1. (a) Show that Yager’s class of fuzzy complements satisfies the involution property.
   (b) Prove that for this class of complements, the requirement: 
       \[ \mu_A(x_1) - \mu_A(x_2) = \mu_{Abar}(x_2) - \mu_{Abar}(x_1) \]
       is satisfied for all \( x_1 \) and \( x_2 \) iff the parameter \( w = 1 \).
   (c) Prove or Disprove that Bounded Product and Bounded Sum as T-norm and T-conorm operators are dual of each other in the sense of the generalized DeMorgan’s Law with Yager’s class of complements as the complementation functions. [5+5+5=15]

2. If a fuzzy set A has membership function: Trapezoid(x; 1, 5, 18, 20) and another fuzzy set B has membership function: Trapezoid(x; 2, 6, 12, 20), plot the value of \( A \cup B \) between \( x = 5 \) and \( x = 15 \) using bounded sum as the S-norm operator. [5]

3. (a) Define a Contrast Diminisher operator (DIM) such that \( \text{DIM}(	ext{INT}(A)) = A \), where \( \text{INT} \) is the contrast intensification operator.
   (b) Define the membership functions of an orthogonal term set \{young, middle-aged, old\} of the linguistic variable age on the universe of discourse \( X = [0, 80] \). The fuzzy sets should be normal and membership functions should be non trivial and meaningful.
   (c) Using the operator in (a) above, what is the value of \( \text{DIM}(\text{old}) \) for age = 70 considering your definition of membership functions? [5+8+2=15]

4. Consider the fuzzy set \textbf{Young} defined by the membership function \( \text{sig}(age; -4, 12) \).
   (a) Define meaningful membership functions of two fuzzy sets \textbf{Too Young} and \textbf{More or Less Young} based on the membership function of \textbf{Young}.
   (b) What is the degree of membership value of a student of age 15 in the fuzzy set \textbf{More or Less Young but not Too Young}? [2+3=5]