Non-linear spring constant problem observation:

Assumption – 350 unit is the force acting on the system at the time of equilibrium of spring system.

- The problem involved a non-linear equation in two variables.
- To solve the problem, we could form equations based on force balance at different node points.
- We understood that in case of nonlinear spring system in series the external net force acting for each system was same.
- At all points inside the spring system, there was no imbalance force.
- For springs in parallel the deflection was same but the external force acting on them was distributed accordingly so as to have same deflection.

Spring Constant	k at equilibrium	Force acting
500+50u	522.7765	238.141
200+100u	245.553	111.856
		305=total

- Equilibrium Deflection of springs
  Spring 1 = 0.45553
  Spring 2 = 0.45553
  Spring 3 = 0.6225

  Potential Energy stored in non-linear springs:

$$\int_0^{x\_final} k.x.dx$$

  Potential Energy in:

  Spring 1 = $\int_0^{x\_final}(500 + 50x).x.dx$ = $250x^2 + 50x^3/3$ = 53.4523

  Spring 2 = $\int_0^{x\_final}(200 + 100x).x.dx$ = $100x^2 + 100x^3/3$ = 23.9016

  Spring 1 = $\int_0^{x\_final}(500 + 100x).x.dx$ = $250x^2 + 100x^3/3$ = 104.9

  Work done by spring = F.(deflection of right end of spring)
  = potential energy increased
  = 182.254

- As we know that the change in potential energy is equal to the work done by conservation forces and so as to satisfy the equilibrium state of the spring system:

$\int_0^{x\_final} F.dx$ = 182.254

Thus the spring system is acted upon a variable force whose value depends upon the above equation where F varies from 0 to 350.