Question

Given the bandwidth B = 10MHz and the signal-to-noise ratio (in dB) SNR = 20 dB, compute:

1. The SNR in non-dB (linear) form (50 pts)
2. The maximum achievable data rate (50 pts)

Solution

(i) SNR in linear scale

The conversion from decibels to linear scale is:

$$\text{SNR}_{\text{linear}} = 10^{\frac{\text{SNR}_{\text{dB}}}{10}}$$

Substituting the given value:

$$\text{SNR}_{\text{linear}} = 10^{\frac{20}{10}} = 10^2 = 100$$

(ii) Maximum achievable data rate

The Shannon capacity formula is:

$$C = B \log_2(1 + \text{SNR})$$

Given:

$$B = 10 \times 10^6 \,\text{Hz}, \quad \text{SNR} = 100$$

$$C = 10 \times 10^6 \cdot \log_2(101)$$

$$\log_2(101) \approx 6.658$$

$$C \approx 6.658 \times 10^7 \,\text{bps}$$

$$\boxed{C \approx 66.6 \,\text{Mbps}}$$

Final Answers

$$\text{SNR (linear)} = 100$$

$$C \approx 66.6 \text{ Mbps}$$