Department of Computer Science & Engineering

University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination | **Spring 2020** | **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 $[x_1, x_2, x_3] = [1,3,5]$ as the initial guess, find the values of $[x_1, x_2, x_3]$ after **three iterations** in the Gauss-Seidel method for 20

$$\begin{bmatrix} 2 & 8 & -11 \\ 1 & 6 & 4 \\ 16 & ☻ & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 7 \\ -6 \\ 10 \end{bmatrix}$$

Note: Please replace the coefficient of x_2 (☻) 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? 7

c) Why do we need the Gauss-Seidel method to solve a set of simultaneous linear equations when we already have elimination methods such as Gaussian Elimination and LU Decomposition? 3

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)**
8	227.04
36	1004.597
65.75	1902.249
95.5	2799.901
125.25	3697.553
155	4595.205
184.75	5492.857

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 + 10**).

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)** for Linear interpolation to answer question **2. (b)**.

3. **a)** Find the most nearly value of $\int_a^b e^x dx$ 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*** **+ 2**.

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

4. **a)** Given $2\frac{dy}{dx} + 7y^2 = \sin x$, ***y***(0.4) = ☻ and using a step size of ***h*** = 0.4, find the most nearly value of ***y***(1.2) using the Runge-Kutta 2nd order method (you can choose anyone among the three methods taught in the class). 20

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

b) What method of the Runge-Kutta 2nd order have you used to solve question **4. (a)**? Why have you chosen that method? Justify your answer. 10

OR

a) Consider Figure 1 below. The cross-sectional area ***A*** of a gutter with equal base and edge length of 2 is given by $A = 4\sin\theta\,(1 + \cos\theta)$. Using the Golden Section Search method, find the angle θ which maximizes the cross-sectional area of the gutter. Using an initial interval of $\left[0, \frac{\text{☻}}{2}\right]$, find the maximum cross-sectional area ***A*** after **3 iterations**. 20

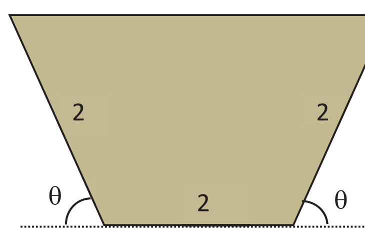

Figure 1

***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 **4**? Explain considering the fundamentals of the Equal Interval Search method. 10