  $v$  is in m/s. Find the distance covered by the body from  $t=3$  to  $t=12$  seconds by using the four segment Simpson's one-third rule. [15] CO3
3. a. How can you achieve the best-fit  $y = f(x)$  regression model to the given  $n$  data points? [5] CO2
- b. Using linear regression, find the value of  $x = 48$  via the function  $f(x) = a_0 + a_1x$ . Also calculate absolute relative approximation error. [20] CO3

x	1	5	25	37	48
y	1	94	456	675	985

4. a. In order to solve Ordinary Differential Equations, which of the following methods is more appropriate and why? [5] CO4
- Euler's method.
  - Runge-Kutta second order method
- b. Assuming that initially the temperature ( $T$ ) of a metal is  $1150^\circ\text{C}$ . After 300 seconds what will be the temperature of the metal, when step size,  $h = 100$ ? Solve this using Euler's method where the function is  $f(t, T) = dT/dt = -3.56 \times 10^{-10} \times (T^2 - 71 \times 10^5)$ . [20] CO3
5. a. Which numerical approach will you employ to solve an interpolation problem, and why? [5] CO4
- b. The velocity of a car is given as a function of time in the table below. [20] CO3

Time (t) in seconds	Velocity (v) in m/s
1	10
5	50
11	120
18	150
25	200

Find the velocity at  $t = 10$  second using the Newton Divided Difference method for cubic interpolation.

- 6. a. State the intermediate points selection algorithm of the Golden Section Search method. [5] CO1
- b. Using the given equation  $f(x) = x^2 - 6x + 15$ , find the value of  $x$  for which the output  $\{f(x)\}$  is maximized. Use the Golden Section Search method to find the solution after 2 iterations. Use the initial interval of  $[0,10]$ . [20] CO3