Problem 1  [6+6=12 marks]

- In this course, the height of an empty tree is -1.
- Some students missed the case where the tree is empty.
- Some students did not provide pseudocodes.
- Some students did not provide a justification of correctness.

Problem 2  [2+6+5=13 marks]

b)  
- Some students did not use the property of AVL tree.
- Some students did not take the other child of $T_{\ell-(i+1)}$ into consideration in the inductive step.

c) Some students said the height of an AVL tree with $n$ nodes is $\log n$, which is not necessarily true; they should say the height is in $\Omega(\log n)$ instead.

Problem 3  [4+1+3+3+4=15 marks]

a) Some students did not use the other part of the given inequality $\text{balance} \geq \frac{1}{2}$ to prove for $\text{leftDescendants}$.

c) Some students overcomplicated the problem by trying to prove for exactly $n$; proving for at most $n$ is enough.

e)  
- Some students did not use the property that $H(n)$ is non-decreasing inside their justification.
- Some students did not give an upper bound for $k$.

Problem 4  [4+4 = 8 marks]

b)  
- Some students did not justify how they get $k = \sqrt{n}$ and why it minimizes the run-time.
- Some students forgot to validate that $\sqrt{n}$ is actually the minimum point by either checking whether the second derivative is positive or checking whether the first derivative changes from negative to positive at $k = \sqrt{n}$.
Problem 5  [6+6=12 marks]
Generally well done.

Problem 6  [2+3+4+5=14 marks]

a) Some students did not mention that the coin flips are independent.

d)  
   • Some students did not justify why $E(V_i) \leq 1$ and $E(V_i) \leq np^i$.
   • Some students split the sum incorrectly.