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1 % Kavya Manchanda
2 % 11/1/2022
3 % ECE 202: Project 1 – Power Expansion Series of function of the form
4 % Acos(wt)
5 % Phase 5 : Letting the user define the parameters
6
7 clear; clf;
8 format shortG;
9
10 A = 12;           % amplitude
11 w = 40;           % angular frequency in rad/s
12 nz = input("Enter number of non zero terms: "); % Number of non-zero terms
13
14 tmin = input("Enter starting time in ms: "); % in ms
15 tmax = input("Enter ending time in ms: "); % in ms
16 N = input("Enter number of intervals: "); % intervals
17
18 tms = linspace(tmin, tmax, N); % time array in ms
19 t = tms/1000; % time array in s
20 n = 0:2:nz - 2; % first "nz" number of non zero term
21 % indices in series (only even values)
22
23
24 % The angular frequency in rad/s
25 an = A*(-1).^(n./2).*w.^n./factorial(n);
26
27 coefTable = table(n.',an.','VariableNames',{'n', 'a_n'})
28
29 %----Adding the for loop and plotting-----
30 f = zeros(1,N);
31 p = zeros(nz,1);
32 plot([tmin,tmax],[0,0],"k","LineWidth",1)
33 hold on
34 for i = 1:nz
35     f = f + an(i)*t.^n(i);
36     if i~=nz % if not the last sum
37         p(i) = plot(tms,f,"LineWidth",2.5);
38     else % if it is the last sum, make the graph thicker
39         p(nz) = plot(tms,f,"LineWidth",5);
40     end
41 end
42 hold off
43
44 %---- Check from the previous phase ----
45 if nz==6 % checking only when non-zero terms are 6
46     f1 = an(1)*t.^n(1); % first sum (ie. first term) in the power series
47     f2 = f1 + an(2)*t.^n(2); % sum of first two terms
48     f3 = f2 + an(3)*t.^n(3); % sum of first three terms
49     f4 = f3 + an(4)*t.^n(4); % sum of first four terms
50     f5 = f4 + an(5)*t.^n(5); % sum of first five terms
51     f6 = f5 + an(6)*t.^n(6); % sum of first six terms
52
53     check = sum(abs(f-f6)) % should be zero
54 end
55
56 %----- Attributes of the graph -----
57 diff = abs(A*cos(w*t) - f); % difference between the two functions
58 aveDeviation = sum(diff)/length(diff) % average standard deviation

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```
59 ax = gca;
60 ax.GridAlpha = 0.4;
61 ax.FontSize = 16;
62 xlabel('time t (ms)', 'FontSize', 18);
63 ylabel('f(t)', 'FontSize', 18)
64 ylim([-1.25*A, 1.25*A])
65 str1 = sprintf("Power series expansion of f(t) = %gcos(%gt)", A, w);
66 str2 = sprintf("using truncated sums up to %g non-zero terms", nz);
67 str3 = sprintf("with an Average Deviation of %0.4g", aveDeviation);
68 title(["ECE 202, Project 1 Phase 5:", str1, str2, str3], "FontSize", 22)
69 legend(p, "Up to n = " + n, "FontSize", 18, "Location", "bestoutside")
70
71 grid on
72
```

```
>> project1phase5
Enter number of non zero terms: 6
Enter starting time in ms: 0
Enter ending time in ms: 200
Enter number of intervals: 400
```

```
coefTable =
```

```
6x2 table
```

n	$a_n$
0	12
2	-9600
4	1.28e+06
6	-6.8267e+07
8	1.9505e+09
10	-3.4675e+10

```
check =
```

```
0
```

```
aveDeviation =
```

```
101.35
```

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>>
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**ECE 202, Project 1 Phase 5:**  
**Power series expansion of  $f(t) = 12\cos(40t)$**   
**using truncated sums up to 6 non-zero terms**  
**with an Average Deviation of 101.3**

