Problem 5 (20 points)
Consider the cantilever beam AB shown in Figure 5a having the channel cross-section shown in Fig. 5b. Assume that a distributed load \( w(\text{KN/m}) \) is acting along the beam. This load is assumed to be uniformly distributed across the width of the top flange of the beam as shown in Fig. 5c.
Calculate:

i. The vertical deflection \( \delta_B \) at B (in terms of \( b, c, t, L, w, E \)).

ii. The angle of twist \( \phi_B \) at B (in terms of \( b, c, t, L, w, E, \nu \)) (neglect warping, i.e. follow what was taught in class).

iii. The minimum and maximum shear stress \( \tau_{xy} (\tau_{xy, \text{min}} \text{ and } \tau_{xy, \text{max}}, \text{respectively}) \) along the beam (in terms of \( b, c, t, L, w, E, \nu \)). Clearly indicate at which section along the beam and at which particular point within this section these minimum and maximum stress occur.

iv. If the end B is not free, but if instead it is attached to a rotational spring with constant \( k_s \) (i.e. a spring that provides a twisting moment \( S_{XB} = -k_s \phi_B \) resisting the rotation \( \phi_B \)), then repeat question 2 to find \( \phi_s \).