Automata Theory and Computability - 15CS54

Module-5: Review Questions

Sl. No.	Questions	Marks
VARIANTS OF TM		
1.	Explain the following types of TM: a. Multitape TM b. Non deterministic TM	6 each
2.	Prove that every language accepted by a multi-tape TM is acceptable by some single-tape TM (that is, the standard TM).	8
3.	Prove that, if M_1 is the single-tape TM that simulates multitape TM M, then the time taken by M_1 to simulate n moves of M is $O(n^2)$.	6
4.	Prove that, if M is a nondeterministic TM, there is a deterministic TM M_1 such that $T(M) = T(M_1)$	6
5.	Explain the model of Linear bounded Automata.	6

DECIDABILITY		
6.	Define : a. recursively enumerable language b. recursive language c. decidable languages d. undecidable languages	2 each
7.	Prove that a. A_{DFA} is decidable. b. A_{CFG} is decidable. c. A_{CSG} is decidable. d. A_{TM} is undecidable.	6 each
8.	Prove $HALT_{TM}$ = {(M, w) |The Turing machine M halts on input w} is undecidable.	6
9.	a. Does the PCP with two lists $x = (b, bab^3, ba)$ and $v = (b^3, ba, a)$ have a solution? b. Prove that PCP with two lists $x = (01, 1, 1)$, $Y = (01^2, 10, 1^1)$ has no solution.	2 each
10.	If L is a recursive language over $\sum$, show that $\bar{L}$ ($\bar{L}$ is defined as $\sum^*$ - L) is also recursive.	4
11.	If L and $\bar{L}$ are both recursively enumerable, show that L and $\bar{L}$ are recursive.	6
12.	Show that the union of two recursively enumerable languages is recursively enumerable and the union of two recursive languages is recursive.	6

COMPLEXITY AND COMPUTATION		
13.	State and explain Church-Turing Thesis.	6
14.	Write a note on quantum computation.	8
15.	Let $f(n) = 4n^3 + 5n^2 + 7n + 3$. Prove that $f(n) = 0(n^3)$.	4
16.	Find the running time for the Euclidean algorithm for evaluating gcd(a, *b)* where *a* and *b* are positive integers expressed in binary representation.	5
17.	Construct the time complexity *T(n)* for the Turing machine *M* :L=$\{0^n1^n: n>=1\}$	5
18.	Prove that, If $p(n) = a_kn^k + a_{k-1}k^{k-1} + \ldots + a_1n + a_0$ is a polynomial of degree k over Z and $a_k > 0$, then $p(n) = O(n^k)$.	6
19.	Prove that the growth rate of any exponential function is greater than that of any polynomial.	6