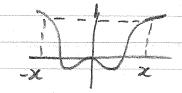
Fourier Scries

these are series of sines and cosines such as those we found when solving the hest equation we need to study these series more carefully.

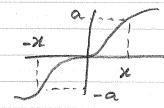
Preliminacies

Even, odd and periodic functions (17.2)

f is even if f(x) = f(-x)



fisodd if f(-x) = -f(x)



Notice that even + even = even odd todd = odd even k even = even odd x odd seven

If fis odd then Safranda = 0 If f is even then $\int_{A}^{A} f(x) dx = 2 \int_{0}^{A} f(x) dx$.

odd x even = odd

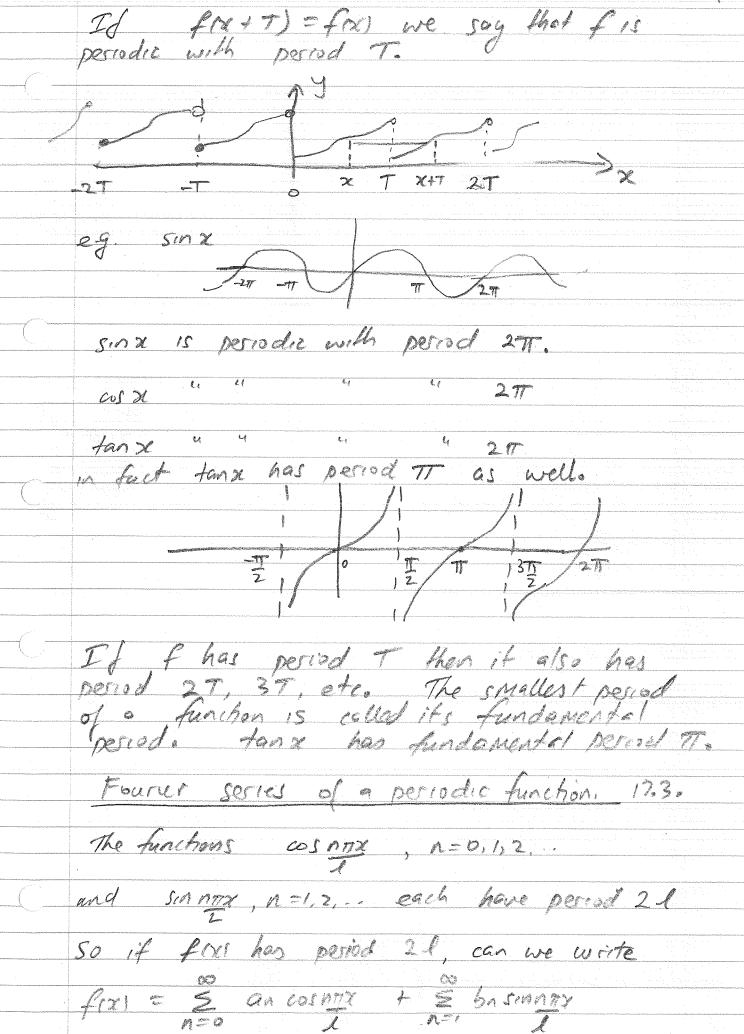
Any function can be written as a som of even

$$f(x) = f(x) + f(-x) + f(x) - f(-x)$$

$$even \qquad odd$$

$$eg. f(x) = e^{x} = e^{x} + e^{-x} + e^{x} - e^{x}$$

= cosh(2) + sonh(2)



	or $f(x) = a_0 + \sum_{n=1}^{\infty} a_n \cos n\pi x + b_n \sin n\pi x$.	
- Annual Control of the Control of t	orthogonality equations	
	$\int_{-1}^{1} \frac{\sin m\pi x}{2} \sin n\pi x dx = \begin{cases} 0 & m \neq n \\ 1 & m \neq n \end{cases}$	
Œ	$\int_{\lambda}^{\lambda} \cos \frac{m\pi x}{2} \cos \frac{n\pi x}{2} dx = \begin{cases} 0 & \text{M} \neq 0 \\ \text{M} = 0 \end{cases}$	
3	$\int_{\mathcal{L}}^{1} \sin m \pi x \cos n \pi x dx = 0.$	
	You can prove these the same way that	
	we proved the equations for sine over	
	the interval [0,6] earlier. Note that (3)	
	Hence It	
	$f(x) = a_0 + \frac{\epsilon}{2} a_0 \cos n \alpha + \frac{\epsilon}{2} \sin n \alpha$	
	and integrate from -1 to 1. Because of	
	the orthogonality, only the N=M sine term contributes to the sum on the RHS	

 $\int_{-2}^{2} f(x) \sin \frac{n\pi x}{2} dx = \int_{-2}^{2} b_m \sin \frac{n\pi x}{2} dx$ bu = d St far surming dx Similary (am = 1) for cosmaxdx m7/ But as is different. Integrate
each side from I to 1 $\int_{\Omega}^{1} F(x) dx = \int_{1}^{1} a_0 dx / x = 2 l a_0$ 50 a0 = I Stande = average necewise continuity A function fix) is piecewise continuous on an interval a sx sb if there exists a finite number of points zi, x2,, xN such that fex) is continuous on each open interval (a, x,), (x, x2), (x2, 23), ..., (2, 24), (XN, b) and has a finite limit as x approaches each endpoint of these intervals from the insides of the intervals. Example $f(x) = \begin{cases} x, & -1 \le x < 0 \\ 1, & 0 \le x \le 1 \end{cases}$ fix) is precessive continuous because it is continuous on (-1,0) and on (0.1) and because as x

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Example Square were 27 The Fourier series converges to $a_0 = \frac{1}{2} \int_0^1 f(x) dx = \frac{1}{2\pi} \int_0^1 4 dx = 2$ an = f f fix) cas nx dx = f f 4 cos nx dx = = [4sinnx] = 0 by = f f f(x) Sinnx by = f f 4 sinnx dx $= \neq \left[-\frac{4}{\pi} \cos n\pi \right]_{S}^{T} = -\frac{4}{n\pi} \left(\cos n\pi - 1 \right)$ - 4 (1- (-1)") So for = 2+ # 5 1-61 sinnx

Make sure that you put myfourier.m in a folder and then set the current directory of Matlab to be this folder. Then just type the following into the command window.

```
>> x=linspace(-pi,pi);
>> plot(x,myfourier(x,7),x,myfourier(x,1000))
>>

Here's a listing of the Matlab file:

function y=myfourier(x,k)
%
% Calculates the sum of the first k terms of a Fourier series.
L = pi;
a0 = 2;
y = a0;

for n = 1:k
    an = 0;
    bn = 4*(1-(-1)^n)/(n*pi);
    y = y + an * cos(n*pi*x/L) + bn * sin(n*pi*x/L);
end
```