1. a) Define fuzzy logic. Distinguish between crisp and fuzzy logic. 2
   b) Mention the importance of fuzzy based logic system in real life. 2
   c) Draw a diagram for fuzzy logic system. Explain its operation with an example. 6

2. a) Show the fuzzification of Good(x) and Bad(x) from the following 5

   Good: A student total mark greater than or equal to 80 is really good, but less than or equal to 60 is not considered as good.

   Also find the value of NOT ((Good(73) AND Bad(52))

   b) Draw a diagram that shows Maximum and Mean of maximum defuzzification with an example. 2

   c) A pot may contain all apples or oranges. The pot may also contain a mixture of apples and oranges in the ratios 0:6, 1:5, 2:4, 3:3, 4:2, 5:1 and 6:0. If there is a question "how many apples in the pot?", what are the answers in crisp and fuzzy words and values? 3

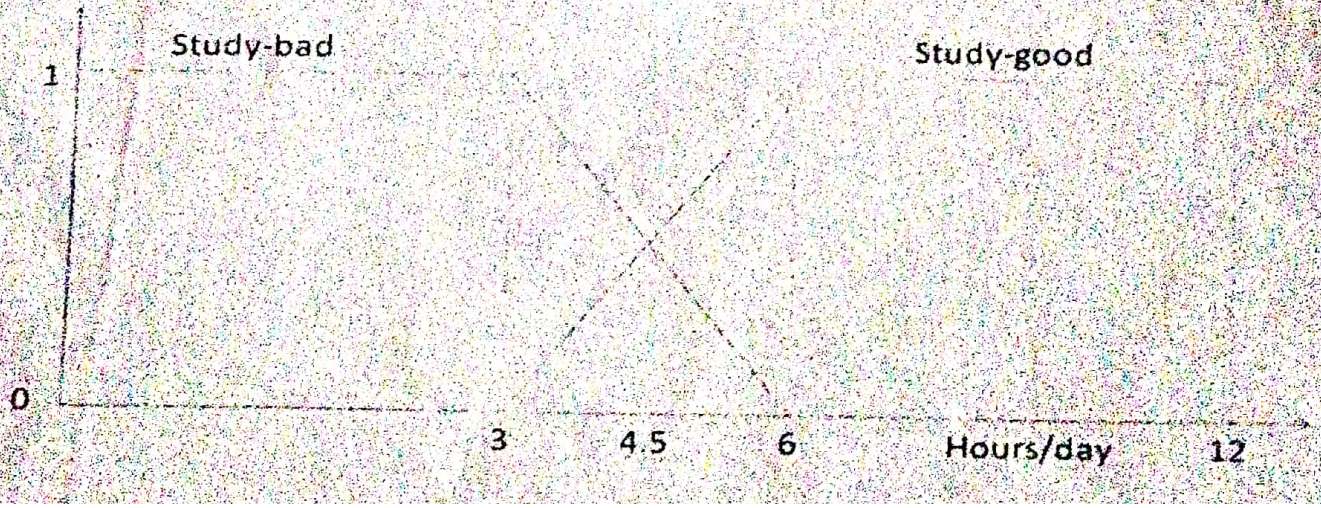
3. Membership functions for STUDY_HOUR {Study-bad, Study-good}, SLEEPING_HOUR {Under-sleep, Well-sleep, Over-sleep} and STUDENT {Good, Bad}, and fuzzy rules are given below. Find the obtained mark of a student who studies 4.5 hours and sleeps 7.5 hours in a day using the centroid defuzzification method. 10

Fuzzy rules:

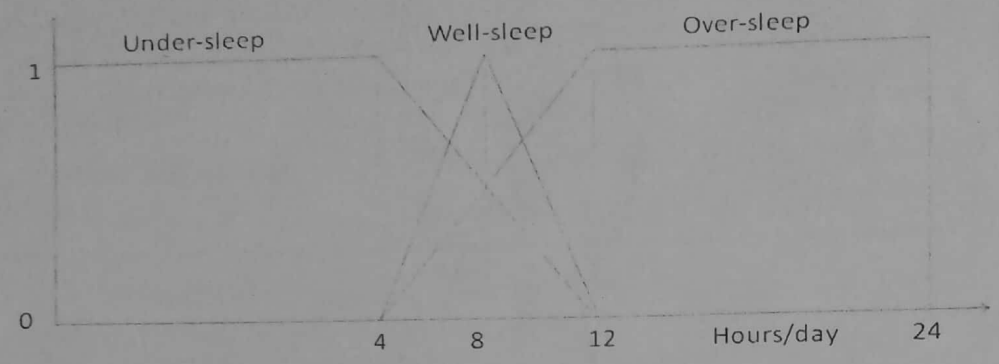
If a student studies and sleeps well, he will be good student.

If a student studies bad, and sleeps bad or over, he will be bad student.

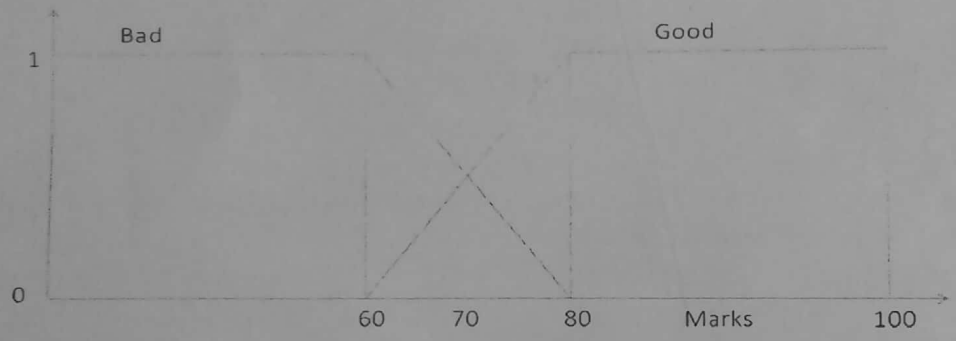
Membership function for STUDY_HOUR:



Membership function for SLEEPING_HOUR:



Membership function for a STUDENT:



4. a) Explain fuzzy and crisp set operation with the multi element set, A and B 2
A={0.8 0.9 0.1} and B={0.9 0.5 0.8}

b)Show fuzzy $((a^3+b^3)/(a-b))$, where a=fuzzy 4 and b=fuzzy 5, where fuzzification is done using the triangular function. 3

c) If fuzzy 4 and 5 are defined as (3, 4, 5) and (4, 5, 6), respectively by using a triangular function, find membership function, μ for fuzzy 4 and fuzzy 5 using continuous functions. Also find $\mu(3.5) + \mu(5.5)$. 2

d) Define fuzzy inference rule. What are the significances of it? 2

e) Draw diagrams for the different fuzzification techniques. 1