

INDIAN INSTITUTE OF TECHNOLOGY BHILAI
CS253: Theory of Computation II
Tutorial Sheet 1

• *Solve the following problems before the Tutorial.*

1. Given input $\langle M_1, M_2 \rangle$, where M_1 and M_2 are two turing machines prove that the problem whether $L(M_1) \cap L(M_2) \neq \emptyset$ is undecidable.
2. Are the following languages decidable ?
 - (a) Given a TM M , whether M ever writes a specific non-blank symbol when started on an empty tape.
 - (b) Given a TM M , whether there is a w such that M enters each of its states during the computation on w .
 - (c) Given a TM M and an input w , does the head ever visit the B -th square for a given integer B .
 - (d) $L = \{ \langle M \rangle \mid M \text{ accepts } w^R \text{ iff it accepts } w \}$.
 - (e) $E_{CFG} = \{ \langle G_1, G_2 \rangle \mid G_1 \text{ and } G_2 \text{ are two CFGs and } L(G_1) = L(G_2) \}$.
3. A useless state in a Turing machine is one that is never entered on any input string. Consider the problem of determining whether a Turing machine has any useless states. Formulate this problem as a language and show that it is undecidable.
4. Construct a turing machine M that accepts all the string that starts and ends with the same symbol (consider $\Sigma = \{0, 1\}$). Taking this turing machine and the string 00100 as an input of A_{TM} , construct an instance of MPCP using the construction idea discussed in the class. Finally, show an arrangement of the constructed string pairs of MPCP that creates two matched strings in the top and bottom.