# Indian Institute of Information Technology Vadodara
# MA 102: Introduction to Discrete Mathematics
# Tutorial 3

1. Which of these sentences are propositions? What are the truth values of those that are propositions?
   a) Answer this question.
   b) Close the door.
   c) 6+5=11.
   d) What time is it?
   e) $x = x$.
   f) This statement is false.

2. What is the negation of each of these propositions?
   a) Surya and Tejay are friends.
   b) The summer in Gandhinagar is hot and sunny.
   c) Shubham sent more than 100 whatsapp messages every day.
   d) $5 * 3 \geq 15$
   e) It is freezing and it is not snowing.

3. Let p and q be the propositions: p- Mahesh choose MA401 as science elective; q-Mahesh likes MA102. Express each of these propositions as an English sentence.
   $p \vee q, \neg p \wedge \neg q, p \Rightarrow q$

4. Write these propositions using p and q and logical connectives. p- Mahesh choose MA401 as science elective; q-Mahesh likes MA102.
   a) Mahesh does not choose MA401 and likes MA102.
   b) Either Mahesh does not like MA102 or he does not choose MA401.

5. Let $p, q, r$ be three propositions with truth values $F, T, F$ respectively. Find the truth values $p \Rightarrow \neg r, p \vee \neq r, (p \wedge \neg q) \Rightarrow r, (r \Rightarrow \neg p) \Rightarrow q$.

6. Suppose there is an island of knights and knaves, where knights always tell the truth and knaves always lie. You encounter two people, A and B. Determine, if possible, what A and B are if they address you in the ways described. If you cannot determine what these two people are, can you draw any conclusions?
   a) A says "At least one of us is a knave" and B says nothing.
   b) A says "The two of us are both knights" and B says "A is a knave."
   c) Both A and B say "I am a knight."

7. Show that the conditional statement is a tautology by using truth table: $[p \wedge (p \Rightarrow q)] \Rightarrow q$

8. Use De Morgan's laws to find the negation of the following statement: Carlos will bicycle or run tomorrow.

9. Solve this famous logic puzzle, attributed to Albert Einstein, and known as the zebra puzzle. Five men with different nationalities and with different jobs live in consecutive houses on a street. These houses are painted different colors. The men have different pets and have different favorite drinks. Determine who owns a zebra and whose favorite drink is mineral water (which is one of the favorite drinks) given these clues: The Englishman lives in the red house. The Spaniard owns a dog. The Japanese man is a painter. The Italian drinks tea. The Norwegian lives in the first house on the left. The green house is immediately to the right of the white one. The photographer breeds snails. The diplomat lives in the yellow house. Milk is drunk in the middle house. The owner of the green house drinks coffee. The Norwegian's house is next to the blue one. The violinist drinks orange juice. The fox is in a house next to that of the physician. The horse is in a house next to that of the diplomat. [Hint: Make a table where the rows represent the men and columns represent the color of their houses, their jobs, their pets, and their favorite drinks and use logical reasoning to determine the correct entries in the table.]