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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 4 : Making the script more effecient and easier to scale to any
6 % number of terms
7
8 clear; clf;
9 format shortG;
10
11 A = 12;           % amplitude
12 w = 40;           % angular frequency in rad/s
13 nz = 6;           % Number of non-zero terms
14
15 tmin = 0;         % in ms
16 tmax = 200;       % in ms
17 N = 400;          % intervals
18
19 tms = linspace(tmin, tmax, N+1); % time array in ms
20 t = tms/1000;     % time array in s
21 n = 0:2:2*nz - 2; % first "nz" number of non zero term
22 % indices in series (only even values)
23
24
25 % The angular frequency in rad/s
26 an = A*(-1).^(n/2).*w.^n./factorial(n);
27
28 coefTable = table(n.',an.','VariableNames',{'n', 'a_n'})
29
30 %----Adding the for loop and plotting-----
31 f = zeros(1,N+1);
32 p = zeros(nz,1);
33 plot([tmin,tmax],[0,0],"k","LineWidth",1)
34 hold on
35 for i = 1:nz
36     f = f + an(i)*t.^n(i);
37     if i~= nz % if not the last sum
38         p(i) = plot(tms,f,"LineWidth",2.5);
39     else % if it is the last sum, make the graph thicker
40         p(nz) = plot(tms,f,"LineWidth",5);
41     end
42 end
43 hold off
44
45 %---- Check from the previous phase ----
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
55 %----- Attributes of the graph -----
56
57
58 ax = gca;

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59 ax.GridAlpha = 0.4;
60 ax.FontSize = 16;
61 xlabel('time t (ms)','FontSize',18);
62 ylabel('f(t)','FontSize',18)
63 ylim([-1.25*A,1.25*A])
64 str1 = sprintf("Power series expansion of f(t) = %gcos(%gt)",A,w);
65 str2 = sprintf("using truncated sums up to %g non-zero terms",nz);
66 title(["ECE 202, Project 1 Phase 4:",str1,str2],"FontSize",22)
67 legend(p,"Up to n = " + n,"FontSize",18,"Location","bestoutside")
68
69 grid on
70
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>> project1phase4
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coefTable =
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```
6×2 table
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n	a_n
0	12
2	-9600
4	1.28e+06
6	-6.8267e+07
8	1.9505e+09
10	-3.4675e+10

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check =
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0
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>>
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ECE 202, Project 1 Phase 4:
Power series expansion of $f(t) = 12\cos(40t)$
using truncated sums up to 6 non-zero terms

