INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Department of Computer Science and Engineering

Algorithms-I (CS21003)

Mid-semester examination (Spring)

Date: Fri, Feb 19, 2016 *Students:* 41 *Time:* 2-4pm (AN)

Place: NC141, NC142, NC242 *Marks:* 60

1. Consider functions from reals to reals; show that Θ is an equivalence relation on these functions. 10

2. Derive the asymptotic form solution for $T_n = aT_{\frac{n}{s}} + bn^r$ when $a = s^r$, $n = s^m$, $m \geq 0$ 10

3. (a) You are given a sorted array `A[1..n]` of integers that has been rotated right k positions, but k is unknown. Examine the following examples:
   - [36, 41, 7, 18, 29, 31] is a sorted array that has been rotated $k = 2$ positions
   - [29, 31, 36, 41, 7, 18] is a sorted array that has been rotated $k = 4$ positions

   Present an efficient algorithm, with suitable justifications, to determine k from the given array `A`. 10

   (b) Derive the recurrence to characterise the running time of the algorithm and also present its solution. 5

4. Show that the AVL balance criterion ensures that the height of the tree is logarithmic in the number of nodes in the tree. 10

5. (a) Present a scheme, with necessary operations and adequate explanations, for extending the AVL tree to store intervals 5

   (b) Write the routine to insert an interval into the extended AVL tree data structure. Only present the steps for correcting imbalances where the left subtree has gained height. 10

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