Sardar Vallabhbhai National Institute of Technology, Surat
Department of Physics
M.Sc Fourth Year; Computational Physics Lab (MP-407)
Practical No:02

Date-14/09/2022 **Time: 4 hours**

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1. Given the equations

$$2x_1 - 6x_2 - x_3 = -38$$
$$-3x_1 - x_2 + 7x_3 = -34$$
$$-8x_1 + x_2 - 2x_3 = -20$$

(a) Solve by Gauss elimination with partial pivoting. Show all steps of the computation.
(b) Substitute your results into the original equations to check your answers.

2. Three masses are suspended vertically by a series of identical springs where mass 1 is at the top and mass 3 is at the bottom. If g = 9.81 m/s^2, m_1 = 2 kg, m_2 = 3 kg, m_3 = 2.5 kg, and the k's = 10 kg/s^2, solve for the displacements x.

3. The following system of equations is designed to determine concentrations (the c's in g/m3) in a series of coupled reactors as a function of the amount of mass input to each reactor (the right-hand sides are in g/day),

4. $15c_1 - 3c_2 - c_3 = 3300$
5. $-3c_1 + 18c_2 - 6c_3 = 1200$
6. $-4c_1 - c_2 + 12c_3 = 2400$

(a) Determine the matrix inverse.
(b) Determine how much the rate of mass input to reactor 3 must be increased to induce a 10 g/m^3 rise in the concentration of reactor 1.
(c) How much will the concentration in reactor 3 be reduced if the rate of mass input to reactors 1 and 2 is reduced by 700 and 350 g/day, respectively?

4. Idealized spring-mass systems have numerous applications throughout engineering. Figure 1 shows an arrangement of our springs in series being depressed with a force of 2000 kg. At equilibrium, force-balance equations can be developed defining the interrelationships between the springs,

$$k_2(x_2 - x_1) = k_1x_1$$
$$k_3(x_3 - x_2) = k_2(x_2 - x_1)$$
$$k_4(x_4 - x_3) = k_3(x_3 - x_2)$$
$$F = k_4(x_4 - x_3)$$

where the k's are spring constants. If k_1 through k_4 are 150, 50, 75, and 225 N/m, respectively, compute the x's.