CS 381 Assignment 6 Solutions

Please note that there are many possible solutions for each of the CFG’s.

1. \{xx^Rww^R | x \in \{a,b\}^*, w \in \{a,b\}^*\}

   S -> EE
   E -> \epsilon | aEa | bEb

2. \{a^nb^n c^{n+m} | n, m \geq 0\}

   S -> aSc | T
   T -> bTc | \epsilon

3. \{a^ib^j | i = j or i = 2j\}

   S -> T | U
   T -> aTb | \epsilon
   U -> aaUb | \epsilon

4. 01\{0^n10^{n+1}\}^*

   S -> 01T
   T -> \epsilon | TT | U01
   U -> 0U0 | 1

5. \{a^ib^j c^k d^l | i = k or j = l\}

   S -> TD | AU
   T -> B | aTc
   U -> C | bUd
   A -> aA | \epsilon
   B -> bB | \epsilon
   C -> cC | \epsilon
   D -> dD | \epsilon

6. The set of all strings not in \{wcw^R | w \in \{a,b\}^*\}

   The idea here is to generate an error in the string wcw^R.
   S -> aSa | bSb | aEc | aEd | bEa | bEc | cEc | cEd
   E -> aE | bE | cE | \epsilon

   The productions from S -> aEc | bEa | bEc | cEa | cEb create the desired error in the string, with either unmatching letters on each side (aEc, bEa) or unequal number of letters on each side of c (aEc, cEa, bEc, cEb).

7. The set of all strings not in \{a^n b^n c^n | n \geq 1\}

   Generate an error by having too many of one letter.
S -> TC | UC | AV
T -> aTb | aT | a (generates excess a’s)
U -> aUb | Ub | b (generates excess b’s)
V -> bVc | Vc | c (generates excess c’s)
A -> aA | ε C -> cC | ε
We also need to Union this with all strings not of the form a*b*c*.

8. The set of all strings not in \{01001000100001…10 n1 | n ≥ 1\}

The idea here is to generate 0^i10^j as a substring, where i+1 != j. There are two cases, either i >= j, or j >= i+2.
S -> E1 Σ * | Σ *1E1 Σ *
E -> T | U (E generates the error)
T -> 0T0 | 0T | 1 (generates i >= j, too many 0’s on the left side)
U -> V00 (generates j >= i+2, too many 0’s on the right side)
V -> 0V0 | V0 | 1