



CS204: Algorithms  
Mid Semester, Autumn 2016  
IIT Patna

Attempt all questions. Do not write anything on the question paper.

Time: 2 Hrs

Full marks: 30

1. Describe an efficient algorithm for construction of min-heap using  $n$  distinct integers. Analyze time complexity of your algorithm. (5)
2. Find asymptotic complexity for the recurrence relation  $T(n) = T(n/2 + \sqrt{n}) + \sqrt{2016}$  (5)
3. The square of a matrix  $A$  is its product with itself,  $AA$ . Show that five multiplications are sufficient to compute the square of a  $2 \times 2$  matrix. (2)
4. You are given two sorted lists of size  $m$  and  $n$ . Give an  $O(\log m + \log n)$  time algorithm for computing the  $k$ th smallest element in the union of the two lists. (4)
5. For a given binary search tree the preorder traversal produces the following sequence: 7, 4, 2, 3, 6, 5, 12, 9, 8, 11, 19, 15, 20. Construct the binary search tree. (4)
6. Given a sequence of  $n$  matrices -  $\{A_1, A_2, \dots, A_n\}$ , you need to find out  $X = A_1 \times A_2 \times \dots \times A_n$ .
  - (a) Present an algorithm to find out  $X$  using *minimum* number of multiplications and an *ordering* of those multiplications.
  - (b) Present a working example to demonstrate your algorithm.
  - (c) Find complexity of your algorithm. (4+3+3)