

### Problem 6.11

The transmission bandwidth  $B_T$  is related to the excess bandwidth  $f_v$  by the formula (see Eqs. (6.21) and (6.22))

$$B_T = B_0 + f_v$$

where  $B_0 = 1/(2T_b)$ . We may therefore express the bit rate  $1/T_b$  as a function of the excess bandwidth  $f_v$  as follows:

$$\frac{1}{T_b} = 2(B_T - f_v) \quad (1)$$

From Eq. (1), we see that the bit rate  $1/T_b$  decreases linearly with the excess bandwidth  $f_v$  for a fixed channel bandwidth  $B_T$ . Specifically, with  $B_T = 3$  kHz, the bit rate versus excess bandwidth graph takes the form shown in Fig. 1. Note that the excess bandwidth  $f_v$  attains its largest value when the roll-off factor  $\alpha$  equals unity, in which case  $f_v = 3$  kHz.

