CHRIST(Deemed to be University), BENGALURU
Department of Mathematics
Numerical methods using Python Programming (MAT551B)

Name : ..... **Roll No.:.....**
Duration : 1.45 Min. **Max Marks: 20**

---

1. Write a python program to plot the relationship between gravitational force and distance between two bodies. Force is given by $F = \frac{Gm_1m_2}{r^2}$, $m_1 = 1.5Kg, m_2 = 2.3Kg, G = 6.674X10^{-}11Nm^2Kg^{-2}$. Plot it for 20 different distances between 100 to $1000m$. (3 Marks + Execution (2))

2. The saturation concentration of dissolved oxygen in freshwater can be calculated with the equation $lno_{sf} = -139.34411 + \frac{1.575701X10^5}{T_a} - \frac{6.642308X10^7}{T_a^2} + \frac{1.243800X10^{10}}{T_a^3} - \frac{8.621949X10^{11}}{T_a^4}$ where, o_{sf} = the saturation concentration of dissolved oxygen in freshwater $1atm(mgL^{-1})$; and T_a = absolute temperature(K). Remember that $T_a = T + 273.15$, where T temperature($degredeC$). According to this equation, saturation decreases with increasing temperature. For typical natural waters in temperature climates, the equation can be used to determine that oxygen concentration ranges from $14.621mg/L$ to 0^0C to $6.949mg/L$ at 35^0C. Given a value of oxygen concentration, this formula and the bisection method can be used to solve for temperature in $degreeC$.

a) If the initial guesses are set as 0 and 35^0C, how many bisection iterations would be required to determine temperature to an absolute error of 0.05^0C?

b) Based on (a), develop and test a bisection program to determine T as a function of a given oxygen concentration. Test your program for $o_{sf} = 8, 10and14mg/L$. Check your results.