Solve all the questions given below:

1) List five use cases where you can apply the knowledge from our CSE331 course.

3) Design a Context Free Grammar for the Language:

a) $L = \{w \in \{a,b,c,p,q,r,\#\}^*: a^i\#^n c^k p^{2x} q^y r^z b^j$ where $i=j+k$, $y=3x+z$, n is odd and $i,j,k,n,x,y,z \geq 0\}$

b) $L = \{w \in \{0,1,2\}^*: w = 0^i 2^j 1^k$, [where .....conditions.....] }

where...

~~i) $i = k$, $i,k \geq 1$ and $j \geq 2$~~

ii) $i = 3k$, j is odd and $i,j,k \geq 0$

iii) i is a multiple of two, k is two more than a multiple of 3, $j = k+i$, and $i,j,k \geq 0$

iv) $i+j > k$ and $i,j,k \geq 0$

v) $i+k$ is even, $j = i+k$ and $j>=1$

c) $L = \{w \in \{0,1\}^*:$ the parity of 0s and 1s is different in w}

d) $L = \{w \in \{0,1\}^*:$ the number of 0s and 1s are different in w}
[Hint: First, try to solve for an equal number of 0s and 1s in w]

e) $L = \{1^i 0 2^j 1^k \mid i, j, k \geq 0, 3i \geq 4k + 2, j$ is not divisible by three}

f) Recall that for a string w, $|w|$ denotes the length of w. $\Sigma = \{0,1\}$

$L1 = \{w \in \Sigma^*:$ w contains exactly two 1s}

$L2 = \{x\#y : x \in \Sigma^*, y \in L1, |x| = |y|\}$

Construct a CFG for L2.

g) Recall that for a string w, $|w|$ denotes the length of w. $\Sigma = \{0,1\}$

$L1 = \{w \in \Sigma^*:$ w contains at least three 1s}

$L2 = \{x\#y : x \in (\Sigma\Sigma)^*, y \in L1, |x| = |y|\}$

Construct a CFG for L2.

4) For all the problems in Question(3), now construct the Pushdown Automata (PDA).