Question 1: Fixed Income Valuation and Analysis (30 points)

You are a bond portfolio manager at Absolute bank and analyse the bond valuation and the risk management.

a) On January 15th, 2025, you bought a US 2-year T-Note maturing on January 15th, 2027 whose annualised yield-to-maturity (YTM) was 4.80%. The bond has a nominal coupon of 4.25%. Coupons are paid semi-annually on January 15th and July 15th as it is the standard in the US. Round your answers to the 3rd decimal (e.g. 1.234).

a1) What was the quoted price of the bond on January 15th, 2025? Show your calculation. (4 points)

a2) Calculate the modified duration of the bond. Use the formula "Modified Duration = Macaulay Duration / (1+YTM/2)" as the coupons are paid semi-annually. Show your calculation.
[Note: In case you have not solved question a1), assume the price of the bond as 99.000] (5 points)

a3) Considering a decrease of 55 basis points in YTM, what is the change in price in USD of the bond using the duration approximation?
[Note: In case you have not solved question a2), assume the modified duration of 1.800 and the price of the bond as 99.000] (2 points)

a4) If the bond yield decreases suddenly from 4.80% to 4.25% on January 15th, 2025, what is the expected real new price? Calculate the approximate new price using the dollar duration and share your observation comparing the expected price. Explain why the expected price is not exactly the same as the approximated one calculated using dollar duration.
[Note: In case you have not solved question a3), assume the change in price as USD 0.98 and the price of the bond as 99.000] (5 points)

a5) On January 15th, 2025, the 1-year spot rate was 4.79% and the 2-year spot rate was 4.39%. Calculate the 1-year forward rate starting in 1 year derived from the US spot rate curve. (3 points)

a6) 1 year before, on January 15th, 2024, the US 3-month T-Bill had a YTM of 5.4% while the US 10-year T-Note had a yield of 4.0%. What can be said about the shape of yield curve at that time? What is the economic interpretation of this yield curve shape? (2 points)

b) On January 15th, 2025, you bought the US 2-year T-Note with the intention of holding it until maturity. As you were concerned about interest rate risk, you noted that at that time the US 3-year T-Note was trading at a YTM of 4.05% with a coupon rate of 4.25% and a Macaulay duration of 2.85.

b1) Explain the concept of interest rate immunization. (3 points)

b2) Assume your investment horizon is 2 years. To immunize your portfolio, how much (in %) should you have invested in the US 3-year T-Note in addition to your sole position in the US 2-year T-Note?
[Note: In case you have not solved question a2), assume the Macaulay duration of the US 2-year T-Note is 1.95]. (2 points)

b3) Assume your investment horizon is 2 years. Explain the risk to immunization that you would have faced by not considering the US 3-year T-Note in your portfolio (that is only investing in the US 2-year T-Note). (2 points)

b4) Why does immunization involve rebalancing the portfolio through time? Explain. (2 points)