Problem 7.19

The bit duration is

$$T_b = \frac{1}{20 \times 10^3} \text{ seconds}$$
$$= 50 \ \mu\text{s}$$

The carrier frequency is

$$f_c = 50 \text{ MHz}$$

From Eq. (7.19), the frequency excursion is

$$\delta f = \frac{1}{2T_b}$$
$$= \frac{1}{2 \times 50 \times 10^{-6}} \text{ Hz} = 10 \text{ kHz}$$

From Eqs. (7.21) and (7.22), we have

$$f_1 = f_c + \frac{\delta f}{2}$$
$$= 50 \text{ MHz} + 5 \text{ kHz}$$
$$= 50.005 \text{ MHz}$$
$$f_2 = f_c - \frac{\delta f}{2}$$
$$= 50 \text{ MHz} - 5 \text{ kHz}$$
$$= 49.995 \text{ MHz}$$

(a) The instantaneous frequency of the MSK signal is therefore

$$f_i(t) = \begin{cases} 50.005 \text{ MHz} & \text{for symbol 1} \\ 49.995 \text{ MHz} & \text{for symbol 0} \end{cases}$$

Specifically, $f_i(t)$ alternates between these two values.

(b) When the incoming data sequence consists of all 1s, we have

$$f_i(t) = 50.005 \text{ MHz} \quad \text{for all time } t$$