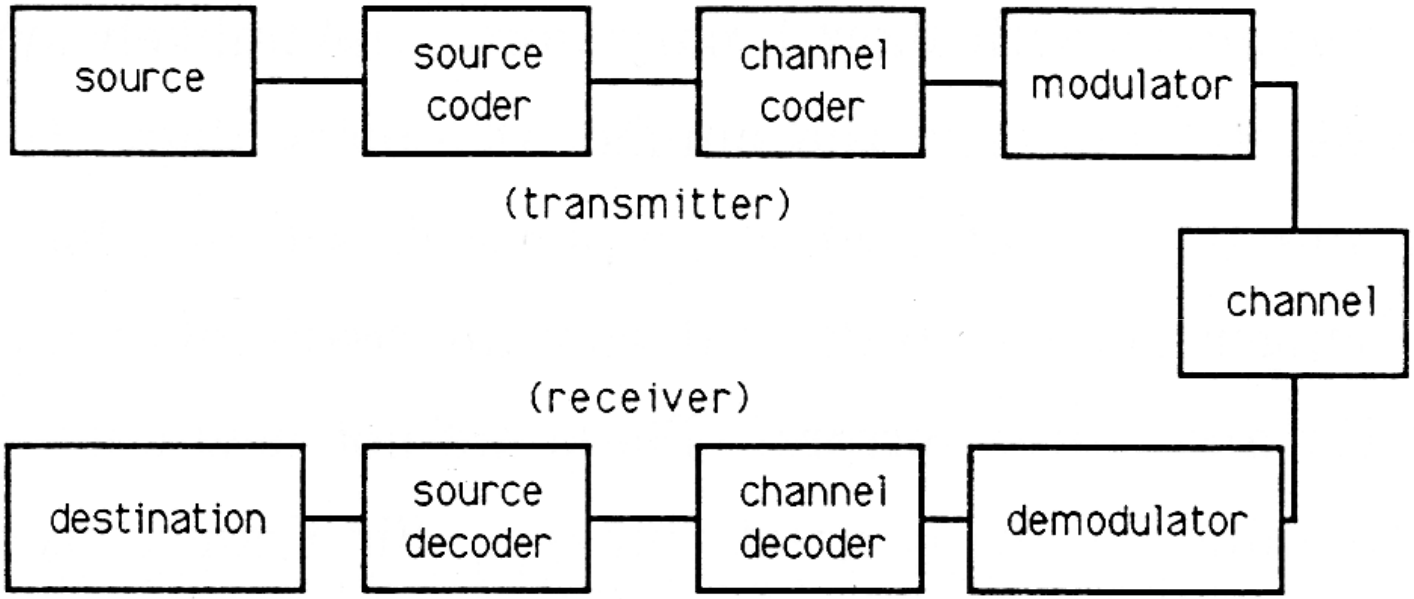
Channel Coding Theorem-II

Introduction

- Consider a DMS with source alphabet S and the entropy H(S) bps.
- DMS emits symbols once every T_s seconds.
- The **average information rate** of the source is **$H(S)/T_s$** bits per second.
- **Note:** The decoder delivers decoded symbols to the destination at the same source rate of every T_s seconds.

Block Diagram of a Digital Communication System



Introduction Contd...

- The discrete memoryless channel (DMC) has a channel capacity equal to C bits per use of the channel.
- The channel is capable of being used once every $\mathbf{T_c}$ seconds.
- Then, **maximum rate of information** transfer over the channel is denoted by $\mathbf{C/T_c}$ bits per second.

Channel Coding Theorem (1/3)

- The channel coding theorem is defined as

1. Let a discrete memoryless source
   - with an alphabet S
   - with an entropy H(S)
   - produce symbols once every Ts seconds
2. Let a discrete memoryless channel
   - have capacity C
   - be used once every Tc seconds.
3. Then if,

Channel Coding Theorem (2/3)

$$\frac{H(S)}{T_s} \leq \frac{C}{T_c}$$

- There exists a coding scheme for which the source output can be transmitted over the channel and be reconstructed with an arbitrarily small probability of error (ϵ).
- The parameter **C/T_c** is called **critical rate**.

4. Conversely, if

Channel Coding Theorem (3/3)

$$\frac{H(S)}{T_s} > \frac{C}{T_c}$$

- It is not possible to transmit information over the channel and reconstruct it with an arbitrarily small probability of error (ϵ).