Q.1. Using two equal linear bar elements for a bar fixed at one end and supported by a spring of stiffness k_s at the other end shown in Figure 1, answer the following questions
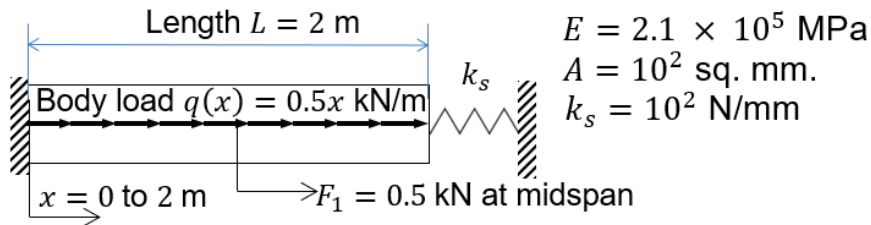

Length $L = 2$ m

Body load $q(x) = 0.5x$ kN/m

k_s

$x = 0$ to 2 m

$\rightarrow F_1 = 0.5$ kN at midspan

$E = 2.1 \times 10^5$ MPa
$A = 10^2$ sq. mm.
$k_s = 10^2$ N/mm

Figure 1

a) Derive the element level force vector for a generic element   [4 marks]
b) Write the element level equations in matrix form   [2 marks]
c) Write global matrix equations, apply BCs and show partitioning   [3 marks]
d) find the primary and secondary unknowns   [3 marks]
e) find the stress and strain in each element   [2 marks]