INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR
COMPUTER SCIENCE AND ENGINEERING DEPARTMENT

B.TECH. END-SEMESTER EXAMINATION, AUTUMN 2018-19
ALGORITHMS II (CS31005)

**Full marks: 100** **Time: 3 hours**

Answer Questions 1 and 2, and any two from the rest.

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1. Write only the answer/answers (a/b/c/d) in the **1st page** of your answer-script in a tabular form as follows. $(2 \times 10 = 20)$

| Question | i | ii | iii | iv | v | vi | vii | viii | ix | x |
|---|---|---|---|---|---|---|---|---|---|---|
| Answer | | | | | | | | | | |

i) For an input of size $n$, the time complexity of an algorithm is given by $T(1) = 1, T(n) = 3T(n-1) + 1$ for $n \geq 2$. Then $T(n)$ solves to
(a) $\Theta(n)$. (b) $\Theta(n^2)$. (c) $\Theta(n^3)$. (d) $\Theta(3^n)$.

ii) Time complexity of Edmonds-Karp algorithm for max-flow computation is
(a) $O(VE)$. (b) $O(V^2E)$. (c) $O(VE^2)$. (d) $O(V^2E^2)$.

iii) Space complexity of doubly connected edge list in Voronoi diagram algorithm with $n$ sites as input, is
(a) $O(n)$. (b) $O(n \log n)$. (c) $O(n^2)$. (d) $O(n^{3/2})$.

iv) $G(V, E)$ is a flow network with $s$ and $t$ as the source and the sink, $f$ is a flow in $G$, and $(S, T)$ is a cut on $V$. Then $f(S, T) = |f|$ is true for
(a) exactly one cut $(S, T)$ with $s \in S, t \in T$. (b) possibly for more than one cut $(S, T)$ with $s \in S, t \in T$. (c) for any cut $(S, T)$ with $s \in S, t \in T$. (d) cannot be said.

v) Time complexity to compute all intersection points among $n$ line segments by the plane-sweep algorithm, when each line segment intersects at most $k$ line segments, is
(a) $O(kn^2)$. (b) $O(kn \log n)$. (c) $O((k+n) \log n)$. (d) $O(k \log n)$.

vi) An unfair dice has probability 1/12 of showing any of its even faces and 1/4 of showing any of its odd faces. The expected value on throwing this dice is
(a) 3.20. (b) 3.25. (c) 3.50. (d) 3.75.

vii) Time complexity for nondeterministic sorting algorithm is
(a) $O(n \log n)$. (b) $O(n^{4/3})$. (c) $O(n^{3/2})$. (d) none of these.

viii) There are $n$ input boolean variables and $g$ gates in an instance of SAT (circuit satisfiability problem). Its equivalent 3-SAT instance can be constructed in time:
(a) $O(n)$. (b) $O(g)$. (c) $O(n+g)$. (d) $O(ng)$.

ix) Number of clauses in the 3-CNF of $(x_1 \vee \neg x_2) \wedge (\neg x_1 \vee x_2)$ is
(a) 2. (b) 3. (c) 4. (d) none of these.

x) Which of the following is/are not an $\mathcal{NP}$-complete problem?
(a) Max cut. (b) Min cut. (c) Max flow. (d) Minimum set cover.



P.T.O.