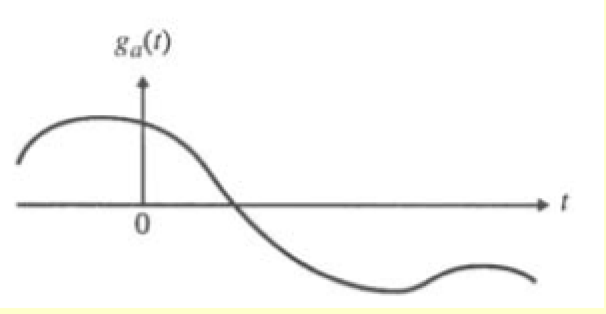
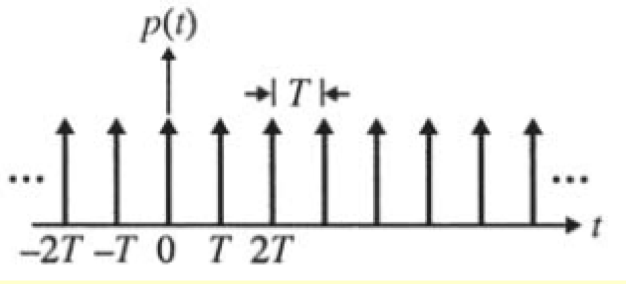
1. 奈奎斯特采样定律

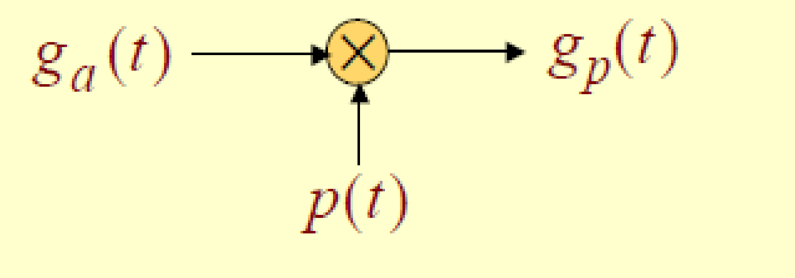
a.连续时间信号 ga(t):

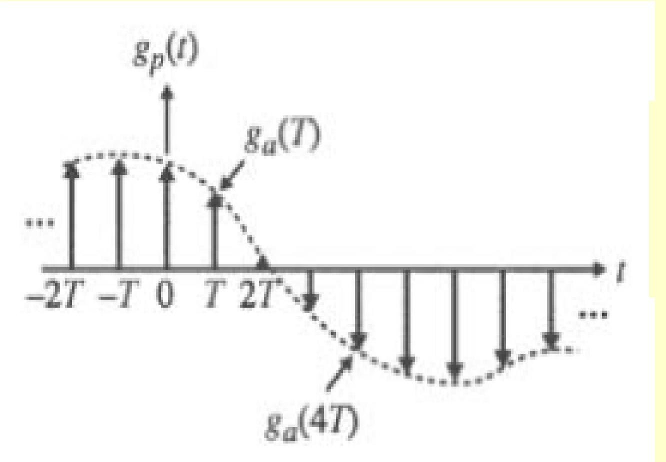


b.周期冲激序列 p(t):



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





$$g_p(t)=g_a(t)p(t)=\sum_{n=-\infty}^{\infty}g_a(nT)\delta(t-nT)$$

b.周期冲激序列p(t):

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

$$p(t)=\frac{1}{T}\sum_{k=-\infty}^{\infty}e^{j(2\pi/T)kT}=\frac{1}{T}\sum_{k=-\infty}^{\infty}e^{j\Omega_T kt}$$

where $\Omega_T=2\pi/T$

c.采样信号的连续傅氏变换CTFT $G_P(j\Omega)$:

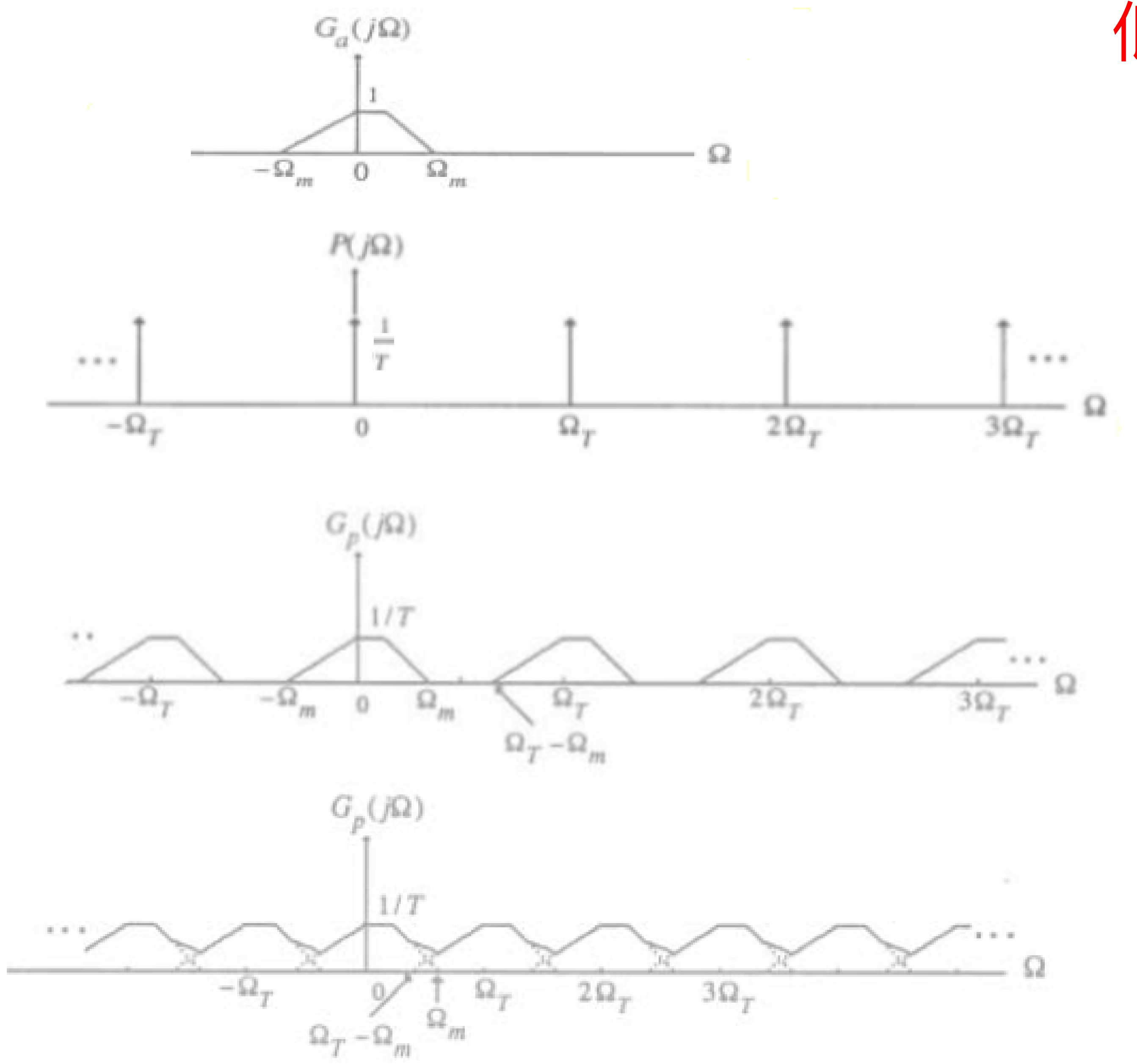
$$g_p(t)=g_a(t)p(t)=\sum_{n=-\infty}^{\infty}g_a(nT)\delta(t-nT)$$

$$g_p(t)=\left(\frac{1}{T}\sum_{k=-\infty}^{\infty}e^{j\Omega_T kt}\right)\cdot g_a(t)$$

$$e^{j\Omega_T kt}g_a(t) \Rightarrow G_a(j(\Omega-k\Omega_T))$$

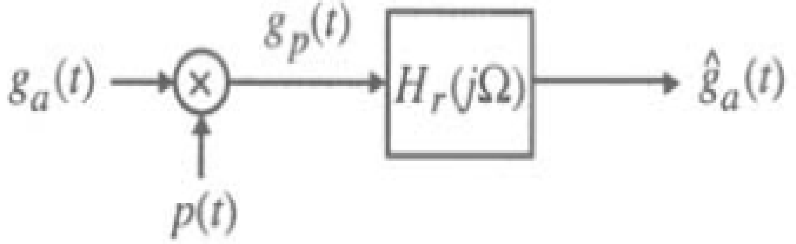
$$G_p(j\Omega)=\frac{1}{T}\sum_{k=-\infty}^{\infty}G_a(j(\Omega-k\Omega_T))$$

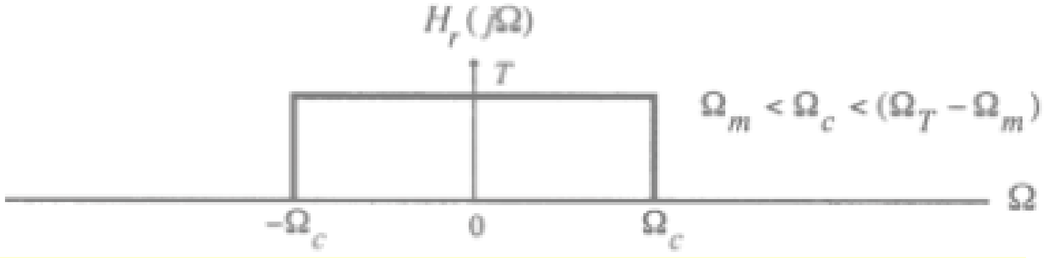
低频限带连续时间信号

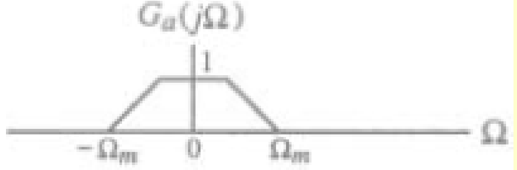


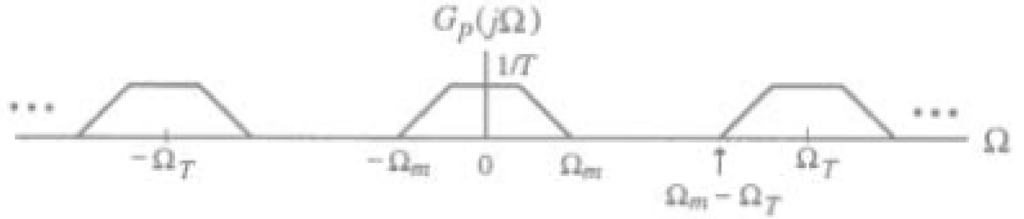
$$G_p(j\Omega)=\frac{1}{T}\sum_{k=-\infty}^{\infty}G_a(j(\Omega-k\Omega_T))$$

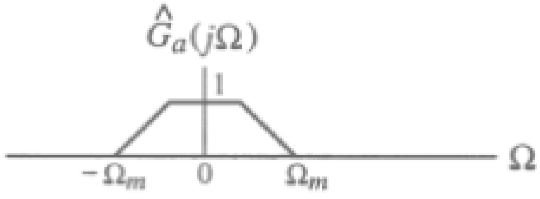
d.


$g_a(t)$
$g_p(t)$
$H_r(j\Omega)$
$\hat{g}_a(t)$
$p(t)$


$H_r(j\Omega)$
T
$\Omega_m < \Omega_c < (\Omega_T - \Omega_m)$
$-\Omega_c$
0
Ω_c
Ω


$G_a(j\Omega)$
1
$-\Omega_m$
0
Ω_m
Ω


$G_p(j\Omega)$
$1/T$
$-\Omega_T$
$-\Omega_m$
0
Ω_m
Ω_T
$\Omega_m - \Omega_T$
Ω


$\hat{G}_a(j\Omega)$
1
$-\Omega_m$
0
Ω_m
Ω

带阻连续时间信号

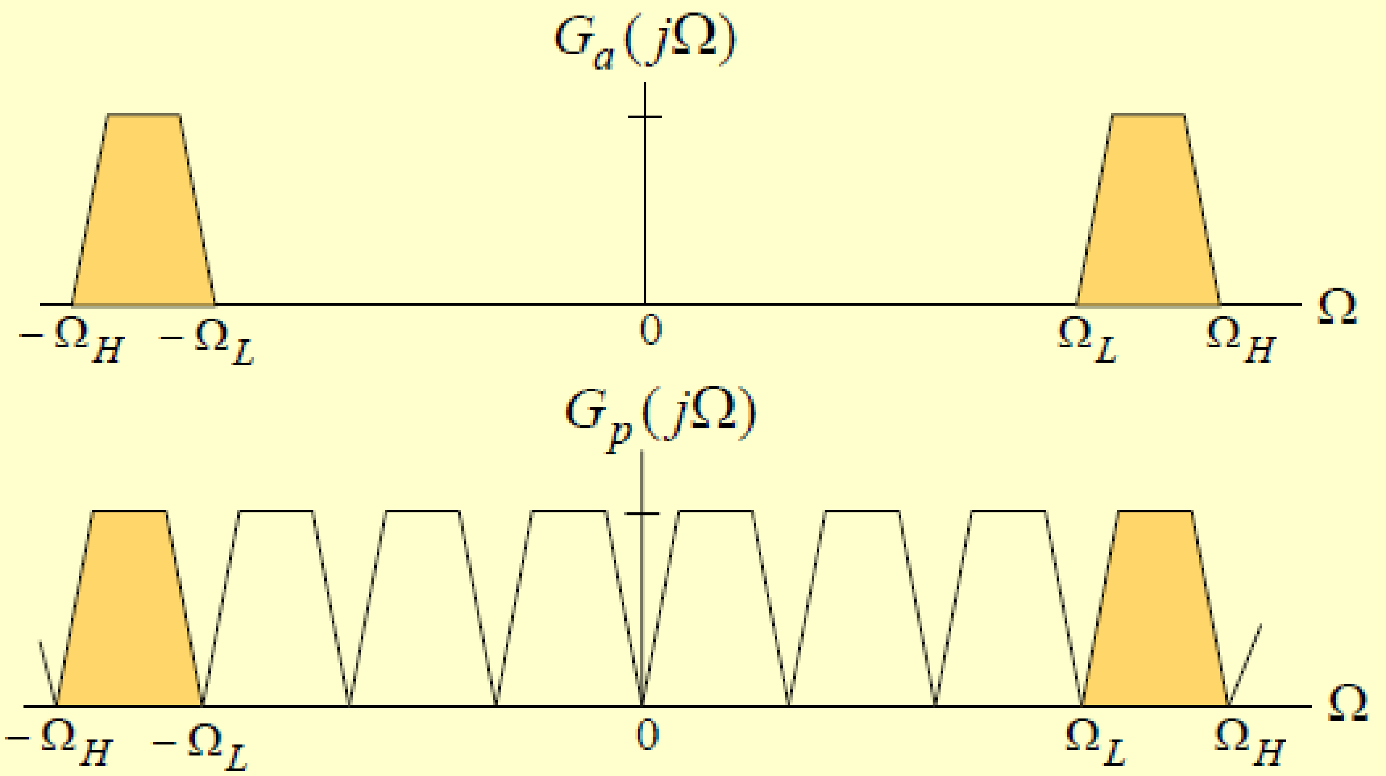
带宽： $\Delta\Omega = \Omega_H - \Omega_L$

假设最高频率满足条件：

$\Omega_H = M(\Delta\Omega)$

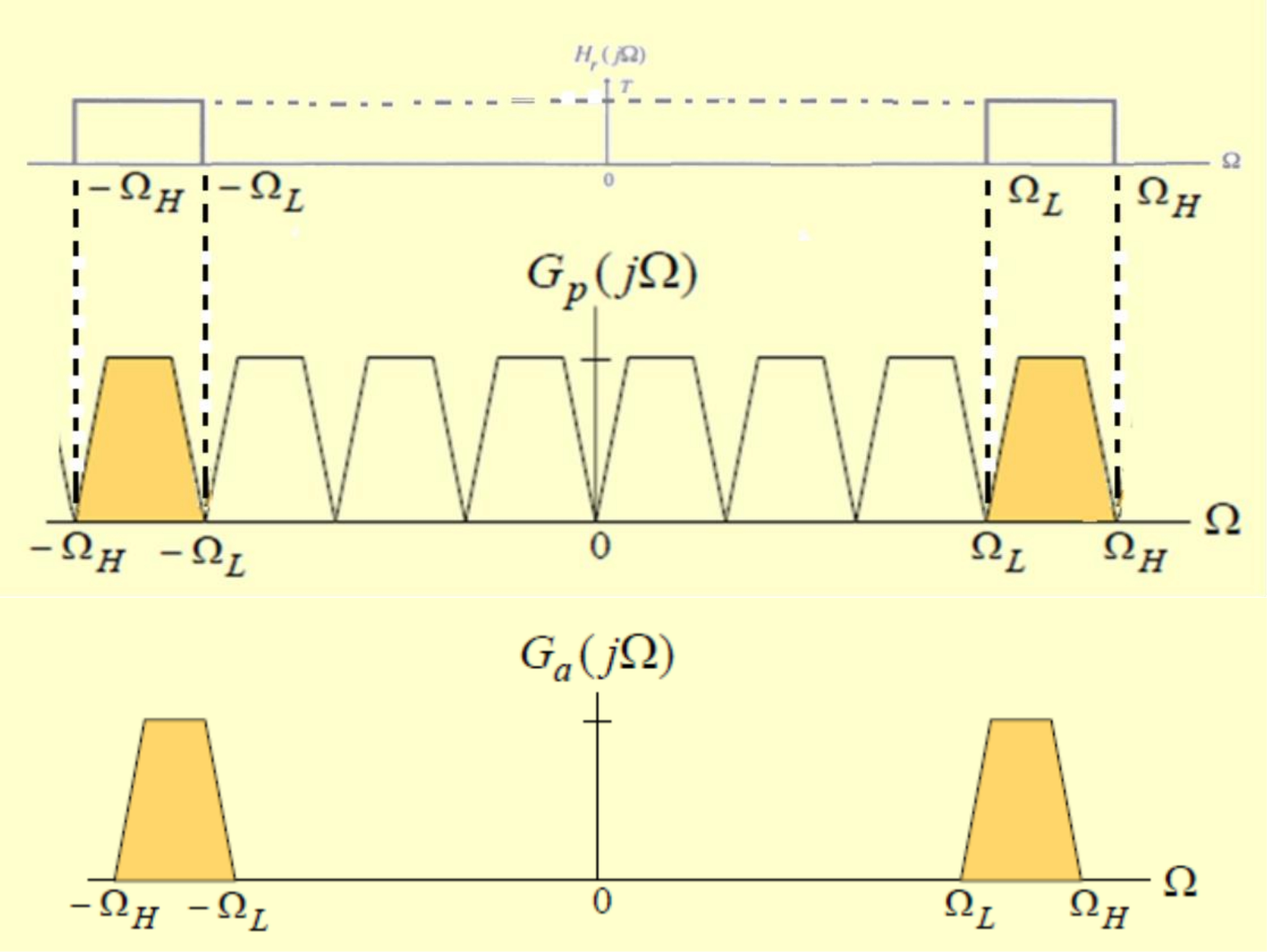
采样角频率为：

$\Omega_T = 2(\Delta\Omega) = \frac{2\Omega_H}{M}$



$$G_p(j\Omega) = \frac{1}{T}\sum_{k=-\infty}^{\infty} G_a\big(j(\Omega - k\Omega_T)\big)$$

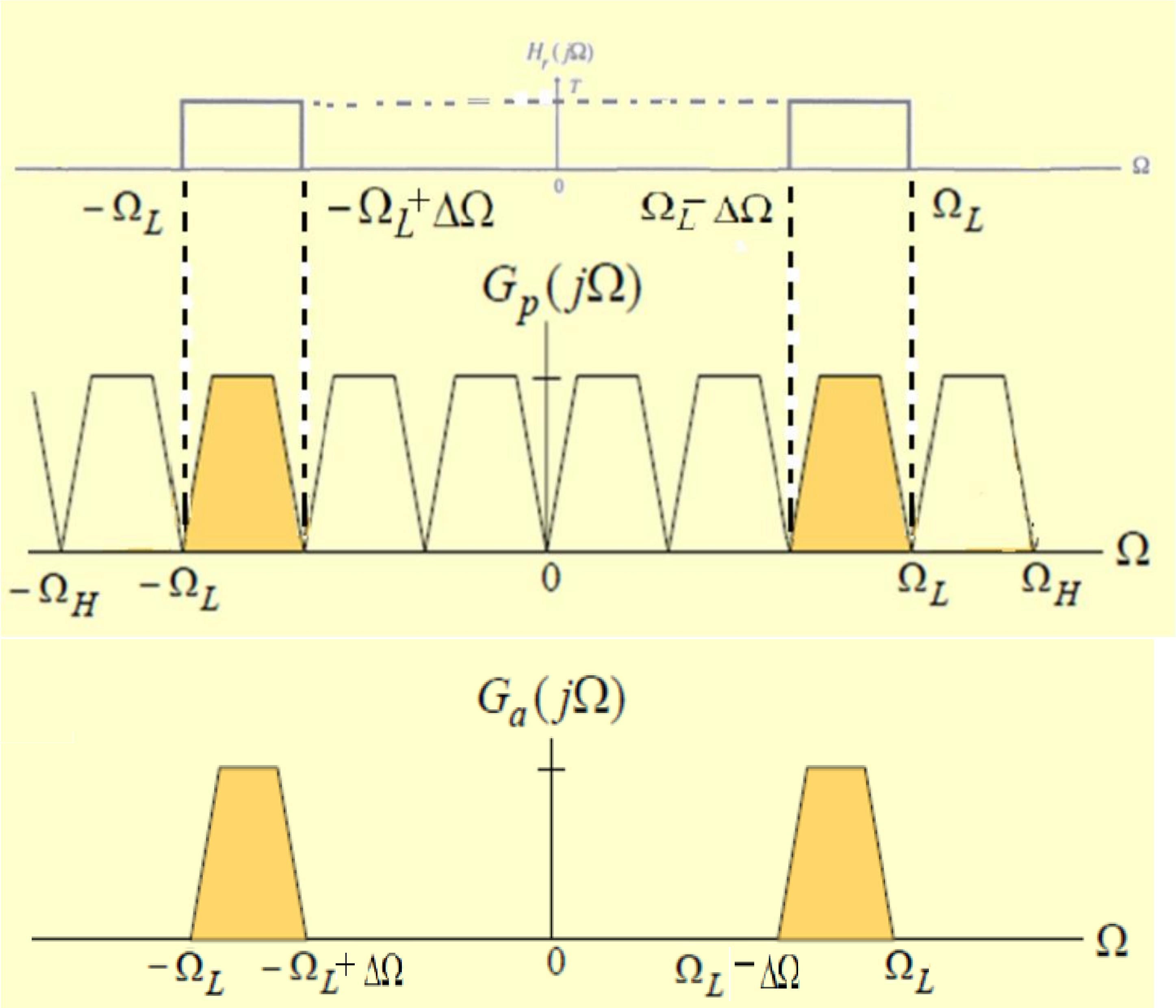
$$G_p(j\Omega) = \frac{1}{T}\sum_{k=-\infty}^{\infty} G_a\big(j\Omega - j2k(\Delta\Omega)\big)$$



$$H_r(j\Omega) = \begin{cases} T, & \Omega_L \le |\Omega| \le \Omega_H \\ 0, & |\Omega| < \Omega_L \text{ or } \Omega_H < |\Omega| \end{cases}$$

获得低频频谱的带通滤波器：

$$H_r(j\Omega)=\begin{cases} T, & \Omega_L-k(\Delta\Omega)\le|\Omega|\le\Omega_H-k(\Delta\Omega) \\ & 1\le k\le M-1 \\ 0, & |\Omega|<\Omega_L-k(\Delta\Omega) \\ & \text{or } \Omega_H-k(\Delta\Omega)<|\Omega| \end{cases}$$



$p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$. Since p(t) is periodic function of time t with a period T, it can be

represented as a Fourier series: $p(t) = \sum_{n=-\infty}^{\infty} c_n e^{j(2\pi nt/T)}$, where $c_n = \int_{-T/2}^{T/2} \delta(t) e^{-j(2\pi nt/T)} dt = \frac{1}{T}$.

Hence $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT) = \frac{1}{T} \sum_{n=-\infty}^{\infty} e^{j(2\pi nt/T)}$.