

00833C PROGRAM DESCRIPTION I

Program Title FOURIER SERIES (41C)
 Contributor's Name James H. LeMay
 Address 6500 Rampart #4
 City Houston State/Country Texas, USA Zip Code 77081

Program Description, Equations, Variables Any periodic function may be written as a series of sine and cosine waves by the application of the following formulas:

RECTANGULAR- $f(t) = a_0/2 + \sum_{i=1}^{\infty} (a_i \cos(i2\pi t/T) + b_i \sin(i2\pi t/T))$

$a_i = 2/T \int_0^T f(t) \cos(i2\pi t/T) dt, \quad i = 0, 1, 2, \dots$

$b_i = 2/T \int_0^T f(t) \sin(i2\pi t/T) dt, \quad i = 1, 2, 3, \dots$

POLAR- $f(t) = a_0/2 + \sum_{i=1}^{\infty} c_i \sin(i2\pi t/T + \Delta_i)$

$c_i = (a_i^2 + b_i^2)^{1/2}$

$\Delta_i = \arctan (a_i/b_i)$

where, T = period of $f(t)$

i = frequency order

N = number of samples of $f(t)$

Necessary Accessories HP-41C, Card Reader, (memory modules)

Operating Limits and Warnings The value of N should be chosen to be more than twice the highest expected multiple of the fundamental frequency present in the wave to be analyzed or else it will cause aliasing, i.e. the function will appear to be a lower frequency. Because of the counters, N should be less than 1000.

Reference(s) Hewlett-Packard Library Program: Fourier Series (97) 00026D

This program has been verified only with respect to the numerical example given in Program Description II. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

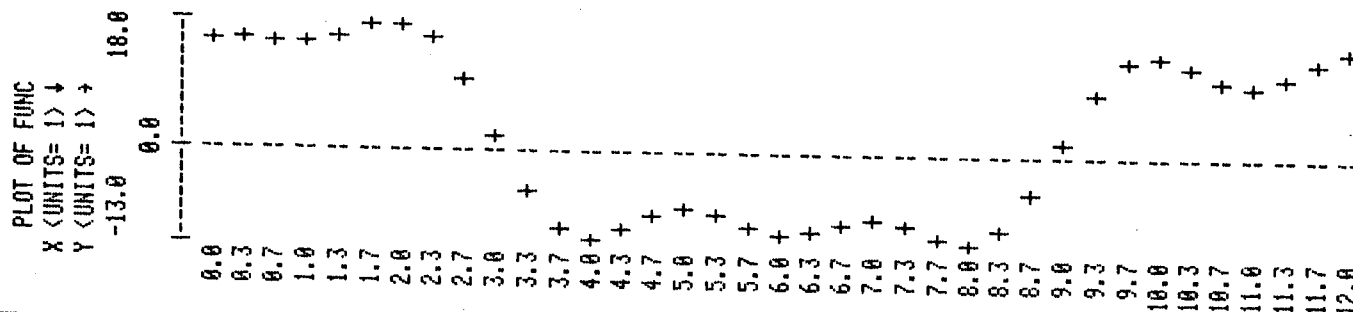
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PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

Compute a discrete Fourier series representation for the following 12 samples. Select 7 frequencies (1 absolute term plus 6 harmonics).

t	f(t)	t	f(t)
1	14.758	7	-9.026
2	17.732	8	-12.000
3	2.000	9	2.000
4	-12.000	10	14.268
5	-7.758	11	10.026
6	-11.000	12	15.000



SOLUTION:

Input	Function	Display	Comments
			Assume program has already been loaded and this is a new problem. One memory module is used. (Set printer to NORM)
	SIZE 020		
	a	N=?	
12	R/S	FREQS=?	
7	R/S	J=?	J is the first freq. order that is desired.
0	R/S	Y1=?	
14.758	R/S	Y2=?	
17.732	R/S	Y3=?	
2	R/S	Y4=?	
12	R/S	Y5=?	Input error
	B	Y4=?	Delete last entry
-12	R/S	Y5=?	
-7.758	R/S	Y6=?	
-11	R/S	Y7=?	
-9.026	R/S	Y8=?	
-12	R/S	Y9=?	
2	R/S	Y10=?	
14.268	R/S	Y11=?	
10.026	R/S	Y12=?	
15	R/S	SELECT	
	C or R/S	A0=2.000E0	Display is shown by PROMPT.
	*R/S	B0=0.000E0	The same number is in the X register. The PROMPT may be cleared by using to view the X register and see more decimal places. Step 170 can be changed to alter the display in the ALPHA register. In this case ENG 3 is used.
	R/S	A1=15.000E0	
	R/S	B1=1.000E0	
	R/S	A2=1.000E-9	
	R/S	B2=1.000E0	
	R/S	A3=-5.000E0	
	R/S	B3=1.000E0	
	R/S	A4=0.000E0	
	R/S	B4=0.000E0	
	R/S	A5=3.000E0	
	R/S	B5=14.67E-6	*If the printer exists, all coefficients will be printed; the R/S commands are superfluous. The printer uses ENG 9.

00833C

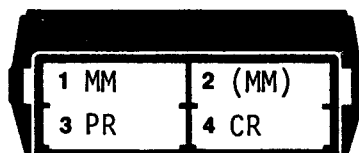
FOURIER
SERIES

PROGRAM DESCRIPTION II

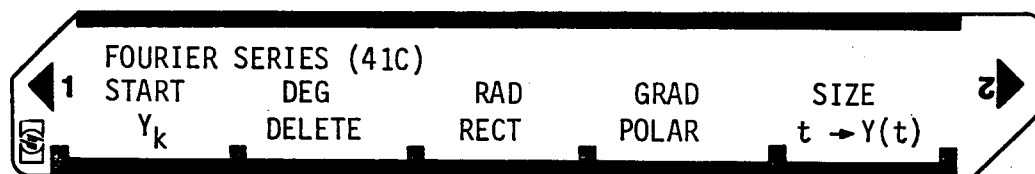
Page 3 of 7

(CONTINUATION PAGE)

Input	Function	Display	Comments
	R/S	A6=0.000E0	
	R/S	B6=0.000E0	
	R/S	T=?	
11	R/S	Y=10.026E0	$t \rightarrow Y(t)$

SYSTEM
CONFIGURATION

CARD



NOTES:

1. A maximum number of 6 frequencies can be used on the standard HP-41C with the program written as is. Each memory module would allow up to 32 more frequencies. If necessary, subroutines could be split on to different cards with some rearranging to allow for more storage space.
2. The value of A0 and B0 that is displayed and stored in this program is equal to $a_0/2$ in the equations listed on page 1.

FOURIER
SERIESSIZE:
(HP-41C) $2F + 6$

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	SET STATUS			
2	Size storage ($SIZE \geq 2 \times \text{FREQS} + 6$)		e	SIZE _ _ _
3	Load program and press R/S		R/S	N=?
4	Input N (number of samples)	N	R/S	FREQS=?
5	Input FREQS (number of frequencies)	FREQS	R/S	J=?
6	Input J (frequency of first coefficient)	J	R/S	Y1=?
7	Input Y_k , $k=1, N$	Y_k	R/S	$Y_{k+1}=?$
8	If an input error is made in step 7, press B and continue with input. (Deletes last entry only)		B	$Y_k=?$
9	Repeat step 7 until display shows:			SELECT
10	To display coefficients for $J \leq i \leq J + \text{FREQS}$, use either:			
	RECTANGULAR form,		C	$A_i = \dots$
	(with printer, R/S is superfluous)		R/S	$B_i = \dots$
	(assumes step 11b when complete)		R/S	T=?
	POLAR form,			
	Select angle mode: DEG		b	
	RAD		c	
	GRAD		d	
	Select Polar form		D	$C_i = \dots$
	(with printer, R/S is superfluous)		R/S	$\Delta_i = \dots$
	(assumes step 11b when complete)		R/S	T=?
11	a. Compute a value of Fourier Series @ t		E	T=?
	b. Input t	t	R/S	Y= ...
	c. For new t, repeat step 11b.			
12	For new problem, press a, go to step 4		a	

00833C

PROGRAM LISTING

Page 5 of 7

☐ 67 ☐ 97 ☒ 41CFOURIER
SERIES

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL "FOURIER"		INITIALIZE	51	RCL 00		
02	LBL a			52	/		
03	CLRG			53	P-R		
04	"N=?"		Number of sample points	54	ST+ IND 04		
05	PROMPT			55	X<>Y		
06	STO 00		-----	56	ISG 04		
07	"FREQS=?"		Number of frequencies	57	ST+ IND 04		
08	PROMPT			58	ISG 04		
09	ST+ X			59	GTO 02		
10	STO 01		-----	60	TONE 5		End of computation
11	"J=?"		Frequency of first order	61	FC? 05		Proceed?
12	PROMPT		coefficient	62	ISG 05		Next sample point?
13	ST+ X			63	GTO 00		-----
14	STO 02		-----	64	"SELECT"		End of samples
15	RCL 00		Set sample counter	65	PROMPT		
16	1 E3			66	LBL C		RECTANGULAR
17	/			67	CF 01		
18	1			68	GTO 04		
19	+			69	LBL B		CORRECT
20	STO 05			70	-1		Delete last entry
21	LBL A		DATA ENTRY	71	ST+ 05		
22	LBL 00			72	ST+ 03		
23	CF 05			73	SF 05		
24	"Y"			74	GTO 01		
25	CF 29			75	LBL 03		ANGLE MODE
26	FIX 0			76	100		SUBROUTINE
27	ARCL 05			77	200		
28	"t=?"			78	FS? 42		
29	PROMPT		Prompt Yk	79	X<>Y		
30	STO 03		-----	80	RDN		
31	LBL 01		Set storage counter	81	PI		
32	CF 06			82	FS? 43		
33	6			83	X<>Y		
34	RCL 01			84	RDN		
35	5			85	RCL 04		
36	+			86	6		
37	1 E3			87	-		
38	/			88	INT		
39	+			89	RCL 02		
40	STO 04			90	+		
41	LBL 02		SUM LOOP	91	*		
42	XEQ 03			92	RCL 00		
43	X=0?			93	/		
44	SF 06			94	RTN		
45	RCL 05			95	LBL D		POLAR
46	INT			96	SF 01		-----
47	*			97	LBL 04		Set storage counter
48	RCL 03			98	6		
49	FC?C 06			99	RCL 01		
50	ST+ X			100	5		

00833C

PROGRAM LISTING

Page 6 of 7

☐ 67 ☐ 97 ☒ 41CFOURIER
SERIES

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
101 +				151 RCL IND 04			
102 1 E3				152 *			
103 /				153 X<>Y			
104 +				154 ISG 04			
105 STO 04				155 RCL IND 04			
106 0			----- Set coefficient counter	156 *			
107 STO 03			-----	157 +			
108+LBL 05			DISPLAY LOOP	158 +			
109 RCL IND 04				159 ISG 04			
110 ISG 04				160 GTO 07			
111 RCL IND 04				161 "Y="			----- Display Y(t)
112 X<>Y				162 ARCL X			
113 "A"				163 GTO 06			Set for another example
114 FC? 01			Rectangular?	164+LBL 08			-----
115 GTO 05			-----	165 FIX 0			DISPLAY
116 "C"				166 ARCL 03			SUBROUTINE
117 X<>Y				167 "t="			
118 R-P			-----	168 FS? 55			If printer...
119+LBL 05				169 GTO 09			-----
120 XEQ 08			Ai or Ci	170 ENG 4			
121 "B"				171 ARCL X			
122 FS? 01			Polar?	172 PROMPT			
123 "Z"				173 RTN			Continue display
124 X<>Y				174+LBL 09			-----
125 XEQ 08			Bi or di	175 ENG 9			Print all coefficients
126 ISG 03				176 ACA			
127 X<>Y			(No operation)	177 ACX			
128 ISG 04				178 PRBUF			
129 GTO 05				179 .END.			
130+LBL E			----- t → Y(t)				
131 "T=?"			-----				
132 ENG 4							
133+LBL 06							
134 PROMPT			Prompt T=? or Y(t)				
135 STO 03			-----				
136 6			Set storage counter				
137 RCL 01							
138 5							
139 +							
140 1 E3							
141 /							
142 +							
143 STO 04							
144 0			----- SUM LOOP				
145+LBL 07							
146 XEQ 03							
147 RCL 03							
148 *							
149 1							
150 P-R							

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

[illegible]

00833C

PROGRAM DESCRIPTION I

Page 1 of 11

Program Title FOURIER POWER SERIES (41C)
Contributor's Name James H. LeMay
Address 6500 Rampart #4
City Houston **State/Country** Texas, USA **Zip Code** 77081

Program Description, Equations, Variables This program is designed to convert the coefficients on the FOURIER SERIES (41C) program to a trigonometric power series form developed on the next few pages. The purpose of the conversion is to make a faster curve fit equation. It produces the exact same results as the former, but the empirical equation has to calculate only one single trig function (no matter how many frequencies) while the rest is basic arithmetic reducing the time of calculation to a mere fraction. Conversion, however may take some time - progressively longer the greater the number of frequencies. For example, a seven frequency function takes 40 seconds to convert while one with 40 frequencies will take 15 minutes and 80 will take about an hour. When the conversion is made, it is worth the time, especially if several calculations are needed on the empirical equation.

Necessary Accessories HP- 41C, Card reader; Optional: Memory Modules, Printer

Operating Limits and Warnings (1) The FOURIER SERIES (41C) program must have J=0.
(2) This program is 8 registers longer than FOURIER SERIES (41C). Transferring the "test" routine to another card will make room if it seems that data storage will be a problem for you.

Reference(s) Hewlett- Packard Library Program: Fourier Series (97) 00026D

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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PROGRAM DESCRIPTION I

USE THE FOLLOWING MULTIPLE ANGLE RELATIONS: (Let $x = \frac{t}{N} 360$)

$$A_1 \cos x = A_1 \cos x$$

$$B_1 \sin x = B_1 \sin x$$

$$A_2 \cos 2x = A_2 - 2A_2 \sin^2 x$$

$$B_2 \sin 2x = 2B_2 \cos x \sin x$$

$$A_3 \cos 3x = A_3 \cos x - 4A_3 \cos x \sin^2 x$$

$$B_3 \sin 3x = 3B_3 \sin x - 4B_3 \sin^3 x$$

$$A_4 \cos 4x = A_4 - 8A_4 \sin^2 x + 8A_4 \sin^4 x$$

$$B_4 \sin 4x = 4B_4 \cos x \sin x - 8B_4 \cos x \sin^3 x$$

$$A_5 \cos 5x = A_5 \cos x - 12A_5 \cos x \sin^2 x + 16A_5 \cos x \sin^4 x$$

$$B_5 \sin 5x = 5B_5 \sin x - 20B_5 \sin^3 x + 16B_5 \sin^5 x$$

$$A_6 \cos 6x = A_6 - 18A_6 \sin^2 x + 48A_6 \sin^4 x - 32A_6 \sin^6 x$$

$$B_6 \sin 6x = 6B_6 \cos x \sin x - 32B_6 \cos x \sin^3 x + 32B_6 \cos x \sin^5 x$$

$$A_7 \cos 7x = A_7 \cos x - 24A_7 \cos x \sin^2 x + 80A_7 \cos x \sin^4 x - 64A_7 \cos x \sin^6 x$$

$$B_7 \sin 7x = 7B_7 \sin x - 56B_7 \sin^3 x + 112B_7 \sin^5 x - 64B_7 \sin^7 x$$

$$A_8 \cos 8x = A_8 - 32A_8 \sin^2 x + 160A_8 \sin^4 x - 256A_8 \sin^6 x + 128A_8 \sin^8 x$$

$$B_8 \sin 8x = 8B_8 \cos x \sin x - 80B_8 \cos x \sin^3 x + 192B_8 \cos x \sin^5 x - 128B_8 \cos x \sin^7 x$$

$$A_9 \cos 9x = A_9 \cos x - 40A_9 \cos x \sin^2 x + 240A_9 \cos x \sin^4 x - 448A_9 \cos x \sin^6 x + 256A_9 \cos x \sin^8 x$$

$$B_9 \sin 9x = 9B_9 \sin x - 120B_9 \sin^3 x + 432B_9 \sin^5 x - 576B_9 \sin^7 x + 256B_9 \sin^9 x$$

$$\vdots$$

$$\sin ix = 2\sin(i-1)x \cos x - \sin(i-2)x$$

$$\cos ix = 2\cos(i-1)x \cos x - \cos(i-2)x$$

FOURIER POWER SERIES

PROGRAM DESCRIPTION I

CONVERSION TABLE

	Col 0	Col 1	Col 2	Col 3	Col 4	
- 1	(A ₀ +	A ₂ +	A ₄ +	A ₆ +	A ₈ + ...)	= AP ₀
0 2	(A ₁ +	A ₃ +	A ₅ +	A ₇ +	A ₉ + ...)	= AP ₁ cos x
1 3	+ cos x sin x (2 B ₂ +	4 B ₄ +	6 B ₆ +	8 B ₈ + ...	)	= AP ₂ cos x sin x
2 4	- cos x sin ² x (4 A ₃ +	12 A ₅ +	24 A ₇ +	40 A ₉ + ...	)	= AP ₃ cos x sin ² x
3 5	- cos x sin ³ x (8 B ₄ +	32 B ₆ +	80 B ₈ + ...		)	= AP ₄ cos x sin ³ x
4 6	+ cos x sin ⁴ x (16 A ₅ +	80 A ₇ +	240 A ₉ + ...		)	= AP ₅ cos x sin ⁴ x
5 7	+ cos x sin ⁵ x (32 B ₆ +	192 B ₈ + ...			)	= AP ₆ cos x sin ⁵ x
6 8	- cos x sin ⁶ x (64 A ₇ +	448 A ₉ + ...			)	= AP ₇ cos x sin ⁶ x
7 9	- cos x sin ⁷ x (128 B ₈ + ...				)	= AP ₈ cos x sin ⁷ x
8 10	+ cos x sin ⁸ x (256 A ₉ + ...				)	= AP ₉ cos x sin ⁸ x
	...					...
0 2	+ sin x (B ₁ +	3 B ₃ +	5 B ₅ +	7 B ₇ +	9 B ₉ + ...)	= BP ₁ sin x
1 3	- sin ² x (2 A ₂ +	8 A ₄ +	18 A ₆ +	32 A ₈ + ...	)	= BP ₂ sin ² x
2 4	- sin ³ x (4 B ₃ +	20 B ₅ +	56 B ₇ +	120 B ₉ + ...	)	= BP ₃ sin ³ x
3 5	+ sin ⁴ x (8 A ₄ +	48 A ₆ +	160 A ₈ + ...		)	= BP ₄ sin ⁴ x
4 6	+ sin ⁵ x (16 B ₅ +	112 B ₇ +	432 B ₉ + ...		)	= BP ₅ sin ⁵ x
5 7	- sin ⁶ x (32 A ₆ +	256 A ₈ + ...			)	= BP ₆ sin ⁶ x
6 8	- sin ⁷ x (64 B ₇ +	576 B ₉ + ...			)	= BP ₇ sin ⁷ x
7 9	+ sin ⁸ x (128 A ₈ + ...				)	= BP ₈ sin ⁸ x
8 10	+ sin ⁹ x (256 B ₉ + ...				)	= BP ₉ sin ⁹ x
	...					...

FOURIER
POWER SERIES**PROGRAM DESCRIPTION I**

Page 4 of 11

The coefficient values in each column are:

	AP_n	BP_n
Col 0	2^F	2^F
Col 1	$2^F(F+1)$	$2^F(F+3)$
Col 2	$2^F(F+2)(F+1)/2$	$2^F(F+5)(F+2)/2$
Col 3	$2^F(F+3)(F+2)(F+1)/2 \cdot 3$	$2^F(F+7)(F+3)(F+2)/2 \cdot 3$
Col 4	$2^F(F+4)(F+3)(F+2)(F+1)/2 \cdot 3 \cdot 4$	$2^F(F+9)(F+4)(F+3)(F+2)/2 \cdot 3 \cdot 4$
Col 5	...	...

For any column, C, the coefficients reduce to the following formulas:

Col C	$2^F(F+C)!/(F!C!)$	$\frac{2^F(F+C)!/(F!C!)}{[1 + (2C)/(F+1)]^{-1}}$
-------	--------------------	--

- NOTE:**
1. The subscript i is the frequency order on the 41C FOURIER SERIES program.
 2. The subscript n is the frequency order on the 41C FOURIER POWER SERIES program. For all practical purposes, $n=i$.
 3. In the conversion table, $F = n - 1$.
 4. While the conversion is being calculated, the display on the calculator shows $n + 1$.
 5. Whenever there are 50 frequencies or more, the program has to use Forsyth's formula for $N!$ which is:

$$\ln N! = \ln(2\pi)^{\frac{1}{2}} + (N + \frac{1}{2})[\ln(N^2 + N + 1/6)^{\frac{1}{2}} - 1]$$

EQUATION FORM:

The final form for the Fourier power series in equation form is:

$$Y(t) = AP_0 + AP_1 \cos x + \sin x (BP_1 + AP_2 \cos x + \sin x (BP_2 + \dots))$$

PROGRAMMING FORM:

1. For comparison in time, a ten frequency function takes 17.5 seconds on the FOURIER SERIES program by indirect storage recall, but the same function takes only 6.2 seconds on the POWER SERIES program. Both functions were timed using the "test" routine on each program.

FOURIER
POWER SERIES

PROGRAM DESCRIPTION I

Page 5 of 11

PROGRAMMING FORM: (Con't)

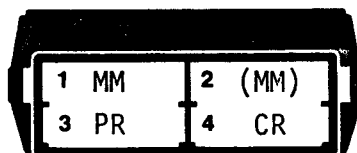
2. For direct storage recall which is faster by 50% more, use the following form if you have sufficient programming room. The program is timed for 3.5 seconds. (Assume a ten frequency function in DEG mode and t is in the X register. Data registers correspond to listing on page 11.)

01 LBL "TEST"		43 RCL 04	
02 RCL 00		44 *	n = 5
03 /		45 RCL 16	
04 360		46 RCL 05	
05 *		47 *	
06 1		48 +	
07 P-R		49 RCL 15	
08 STO 05		50 +	
09 X<>Y		51 RCL 04	
10 STO 04		52 *	n = 4
11 RCL 25		53 RCL 14	
12 *		54 RCL 05	
13 RCL 05	n = 9	55 *	
14 RCL 24		56 +	
15 *		57 RCL 13	
16 +		58 +	
17 RCL 23		59 RCL 04	
18 +		60 *	n = 3
19 RCL 04		61 RCL 12	
20 *	n = 8	62 RCL 05	
21 RCL 22		63 *	
22 RCL 05		64 +	
23 *		65 RCL 11	
24 +		66 +	
25 RCL 21		67 RCL 04	
26 +		68 *	n = 2
27 RCL 04		69 RCL 10	
28 *	n = 7	70 RCL 05	
29 RCL 20		71 *	
30 RCL 05		72 +	
31 *		73 RCL 09	
32 +		74 +	
33 RCL 19		75 RCL 04	
34 +		76 *	n = 1
35 RCL 04		77 RCL 08	
36 *	n = 6	78 RCL 05	
37 RCL 18		79 *	
38 RCL 05		80 +	
39 *		81 RCL 06	
40 +		82 +	n = 0
41 RCL 17		83 RTN	
42 +		84 .END.	

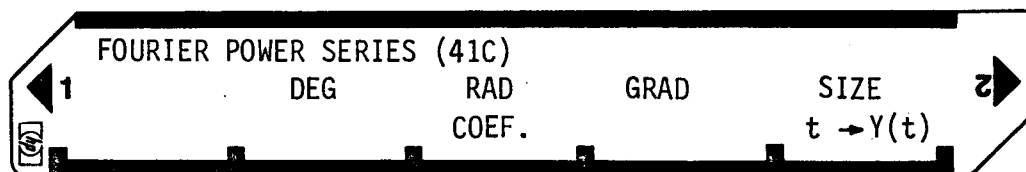
PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

Convert the data from the example problem in the FOURIER SERIES (41C) program. The conversion assumes you are using one Memory Module.
Determine the new coefficients.

SYSTEM
CONFIGURATION

CARD



SOLUTION:

Input	Function	Display	Comments
Load Program		FREQ 1 ... FREQ 7	At least steps 1 to 9 have been completed on FOURIER SERIES (41C). (Auto execution)
	C	AP0=2.0000E0	Conversion completed
	*R/S	BP0=0.0000E0	BP0 is superfluous
	R/S	AP1=13.000E0	
	R/S	BP1=4.0001E0	
	R/S	AP2=1.9999E0	
	R/S	BP2=-2.000E-9	Display is shown by PROMPT
	R/S	AP3=-16.002E0	which may be cleared by using the backarrow to view the X register
	R/S	BP3=-4.0003E0	and see more decimal places. Step 226 can be changed to alter the display in the ALPHA register. In this case, ENG 4 is used.
	R/S	AP4=0.0000E0	
	R/S	BP4=0.0000E0	
	R/S	AP5=48.003E0	
	R/S	BP5=234.66E-6	
	R/S	AP6=0.0000E0	
	R/S	BP6=0.0000E0	
	R/S	T=?	*If the printer exists, all coefficients will be printed; the R/S commands are superfluous.
11	R/S	Y=10.026E0	(For the coefficients, the printer uses ENG 9.)

USER INSTRUCTIONS

FOURIER POWER SERIES

 SIZE:
(HP-41C)

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Complete at least steps 1 to 9 on FOURIER SERIES (41C) program.			
2	Optional: Record data		WDTA	RDY kk OF nn
3	Load FOURIER POWER SERIES program (auto execution)* (assumes step 5b)			FREQ 1 T=?
4	To display coefficients (with printer, R/S is superfluous) (assumes step 5b when complete)		C R/S R/S	APi=... BPi=... T=?
5	a. Compute a value of Y at t b. Input t (program assumes DEG mode) c. For new t, repeat step 5b	t	E R/S	T=? Y(t)=...
6	For a new curve, return to FOURIER SERIES program.			
	* This step assumes there is room for the extra 8 registers required on the new program. If TRY AGAIN is dis- played: a. SIZE again to minimum requirements, b. Or, add a memory module and SIZE again, c. Split the program onto two cards. (See operating limits)			

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C ☒ SF 11
FOURIER
POWER SERIES

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	LBL "POWER"		CONVERSION	51	1		Initialize
02	CF 05			52	ST+ 07		
03	CF 21			53	SF 06		
04	CF 29			54	GTO 05		Go to START
05	FIX 0			55	LBL 02		-----
06	"FREQ 1"			56	ISG 07		CALC. POWER
07	AVIEW		-----	57	69		COEFFICIENT
08	RCL 01		Coefficient counter	58	RCL 04		
09	5.04		for AP0	59	RCL 05		
10	+			60	+		
11	1 E3			61	INT		
12	/			62	X>Y?		If N!>69...
13	6			63	GTO 03		-----
14	+			64	FACT		Use FACT
15	STO 02		-----	65	RCL 04		
16	RCL 01		Frequency counter	66	INT		
17	2			67	FACT		
18	/			68	/		
19	LASTX			69	GTO 04		-----
20	-			70	LBL 03		Use Forsyth's formula
21	1 E3			71	XEQ 08		
22	/			72	RCL 04		
23	STO 04		-----	73	INT		
24	8.2		Storage counter	74	XEQ 08		
25	STO 03		-----	75	-		
26	CLX			76	ETX		-----
27	LBL 00		Loop for AP0	77	LBL 04		Continue
28	RCL IND 02			78	RCL 05		
29	+			79	INT		
30	ISG 02			80	FACT		
31	GTO 00			81	/		-----
32	STO 06		Store AP0	82	LBL 05		(START)
33	LBL 01		-----	83	2		
34	"FREQ "		COEFFICIENT	84	RCL 04		
35	RCL 04		LOOP	85	INT		
36	2			86	YTX		
37	+			87	*		2F[(F+C)!/F!C!]
38	ARCL X			88	RCL IND 02		
39	AVIEW		Display frequency	89	X<>Y		
40	LASTX		-----	90	*		
41	+			91	RCL IND 07		
42	INT			92	LASTX		
43	ST+ X			93	*		
44	RCL 02			94	FS? 05		If odd frequency...
45	FRC			95	X<>Y		
46	+			96	RCL 04		
47	STO 02			97	INT		
48	STO 07		-----	98	1		
49	.1		Column counter	99	+		
50	STO 05			100	RCL 05		

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C
FOURIER
POWER SERIES

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
101	INT			151	360		
102	ST+ X			152	*		
103	X<>Y			153	1		
104	/			154	P-R		
105	1			155	STO 05		Cos(360t/N)
106	+			156	X<>Y		
107	*		2F[...][1+2C/(F+1)]	157	STO 04		Sin(360t/N)
108	X<>Y			158	RCL 01		-----
109	ST+ IND 03		ΣAPn	159	5.007		Set storage counter
110	FS? 06		First time?	160	+		
111	STO IND 03			161	STO 03		-----
112	ISG 03			162	0		
113	X<>Y			163	LBL 07		SUM LOOP
114	ST+ IND 03		ΣBPn	164	RCL IND 03		
115	FS?C 06		First time?	165	+		
116	STO IND 03			166	RCL 04		
117	1			167	*		
118	ST- 03			168	DSE 03		
119	ISG 05			169	RCL IND 03		
120	ISG 02		More coefficients?	170	RCL 05		
121	GTO 02			171	*		
122	RCL 04		Sign for APn	172	+		
123	4			173	DSE 03		Another frequency?
124	MOD			174	GTO 07		-----
125	2			175	RCL 06		Add AP0
126	-			176	+		
127	CHS			177	"Y="		
128	SIGN			178	ARCL X		
129	ST+ IND 03			179	GTO 06		
130	ISG 03		Sign for BPn	180	LBL 08		-----
131	FS? 05			181	ENTER↑		FACTORIAL
132	CHS			182	X↑2		SUBROUTINE
133	ST+ IND 03			183	LASTX		(Forsyth's formula)
134	ISG 03			184	+		
135	FC?C 05		Even-Odd flag	185	6		
136	SF 05			186	1/X		
137	ISG 04		Next frequency?	187	+		
138	GTO 01			188	SQRT		
139	0		Set BP0=0	189	LN		
140	STO 07			190	X<>Y		
141	SF 21		Conversion completed	191	.5		
142	BEEP			192	+		
143	LBL E		t → Y(t)	193	*		
144	"T=?"			194	LASTX		
145	ENG 4			195	-		
146	LBL 06		Display T=? or Y(t)	196	RTN		
147	PROMPT		Calculate Y(t)	197	LBL C		-----
148	RCL 00			198	RCL 01		DISPLAY
149	/			199	2		COEFFICIENTS
150	DEG			200	/		Set frequency counter

00833C

B

PROGRAM LISTING

Page 10 of 11

☐ 67 ☐ 97 ☒ 41CFOURIER
POWER SERIES

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
281	1						
282	-						
283	1 E3						
284	/						
285	STO 04		-----				
286	6.4		Set storage counter				
287	STO 03		-----				
288	LBL 09		DISPLAY LOOP				
289	"AP"						
210	XEQ 10						
211	"BP"						
212	XEQ 10						
213	ISG 04		Another frequency?				
214	GTO 09						
215	GTO E		-----				
216	LBL 10		DISPLAY				
217	FIX 0		SUBROUTINE				
218	RCL 04						
219	RND						
220	ARCL X						
221	"t="						
222	RCL IND 03						
223	ISG 03						
224	FS? 55		If printer...				
225	GTO 11		-----				
226	ENG 4						
227	ARCL X						
228	PROMPT						
229	RTH		Continue display				
230	LBL 11		-----				
231	ENG 9		Print all coefficients				
232	ACA						
233	ACX						
234	PRBUF						
235	.END.		-----				

B

Page 11 of

[illegible]

PROGRAM REGISTERS NEEDED: 44

ROW 1 (1 : 2)



ROW 2 (3 : 7)



ROW 3 (7 : 13)



ROW 4 (14 : 23)



ROW 5 (23 : 28)



ROW 6 (29 : 38)



ROW 7 (39 : 48)



ROW 8 (49 : 57)



ROW 9 (57 : 63)



ROW 10 (64 : 68)



ROW 11 (68 : 74)



ROW 12 (75 : 81)



ROW 13 (82 : 93)



ROW 14 (94 : 102)



ROW 15 (103 : 112)



ROW 16 (113 : 120)



ROW 17 (120 : 126)



ROW 18 (127 : 132)



ROW 19 (133 : 143)



ROW 20 (144 : 153)



ROW 21 (154 : 161)



ROW 22 (161 : 167)



ROW 23 (168 : 175)



ROW 24 (176 : 179)



