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DEPARTMENT OF MATHEMATICS

Harmonic Analysis

Definition: The process of finding the Fourier Series for fa function given by numerical values is known as harmonic analysis.

The Fourier Series for f(x) is

$$f(x) = \underbrace{a_o}_{2} + \underbrace{\frac{\infty}{5}}_{n=1} a_n \cos \frac{n\pi x}{1} + \underbrace{\frac{\infty}{5}}_{n=1} b_n \sin \frac{n\pi x}{1}$$

$$\frac{2}{2} \int_{n=1}^{n=1} \frac{1}{n} \int_{n=1}^{n} \frac{1}{n} \int_{n=1}^{n=1} \frac{1}{n} \int_{n=1}^{n=1} \frac{1}{n} \int_{n=1}^{n} \frac{1}{n} \int_{n=1}^{n=1} \frac{1}{n} \int_{n=1}^{n=1} \frac{1}{n} \int_{n=1}^{n} \frac{1}{n} \int_{n} \frac{1}{n} \int_{n=1}^{n} \frac{1}{n} \int_{n=1}^{n} \frac{1}{n} \int_{n=1}^{n} \frac{$$

$$b_2 \sin \frac{2\pi x}{l} + b_3 \sin \frac{3\pi x}{l} + \cdots$$

Where

$$a_0 = 2 \times \text{mean value of } y = 2 = 2 = \frac{2y}{N}$$

$$a_n = 2 \times \text{mean value of } y \cos\left(\frac{n\pi x}{L}\right) = 2 \times y \cos\left(\frac{n\pi x}{L}\right)$$

$$b_n = 2 \times \text{mean value of } y \sin(\frac{n\pi x}{2}) = 2 \pm y \sin(\frac{n\pi x}{2})$$

and N = number of non-repeated Values.

Note:

- * The term a, cosx + b, sinx is called fundamental or first harmonic
- * The term a cos 2x + b2 Sin 2x is called Second harmonic.

$$T = 2\pi = 360 (8 T = 180)$$

all are same

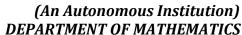


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①	1) The following table gives the variation of						
	la periodic function over a period T.						
Jos	X: 0 T/6 T/3 T/2 2T/3 5T/6 T						
1	f(x): 1.98 1-3 1.05 1.3 -0.88 -0.25 1.98						
	Find the Fourier Series upto Second harmonic.						
	Soln						
	$N = 6$ $T = 2\pi = 360$ $1 = \pi$						
	$f(x) = \frac{a_0}{2} + \frac{5}{5} a_n \cos\left(\frac{n\pi x}{2}\right) + \frac{5}{5} b_n \sin\left(\frac{n\pi x}{2}\right)$						
1 1 1 1 1 1 1 1 1 1							
	atoros t	\dot{a}	$\sum_{n=1}^{\infty} a_n co$	1.0		2 1 1	
(alcula	L Sing +						
COX	$a_{2} = \frac{a_{0}}{2} + a_{1} \cos x + a_{2} \cos 2x + b_{1} \sin x$ $b_{2} \sin 2x + \cdots$						
	χ	y = f(x)	y cosx	y cosax	y sin x	y sin 2x	
<u>-</u>		66	KN298 (D	1-98	, O (K) }	.0	
			0.65	-0.65		1-126	
	T/3	1.05	-0.585 -x 000 d	-0.525	6.909	-0-909	
	T/2	1.3	-1-3	1-3	0	0	
	27/3	-0.88	0.44	0.44	0.762	-0-762	
	5T/6	-0.25	-0.125	0.125	0.217	0-217	
	ŧ				27712		
	Early 1	4.5	1.12	2-67	3.014	-0.328	
	e <mark>e</mark>						





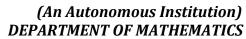


5TT/3

85

0.866







$$a_0 = 28.33$$
 $a_1 = -4.833$
 $b_1 = -0.289$
 $a_2 = 0.834$
 $b_2 = 0.866$
 $f(x) = 14.165 - 4.833 cos x - 0.289 sin x$

3 Compute the first harmonic of Fourier Series of $f(x)$ from the following data:

 $x = 0.30 = 60.90 = 120.150 = 180.210$
 $y = 1.8 = 1.1 = 0.3 = 0.16 = 0.5 = 1.3 = 2.16 = 1.25$
 $240 = 270 = 300 = 330 = 360$
 $1.3 = 1.52 = 1.76 = 2.0 = 1.8$
 $soln:$
 $21 = 2\pi \Rightarrow 1 = \pi$
 $31 = 1.26 + 0.04 cos x + 0.53 cos 2x - 0.1 cos 3x - 0.63 sin x - 0.23 sin 2x + 0.085 sin 3x.

4) Find the fourier Series as far as the second harmonic to represent the function given in the following data:

 $2 = 0.63 = 1.26 = 1$$



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1		1		E	.83.	
	x	y	y cos πx	y sin_	πx y cas211	x ysin 2TH
	0	0	9	0		0
	1	18	9	1	-9	15.6
	2	24	-12	20.9	-24	0
	3	28	- 28	0	+28	0
	4	26	-13	-22.6	- 13	22.6
	5	20	0210 05	-17.4	-1000 -	-17.4
		125	- 25	-3.4	-19	20.8
	C.		C # 2-		ap 61.81	0-65

$$f(x) = \frac{41.66}{2} - 8.33 \cos(\frac{\pi x}{3}) - 6.33 \cos(\frac{2\pi x}{3})$$

$$-1.13 \sin(\frac{\pi x}{3}) + 0.009 \sin(\frac{2\pi x}{3})$$

Find the fourier series for the following Volues up to third harmonic.

2: 0 T/6 2T/6 3T/6 4T/6 5T/6 TT

f(x1). 2.34 2.2 1.6 0.83 0.51 0.88 1.19

Soln: N=6, l=T, $f(x) = b_1 \sin x + b_2 \sin 2x + b_3 \sin 3x$

			1		The same of the sa	1-3 5 1
	χ	y	ysinx	ysin 27	ysin 3 d	
	0	2.34	0	0	0	
	TT/6	2.2	1.1	1.91	2.2	b, = 1.40
	211/6	1.6	1.392	1-392	Ö	b2=1-201
Constant and other	3T/6	0.83	0.83	٥	-0.83	b3 = 0.75
and the same of the last	411/6	0.51	0.44	-0-44	0	-3 1
Section of the last of the last	511/6	0.88	0-44	0.76	0.88	