End Semester Exam-2017 – CS302 Theory of Computation – 6th Sem, 3rd Btech

Please attempt all questions carefully. This exam of three hours is of 60 marks.

1. (a) What is an LBA? [2]

   (b) Prove that A_{LBA} is decidable. [4]

2. Prove that every context-free language is a member of P. [4]

3. In the proof of *VERTEX-COVER* as NP-complete, reduction through 3SAT problem is used. Construct the **graph** that the reduction produces[4]

$$\boxed{\phi = (x_1 \vee x_1 \vee x_2) \wedge (\overline{x_1} \vee \overline{x_2} \vee \overline{x_2}) \wedge (\overline{x_1} \vee x_2 \vee x_2)}$$

4. Give quick proofs for the following(in one line):-

   (i) Prove that $\overline{\text{HAM}}$ is in CO-NP, i.e. complement of the Hamiltonian Cycle. [2]

   (ii) Prove that Vertex Cover (VC) is in NP [2]

   (iii) Prove that every context-free language is a member of P [2]

   (iv) Prove that $A=\{0^k1^k \mid k>0\}$ is in L. [2]

5. Let *t(n)* be a function, where *t(n) > n*. Then Prove that every *t(n)* time nondeterministic single-tape Turing machine has an equivalent $2^{O(t(n))}$ time deterministic single tape Turing machine. [4]

6. State the polynomial-time 2-optimal approximation algorithm for VERTEX-COVER and prove that algorithm produces no more than twice as large as a smallest vertex cover. [2+2]

7. SAT-Solver: classify the clause given in figure:

   (a) Satisfied(b) Conflicting(c)unit(d)unresolved [2]

   (ii) Short notes on DPLL Algorithm [3]

Given the partial assignment
$(x_1 = 1, x_2 = 0, x_4 = 1)$
$(x_1 \vee x_3 \vee \neg x_4)$ $(\neg x_1 \vee x_2)$ $(\neg x_1 \vee \neg x_4 \vee x_3)$ $(\neg x_1 \vee x_3 \vee x_5)$

8. (i) Define NL-complete [2]

   (ii) State TQBF problem and its space complexity [2]

   (iii) State GG problem and its space complexity [2]

9. Give short notes on the following:-

   (i) State the theorem of Stephen Cook and Leonid Levin. [2]

   (ii) NP-complete, NP-hard, PSPACE-complete, PSPACE-hard. [2]

   (iii) State the Savitch's Theorem [2]

   (iv) $P \subseteq NP \subseteq PSPACE = NPSPACE \subseteq EXPTIME$ [2]

   (v) State PCP problem [2]

10. Choice: Give the proof sketch (i) PCP problem OR (ii) Cook-Levin Theorem [3]

11. Define: (i) Class P (ii) Class PSPACE (iii) Class NP (iv) Class NPSPACE [2]

12. Explain: (i) $P \subseteq PSPACE$ for $t(n) \geq n$ [2]

    (ii) $NP \subseteq NPSPACE$, and so $NP \subseteq PSPACE$ [2]