UNIVERSITY OF ILLINOIS

DIGITAL COMPUTER

LIBRARY ROUTINE T 7 - 293

TITLE: 1/2 sin X/X (SADOI Only)

TYPE: Closed subroutine (Uses T 5)

NUMBER OF WORDS: 37

TEMPORARY STORAGE: 0, 1, 2, and 3.

ACCURACY: $\pm 2^{-37}$

DURATION: $(15 + \frac{n}{2})$ milliseconds for $|X| \geq 1/2$, where $2^{-n}|X| = 1$.
7 milliseconds for $|X| < 1/2$.

DESCRIPTION: X is treated as a double precision number with an integer and fractional part. Enter with the integer part of X in location 3 and the fractional part of X in the accumulator. The accumulator will contain

$$1/2 \ \frac{\sin X}{X}$$

upon exit.

CAUTION: This routine uses library routine T 5 - 157 and identifies it by means of the symbolic address (T5). (T5) must be supplied by the programmer.

METHOD: For $|X| \geq 1/2$, T 5 is used to compute 1/2 sin X. This quantity is shifted right simultaneously with X until division by X is possible. For $X < 1/2$, a power series is used. The power series coefficients were obtained using routine KA1.

NUMBER REPRESENTATION:

The double precision numbers are correctly represented by a signed integer and a positive fraction. For example, the number +2.4 should be represented by the integer +2 and the fraction +0.4. The number -2.4 should be represented by the integer -3 and the fraction +0.6. Numbers generated by multiplication are correctly represented since $q_0 = 0$ after multiplication in all cases.

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ns

LOCATION	ORDER		NOTES PAGE 1 T 7
	00K(T7)		
0	40 36L		save fraction
	K5 31L		
1	42 20L		link
	L5 L		
2	42 24L		
	L5 3F		integer part of X
3	32 6L		
	L1 36L		
4	10 39F		convert negative
	L0 3F		X to positive
5	40 3F		
	01 39F		
6	40 36L		
	43 18L		
7	L3 3F		
	36 21L		integer part = 0?
8	5L 36L		
	7J 30L		order pair near 3/4
9	50 3F		
	74 30L		$\frac{1}{\pi}[X_I + 2^{-39} X_F]$
10	00 39F		into A.
	50 10L		
11	26 (T5)		1/2 sin X in 1.
	40 1F		
12	50 36L		
	F5 18L		
13	42 18L		
	L3 3F		Shift X until
14	32 16L		pure fraction.
	L5 3F		Count shifts.
15	10 1F		
	40 3F		
16	22 12L		
	S5 F	from 14L	

LOCATION	ORDER		NOTES PAGE 2 T 7
17	40 3F		save shifted X.
	50 19L		Clear Q.
18	L5 1F		
	10 F		Shift 1/2 sin X same as X.
19	00 1F		
	66 3F		
20	S5 F		
	22 F		exit.
21	50 36L	from 7L	
	79 36L		
22	40 F		$-X_F^2$ in 0.
	L0 8L		
23	36 8L		jump if X > 1/2.
	50 3F		3 = 0 initially
24	79 F		
	L4 F		
25	40 3F		Compute 1/2 $\frac{\sin X}{X}$
	F5 24L		by power
26	42 24L		
	L0 29L		series when
27	32 23L		X < 1/2
	L5 3F		
28	22 20L		
	00 F		
29	L9 F		end test
	L4 36L		constant
30	00 F		
	00 318 309 886 184 J		$\frac{1}{\pi}$
31	00 F		
	00 1 370 058 J		
32	80 F		
	00 999 900 795 357 J		Coefficients
33	00 F		for power
	00 4 166 666 514 J		

LOCATION	ORDER	NOTES
34	80 F	series.
	00 916 666 666 671 J	
35	40 F	
	00 F	
36	00 F	
	00 F	Fractional part of X.