1. Please describe the types and functions of admixtures for concrete.  
   (10%) 

2. Please describe the effect and control of chloride ions ($Cl^-$) for concrete under current standards/codes.  
   (10%) 

3. Please describe the effect of the following factors on the strength of concrete,  
   (10%)
   a. w/c
   b. the strength of coarse aggregates
   c. the content of cement
   d. the curing temperature
   e. the relative humidity of curing

4. Please describe the definition, classification, and testing methods of self-compacting concrete.  
   (10%) 

5. Please describe the methods for the following testing of concrete,  
   (10%)
   a. compressive strength
   b. splitting strength
   c. flexural strength
6. A beam is to be designed for factored loads causing a maximum shear of 50 kips, using concrete $f'_c = 4000$ psi. Proceeding on the basis that the concrete dimensions will be determined by diagonal tension, select the appropriate width and effective depth (a) for a beam in which no web reinforcement is to be used, (b) for a beam in which the minimum web reinforcement is provided, and (c) for a beam in which web reinforcement provides shear strength $V_s = 2V_c$.

$$V_c = 2\sqrt{f'_c \cdot b \cdot d}$$

Minimum Web Reinforcement $A_{yw} = 0.25\sqrt{f'_c \cdot \frac{b \cdot s}{f_y}} \geq 0.5 \cdot \frac{b \cdot s}{f_y}$

where $s =$ longitudinal spacing of web reinforcement, in.

$f_y =$ yield strength of web steel, psi

$A_{yw} =$ total cross-sectional area of web steel within distance $s$, in²

In all cases, let $d = 2b$.

($> 5\%$)
7. The short column shown in the following figure will be subjected to an eccentric load causing uniaxial bending about the Y axis. Material strength are $f_y = 60$ ksi, $f_c = 4$ ksi.

Construct the nominal strength interaction curve for this column, calculating no fewer than five points, including those corresponding to pure bending, pure axial thrust, and balanced failure. ($A_s = 1.56 \text{ in}^2$) (75%)