## 1.1.2 Recells and prelim

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- Penelt 1:	let min e	: N <sup>*</sup> and T	">o then
a) $\frac{2}{T}\int_{0}^{T}$	$S\left(\frac{2\pi n}{T}\times\right)$	SO ( TT X	$d \propto d \propto$

Proof: for the save of simplicity T=211. Then

 $I = \frac{1}{\pi} \int_{0}^{2\pi} \omega_{S}(nx) \omega_{S}(mx) dx = \frac{1}{2\pi} \int_{0}^{2\pi} \omega_{S}(n-m) x dx$ 

 $conaconb = \frac{1}{2} [cos(a-b) + cos(a+b)] + \frac{1}{2\pi} \int_{-\infty}^{2\pi} cos(cn+m) \times dx$ 

If n=m  $I=\frac{1}{2\pi}\int_{0}^{2\pi}dx+\frac{1}{2\pi}\int_{0}^{2\pi}cs(2mx)dx$ 

 $= 1 + \frac{\sin(2mx)}{2m} \bigg|_{0}^{\pi i} = 1$ 

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 $= \frac{2}{T} \int_{S}^{T} \sin\left(\frac{2\pi n}{T} \times\right) \sin\left(\frac{2\pi m}{T} \times\right) dx = \begin{cases} 0 & \text{if } n \neq m \\ 1 & \text{if } n = m \end{cases}$   $b) \int_{S}^{T} \sin\left(\frac{2\pi n}{T} \times\right) \cos\left(\frac{2\pi m}{T} \times\right) dx = 0.$ 

$$J = \frac{1}{\pi} \int_{0}^{2\pi} 8in(nx) 8in(mx) dx =$$

$$= \frac{1}{2\pi} \int_{0}^{2\pi} \left[ \omega_{0}((n-m)x) - \omega_{0}((n+m)x) \right] dx$$

Sinarinb = 
$$\frac{1}{2}$$
 (cos(a-b) - cos(a+b)).

If  $n \neq m$ 

$$\int = \frac{1}{2\pi i} \left[ \frac{\sin((n-m)x)}{n-m} \right]^{2\pi i} - \frac{\sin((n+m)x)}{n+m} = 0$$

If n=m  $J = \frac{1}{2\pi} \int_{-\infty}^{\infty} \left[ \omega_{J}(0) - \omega_{D}(2mx) \right] dx$ 

$$J = \frac{1}{2\pi} \int_{0}^{2\pi} \left( \omega_{3}(0) - \omega_{5}(2mx) \right) dx$$

$$= \frac{1}{2\pi} \int_{0}^{2\pi} dx - \frac{1}{2\pi} \int_{0}^{2\pi} \omega_{5}(2mx) dx = 1$$

$$\int_{0}^{2\pi} dx = 0$$

$$= \frac{1}{2\pi} \int_{0}^{2\pi} dx - \frac{1}{2\pi} \int_{0}^{2\pi} \omega s(2mx) dx = 1$$
b)  $K = \int_{0}^{2\pi} \sin(nx) \omega s(mx) dx$ 

$$= \frac{1}{2} \int_{0}^{2\pi} \left[ \sin((n-m)x) + \sin((n+m)x) \right] dx$$

 $\sim$  sina  $cosb = \frac{1}{2} \left[ sin(a-b) + sin(a+b) \right]$ 

If 
$$n \neq m$$
:
$$K = \frac{1}{2} \left[ -\frac{\cos((n-m)\times)}{n-m} \left| \frac{\pi}{0} - \frac{\cos((n+m)\times)}{n+m} \right| \right] = 0$$

If n=m:  

$$K = \frac{1}{z} \int_{0}^{2\pi} \sin(0) dx + \sin(2mx) dx = 0.40 = 0$$