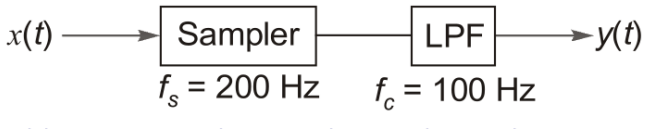
GATE:EE/63

EE23BTECH11208 - Manohar K*

Question: A signal $x(t) = 2\cos(180\pi t)\cos(60\pi t)$ is sampled at 200 Hz and then passed through an ideal low pass filter having cut-off frequency of 100 Hz.
The maximum Frequency present in the filtered signal in Hz is ____ (Round off to the nearest integer.) (GATE 2023 EE)

Solution:
Given,



$$x(t) = \cos(240\pi t) + \cos(120\pi t) \tag{1}$$

symbol	value	description
$x(t)$	$2\cos(180\pi t)\cos(60\pi t)$	input signal
f_s	$200Hz$	sampling frequency
f_c	$100Hz$	cut-off frequency
$y(t)$		output signal
f_1	$120Hz$	first signal frequency
f_2	$60Hz$	second signal frequency

TABLE I
PARAMETERS

Aliased frequencies when f_1 frequency signal is sampled at $200Hz$

$$f_1, |f_s \pm f_1|, |2f_s \pm f_1| \ldots \tag{2}$$
$$120, 80, 340, 280, 520 \ldots \tag{3}$$

Aliased frequencies when f_2 frequency signal is sampled at $200Hz$

$$f_2, |f_s \pm f_2|, |2f_s \pm f_2| \ldots \tag{4}$$
$$60, 140, 260, 340, 460 \ldots \tag{5}$$

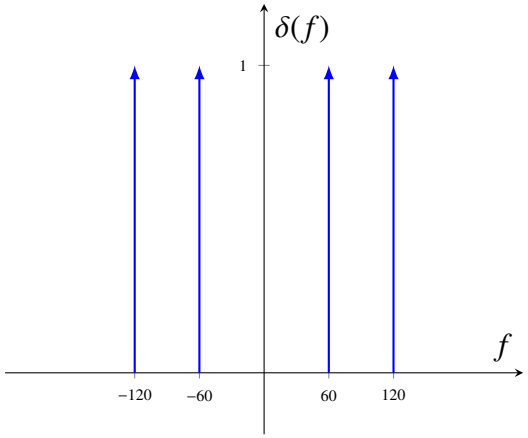


Fig. 1. delta function of input signal

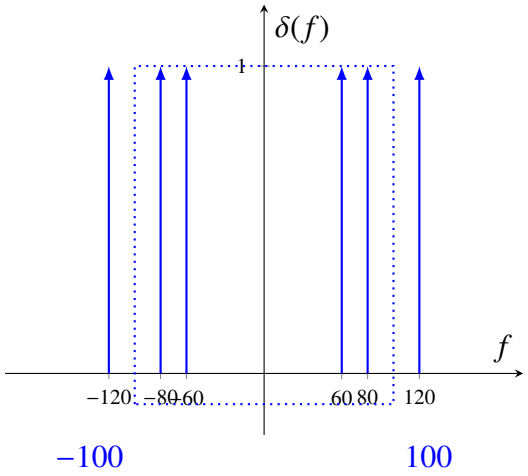


Fig. 2. delta function of sampled and filtered signal

from table $f_c = 100Hz$
LPF output : $60Hz$, $80Hz$
Maximum Frequency present in the filtered signal is $80Hz$.