B.C.S.E 3rd Year 2nd Semester Examination 2018

DESIGN AND ANALYSIS OF ALGORITHMS

Time: **Three hours** Full Marks: **100**

Answer Question #1 and any four from the rest, all having the same value

1. Draw a line from each of the three functions in the centre to the best big Ω value on the left and the best big O on the right:

$\Omega(1 / n)$		$O(1 / n)$
$\Omega(1)$		$O(1)$
$\Omega(\log \log n)$		$O(\log \log n)$
$\Omega(\log^2 n)$		$O(\log^2 n)$
$\Omega(n^{1/3})$		$O(n^{1/3})$
$\Omega(n / \log n)$	$1 / (\log n)$	$O(n / \log n)$
$\Omega(n)$	$7n^5 - 3n + 2$	$O(n)$
$\Omega(n^{1.00001})$	3^n	$O(n^{1.00001})$
$\Omega(n^2 / \log^2 n)$		$O(n^2 / \log^2 n)$
$\Omega(n^2 / \log n)$		$O(n^2 / \log n)$
$\Omega(n^2)$		$O(n^2)$
$\Omega(n^{3/2})$		$O(n^{3/2})$
$\Omega(2^n)$		$O(2^n)$

2. Design a randomized algorithm and then give an analysis for identifying n / 2 repeated elements in an array which has another n / 2 distinct elements other than the repeated elements.

3. Design and analyze the KMP algorithm for string matching.

4. Prove that the following algorithm for the addition of natural numbers is correct:

```
add(y, z) {
    x = 0; c = 0; d = 1;
    while (y > 0) ∨ (z > 0) ∨ (c > 0) {
        a = y mod 2; b = z mod 2;
        if a ⊕ b ⊕ c then x = x + d;
        c = (a ∧ b) ∨ (b ∧ c) ∨ (c ∧ a); d = 2d; y = ⌊y/2⌋; z = ⌊z/2⌋;
    };
    return x;
}
```

[Turn over

5. Design and analyze a dynamic programming solution for the matrix-chain multiplication problem.

6. How does a randomized input significantly improve the performance of quicksort? Give a detailed study.
