Department of Computer Science & Engineering

University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination   **Spring 2021**   **3rd Year 2nd Semester**

Course Code: CSE 313   **Course Title: Numerical Methods**   **Credits: 3**

Full Marks: 120* (Written)   **Duration: 2 Hours**

* Total Marks of Final Examination: 150 (Written: 120 + Viva: 30)

Instructions:
1. There are **Four (4)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

1.   **a)** Using $[x_1, x_2, x_3] = [0,0,0]$ as the initial guess, find the values of $[x_1, x_2, x_3]$ after **three iterations** in the Gauss-Seidel method for   20

$$\begin{bmatrix} 4 & 2 & -7 \\ 1 & -3 & -1 \\ 22 & -1 & ☻ \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 7 \\ 5 \end{bmatrix}$$

Note: Please replace the coefficient of x_3 (☻) in the equation (iii) with the multiplication of your roll number (e.g. xxxxxx**51**) and 0.1 (i.e. **51 × 0.1**).

b) How to ensure that the above system of equations (in question 1. (a)) will converge using the Gauss-Seidel method?   10

2.   **a)** The upward velocity of a rocket is given as a function of time in the Table 1. Find the velocity at $t = ☻$ seconds using the Newton Divided Difference method for Quadratic interpolation.   20

Table 1: Velocity as a function of time

t (s)	v(t) (m/s)
3.5	27.4
36.3	64.5
59.75	98.24
93.5	123.9
119.15	187.5
155.35	240.2
203.75	355.8

Note: Please replace the value of t (☻) in the question with the addition of your roll number (e.g. xxxxxx**51**) and 10 (i.e. **51 + 3**).

b) How will you calculate the absolute relative approximate error $|\epsilon_a|$ obtained between the results from the first order (Linear interpolation) and second order (Quadratic interpolation) polynomial?   10

Note: You have to solve question **2. (a)** using the Newton Divided Difference method for Linear interpolation to answer question **2. (b)**.

3.　**a)** Find the most nearly value of $\int_a^b \frac{dx}{2x+4}$ by using 4-segment Simpson's 1/3 rule.　　　20

　　Note: Please assume the value of *a* is the multiplication of your roll number (e.g. xxxxxx**51**) and **0.2** (i.e. **51 × 0.2**), and the value of *b* is *a* + **5**.

　　b) Find the true error, E_t and absolute relative true error, $|\epsilon_a|$ for question **3. (a)**.　　　10

4.　**a)** To find the longitudinal modulus of composite, the following data is collected. Find the constants for the regression model given by $y = a_0 + a_1 x$.　　　20

x	2	11	☻	27	50
y	3	110	350	500	950

　　Note: Please replace the 3rd value of x (☻) with the multiplication of your roll number (e.g. xxxxxx**51**) and **0.2** (i.e. **51 × 0.2**).

　　b) How is regression related to the concept of interpolation? Explain.　　　10

OR

　　a) Using the Golden Section Search method, find the maximum value of a function $f(x) = 120x - x^2$. Assuming an initial interval of $\left[0, \frac{☻}{2}\right]$, find the maximum value after **2 iterations**.　　　20

　　Note: Please replace the value of ☻ in the initial interval with the multiplication of your roll number (e.g. xxxxxx**51**) and **0.2** (i.e. **51 × 0.2**).

　　b) What would be the scenario if the Equal Interval Search method is applied to solve **OR(a)** of question number **4**? Explain considering the fundamentals of the Equal Interval Search method.　　　10