Homework 2
Chapter 4

Answer to the Question — [4.1]

Here, DDS system generates a sine wave which;

No. of bits in the phase to amplitude converter, $w = 6$ (used bits)
No. of bits in the phase accumulator, $N = 8$
Phase change for each step of DDS operation, $\delta = 8$
Clock frequency, $F_{clock} = 20\,MHz = 20 \times 10^6\,Hz$
Total no. of available bits, $n_a = 6$ (bits present)

(a)

The operating frequency, $F_{operating}$

$$= \frac{N \times F_{clock}}{2^w}$$

$$= \frac{8 \times 20 \times 10^6}{2^6}\,Hz \quad [\because \text{putting the values}]$$

$$= 2.5 \times 10^6\,Hz \text{ or } 2.5\,MHz$$

$\therefore$ The operating frequency is 2.5MHz.

(b)

The smallest possible frequency, or finding the frequency resolution, $F_{resolution} = \frac{F_{clock}}{2^N}$

$$= \frac{20 \times 10^6}{2^8}\,Hz$$

$$= 78125\,Hz \text{ or } 78.125\,kHz$$

$\therefore$ Smallest possible frequency is 78.125kHz.

(c)

The location of the first three spurs due to phase truncation,

$$F_{spur} = \frac{F_{clock}}{2^N} \times n \quad [\because n = \text{representing location}]$$

So, the first three spurs;

$$F_{spur_1} = \frac{20 \times 10^6}{2^8} \times 1 = 78.125 \text{ kHz}$$

and $F_{spur_2} = \frac{20 \times 10^6}{2^8} \times 2 = 156250 \text{ Hz}$ or 156.25kHz

and $F_{spur_3} = \frac{20 \times 10^6}{2^8} \times 3 = 234375 \text{ Hz}$ or 234.375kHz

∴ The first three spurs are 78.125kHz, 156.25kHz and 284.375kHz.

(d)

The location of the first spur due to periodic jitter,

$$[F_{spur}]_{\text{periodic jitter}} = \frac{F_{clock}}{2^{N+w}}$$

$$= \frac{20 \times 10^6}{2^{8+6}}$$

$$= \frac{20 \times 10^6}{2^{14}}$$

$$= 1220.703 \text{ Hz} \text{ or } 1.221 \text{ kHz}$$

∴ Due to periodic jitter, location of first spur is 1.221 kHz.