Department of Mathematics
Minor I Examination
MTL 342: Analysis and Design of Algorithms

Time 2:30 – 3:30 PM   Full Marks 21

Venue: LH 114   Date: 29-8-2016

Q1. (a) Can the Master method be applied to the following recurrence: $T(n) = 4T(n/2) + n^2 \log n$? Justify your answer.   [2]

(b) Let $T_1(n) = 7 T_1(n/2) + n^2$ and $T_2(n) = aT_2(n/4) + n^2$ describe the worst case running time of T_1 and T_2, respectively, to solve a problem. What is the largest integer value for a such that T_2 runs asymptotically faster than T_1 ?   [2]

(c) Give the asymptotic upper and lower bounds for $T(n)$ where $T(n) = 3T(n/3 +5) + n/2$. Assume that $T(n)$ is constant for sufficiently small n. Make your bound as tight as possible. Justify your answer.   [3]

Q2. (a) Consider the input to a stack to be 1, 2, 3, 4, 5, 6, 7. Answer the following with justification.

- Find the number of permutations starting with 6 that can be formed using the stack.
- Find the number of permutations starting with 3, 2 that can be formed using the stack.
- Find the number of permutations ending with 5 that can be formed using the stack.

[1.5+1.5+ 1.5 =4.5]

(b) Prove that the number of permutations of 1,2,3, ...n, that can be generated using an IRD is same as that can be generated using an ORD.   [2.5]

Q3. (a) Prove that any Binary tree that is not Full cannot correspond to an optimal Pre-fix code.   [3]

(b) Below you have lengths of 10 files, and their reading frequencies. How will you store them on a tape so that the total reading time is optimal? Justify your answer

Length	1	2	3	4	5	6	7	8	9	10
Frequency	1	2	3	4	5	6	7	8	9	10

Note that each time you read a file, the tape rewinds to the beginning before initiating the next reading.

[4]