Sampling

Sampling Theorem

- Equally Spaced Samples of $x(t)$

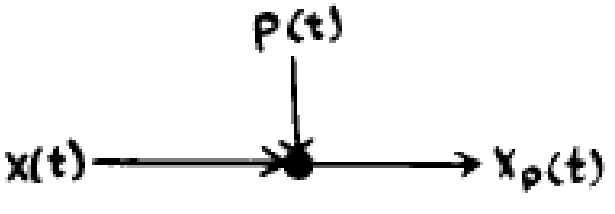
$$x(nT) \quad n = 0, \pm 1, \pm 2 \ldots$$

- $x(t)$ Band limited

$$X(\omega) = 0 \quad |\omega| > \omega_M$$

If $\frac{2\pi}{T} \triangleq \omega_s > 2\omega_M$

Then $x(t)$ uniquely recoverable



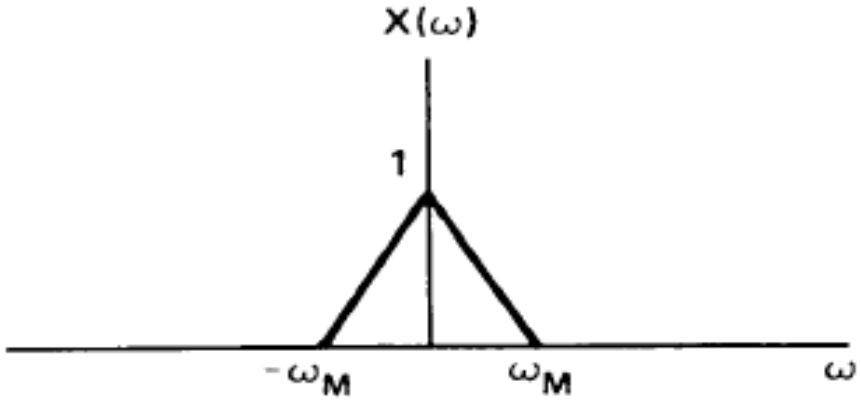
$$x_p(t) = x(t) \sum_{n=-\infty}^{+\infty} \delta(t - nT)$$

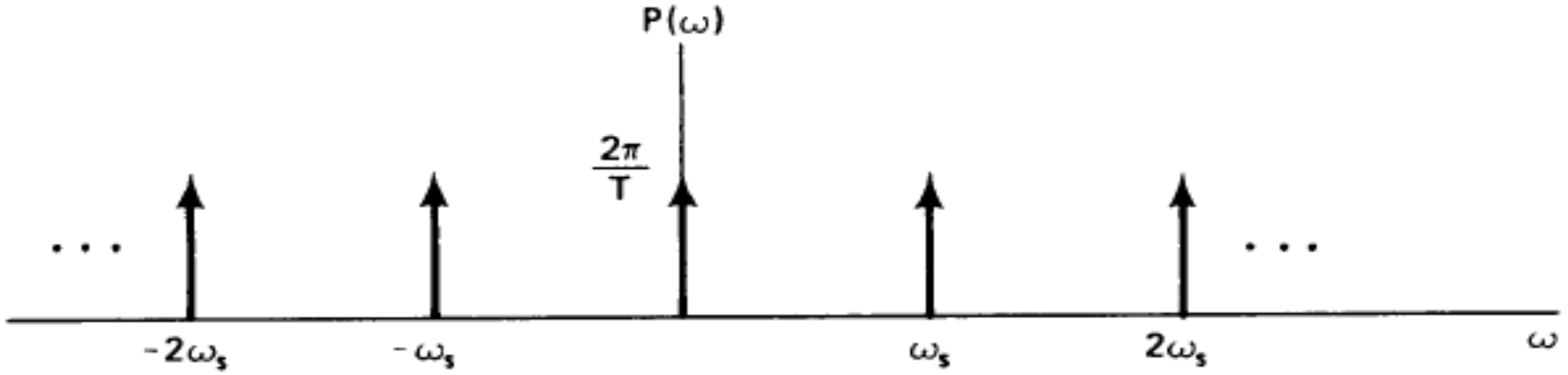
$$= \sum_{n=-\infty}^{+\infty} x(nT)\delta(t - nT)$$

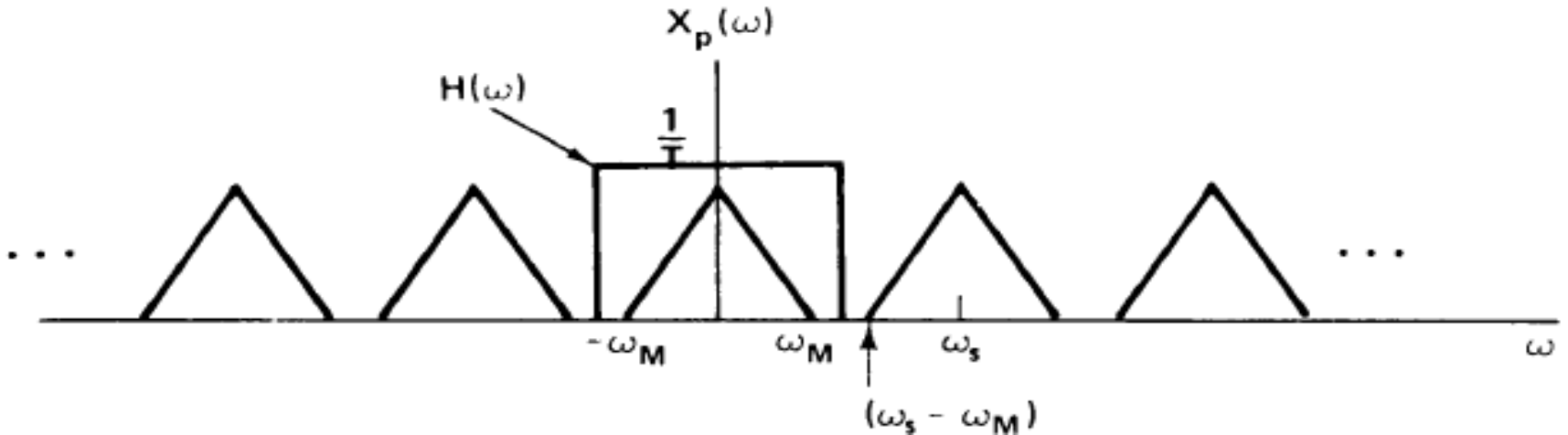
$$X_p(\omega) = \frac{1}{2\pi}\left[X(\omega) * P(\omega)\right]$$

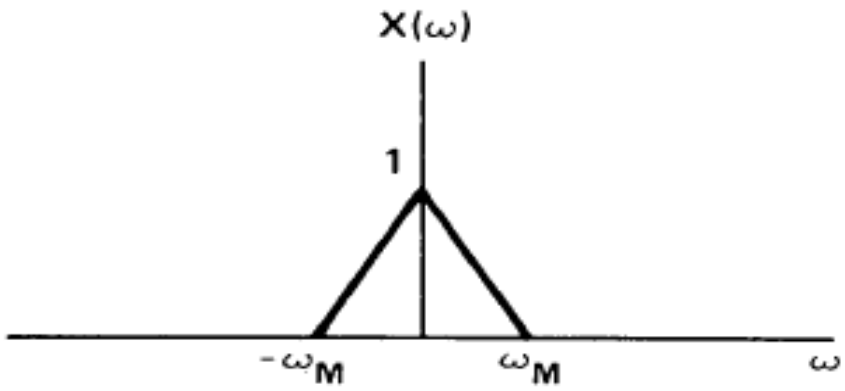
$$P(\omega) = \frac{2\pi}{T} \sum_{k=-\infty}^{+\infty} \delta\left(\omega - k\frac{2\pi}{T}\right)$$

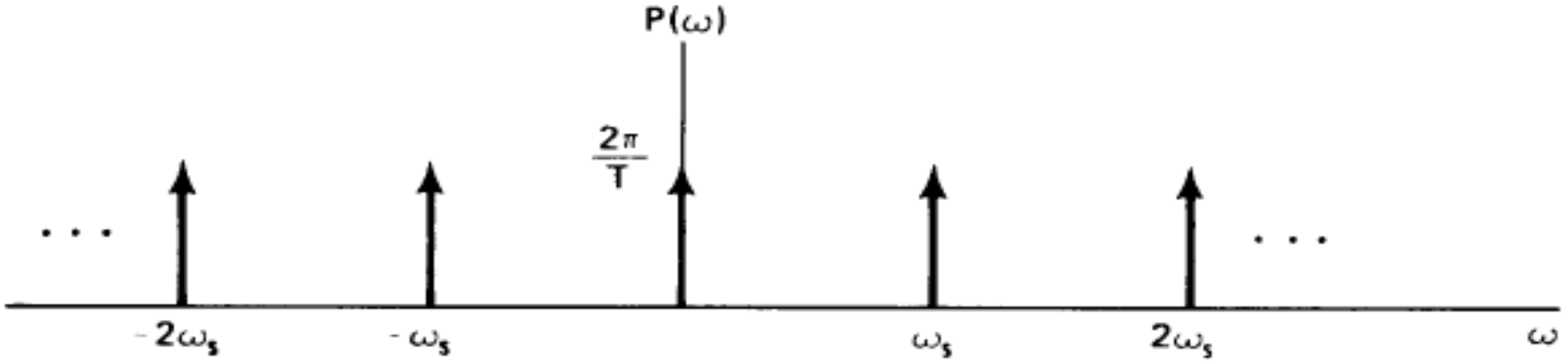
$$X_p(\omega) = \frac{1}{T} \sum_{k=-\infty}^{+\infty} X\left(\omega - k\frac{2\pi}{T}\right)$$

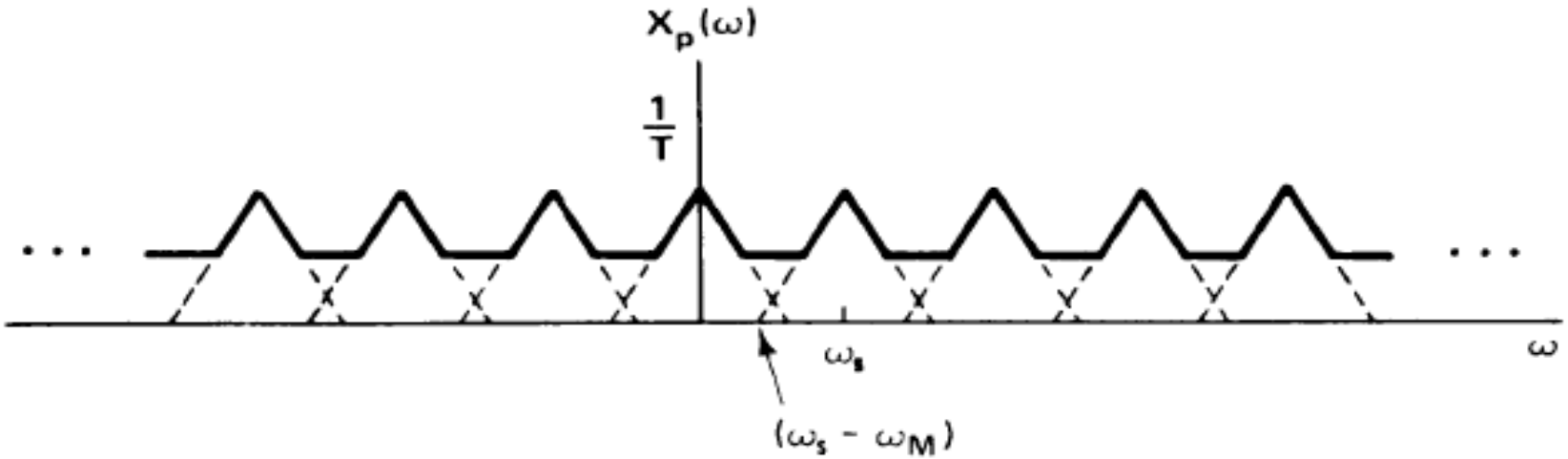

X(ω)
1
-ω_M
ω_M
ω

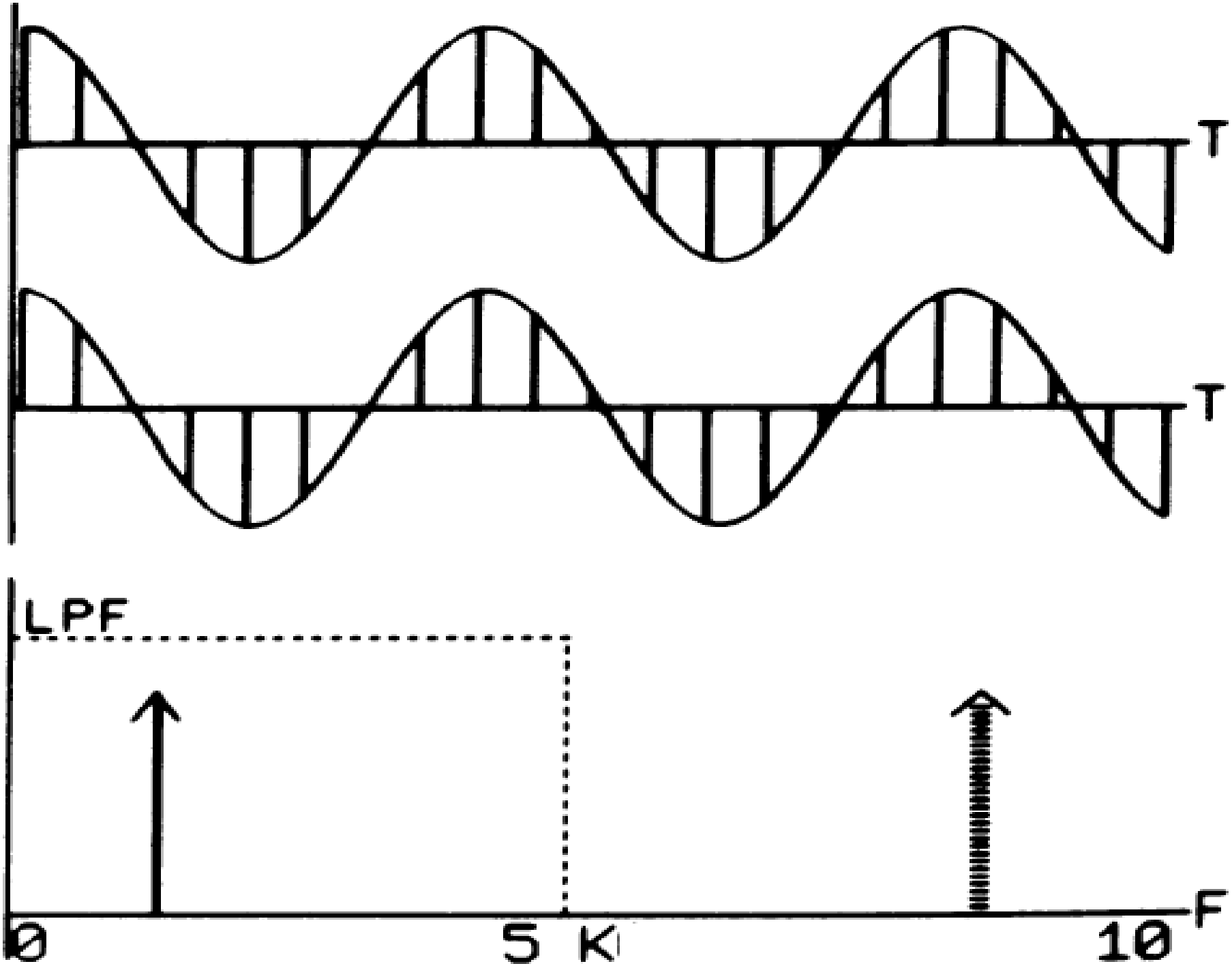

P(ω)
2π/T
-2ω_s
-ω_s
ω_s
2ω_s
ω

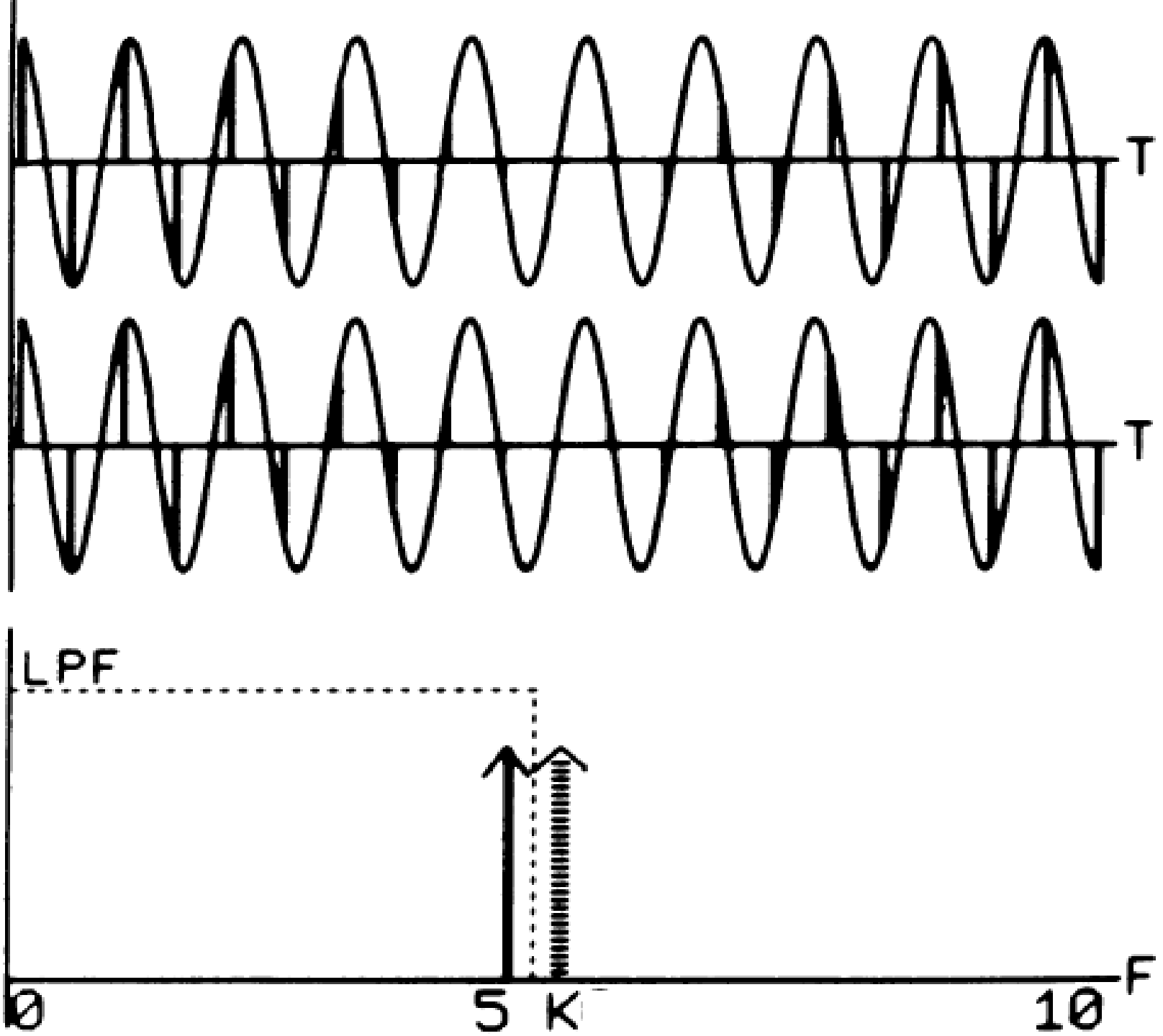

X_p(ω)
H(ω)
1/T
-ω_M
ω_M
ω_s
(ω_s - ω_M)
ω

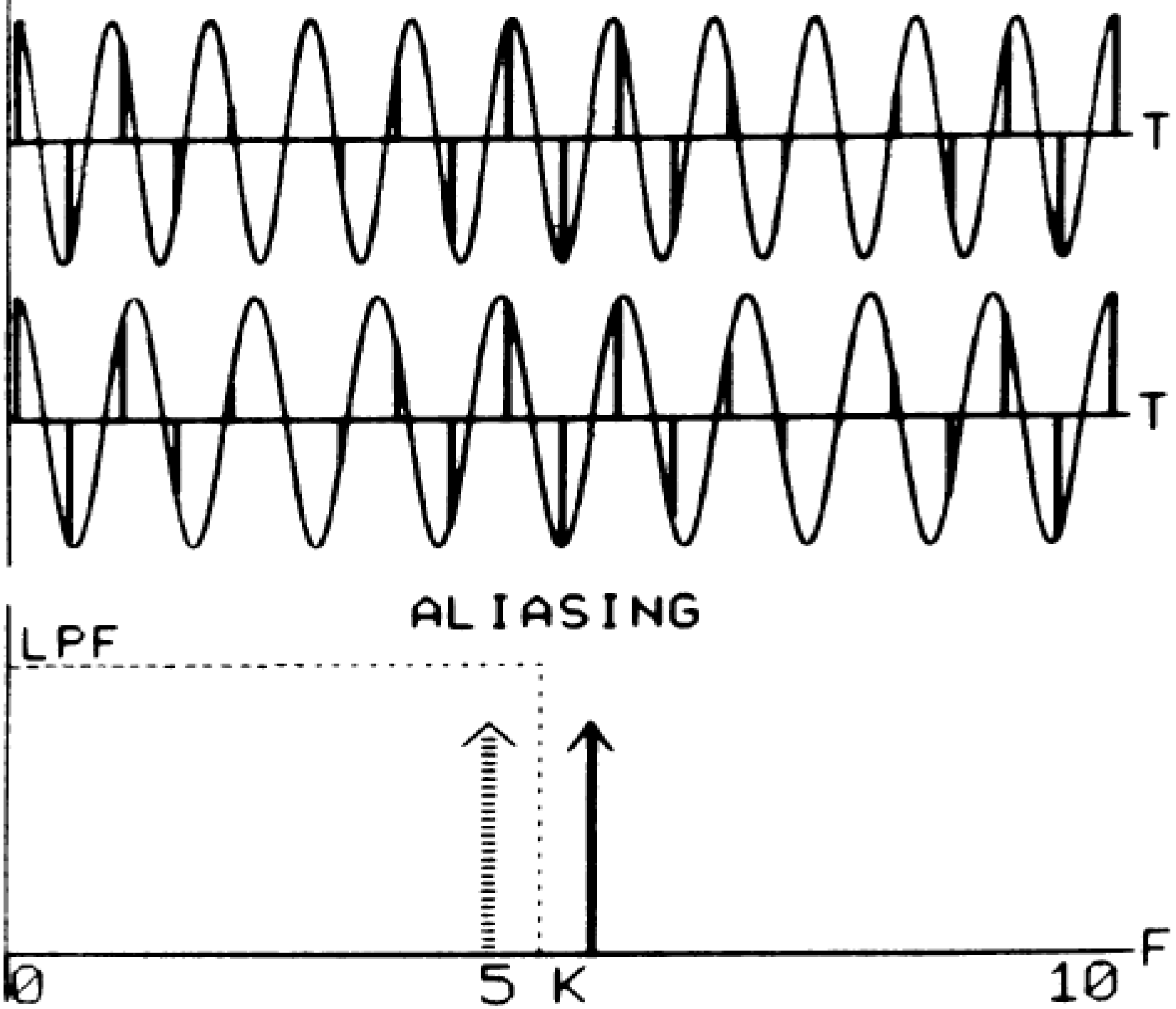

X(ω)
1
-ωM
ωM
ω

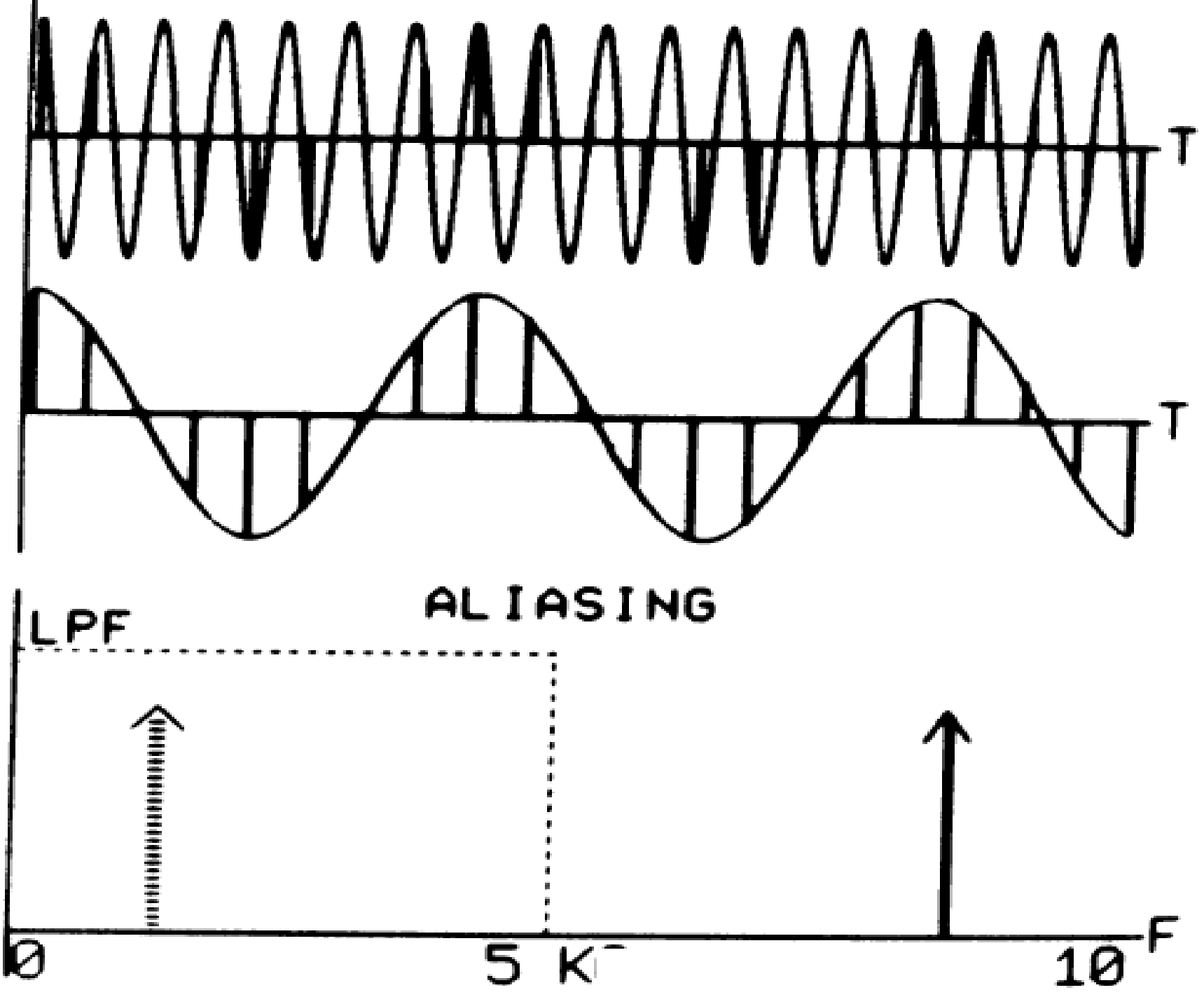

P(ω)
2π/T
-2ωs
-ωs
ωs
2ωs
ω


Xp(ω)
1/T
ωs
ω
(ωs - ωM)


T
T
LPF
0
5 K
10
F


T
T
LPF
0
5
K
10
F


T
T
ALIASING
LPF
F
0
5 K
10


T
T
ALIASING
LPF
0
5 K
10
F