Prob1

1) Fourier Analysis

a) L={10, 40, 20, 90, 5, 30} N={0, 1, 2, 3, 4, 5}

F0 = (10e^(-i2*pi*0*0/6) + 40e^(-i2*pi*0*1/6) + 20e^(-i2*pi*0*2/6) +

90e^(-i2*pi*0*3/6) + 5e^(-i2*pi*0*4/6) + 30e^(-i2*pi*0*5/6))/6

= (10 + 40 + 20 + 90 + 5 + 30)/6

= **32.5 + 0i**

F1 = 10e^(-i2*pi*1*0/6) + 40*e^(-i2*pi*1*1/6) + 20*e^(-i2*pi*1*2/6) +

90*e^(-i2*pi*1*3/6) + 5*e^(-i2*pi*1*4/6) + 30*e^(-i2*pi*1*5/6)

= 10 + 40*cos(-pi/3) - 40i*sin(-pi/3) + 20*cos(-pi*2/3) - 20i*sin(-pi*2/3) +

90*cos(-pi) - 90i*sin(-pi) + 5*cos(-pi*4/3) - 5i*sin(-pi*4/3) + 30*cos(-pi*5/3) - 30i*sin(-pi*5/3)

= **-9.58 - 3.61i**

F2 = 10*e^(-i2*pi*2*0/6) + 40*e^(-i2*pi*2*1/6) + 20*e^(-i2*pi*2*2/6) +

90*e^(-i2*pi*2*3/6) + 5*e^(-i2*pi*2*4/6) + 30*e^(-i2*pi*2*5/6)

= 10 + 40*cos(-pi*2/3) - 40i*sin(-pi*2/3) + 20*cos(-pi*4/3) - 20i*sin(-pi*4/3) +

90*cos(-pi*2) - 90i*sin(-pi*2) + 5*cos(-pi*8/3) - 5i*sin(-pi*8/3) + 30*cos(-pi*10/3) - 30i*sin(-pi*10/3)

= **8.75 + 0.72i**

F3 = 10*e^(-i2*pi*3*0/6) + 40*e^(-i2*pi*3*1/6) + 20*e^(-i2*pi*3*2/6) +

90*e^(-i2*pi*3*3/6) + 5*e^(-i2*pi*3*4/6) + 30*e^(-i2*pi*3*5/6)

= 10 + 40*cos(-pi) - 40i*sin(-pi) + 20*cos(-pi*2) - 20i*sin(-pi*2) +

90*cos(-pi*3) - 90i*sin(-pi*3) + 5*cos(-pi*4) - 5i*sin(-pi*4) + 30*cos(-pi*5) - 30i*sin(-pi*5)

= **-20.83 + 0i**

F4 = 10*e^(-i2*pi*4*0/6) + 40*e^(-i2*pi*4*1/6) + 20*e^(-i2*pi*4*2/6) +

90*e^(-i2*pi*4*3/6) + 5*e^(-i2*pi*4*4/6) + 30*e^(-i2*pi*4*5/6)

= 10 + 40*cos(-pi*4/3) - 40i*sin(-pi*4/3) + 20*cos(-pi*8/3) - 20i*sin(-pi*8/3) +

90*cos(-pi*4) - 90i*sin(-pi*4) + 5*cos(-pi*16/3) - 5i*sin(-pi*16/3) + 30*cos(-pi*20/3) - 30i*sin(-pi*20/3)

= **8.75 - 0.72i**

F5 = 10*e^(-i2*pi*5*0/6) + 40*e^(-i2*pi*5*1/6) + 20*e^(-i2*pi*5*2/6) +

90*e^(-i2*pi*5*3/6) + 5*e^(-i2*pi*5*4/6) + 30*e^(-i2*pi*5*5/6)

= 10 + 40*cos(-pi*5/3) - 40i*sin(-pi*5/3) + 20*cos(-pi*10/3) - 20i*sin(-pi*10/3) +

90*cos(-pi*5) - 90i*sin(-pi*5) + 5*cos(-pi*20/3) - 5i*sin(-pi*20/3) + 30*cos(-pi*25/3) - 30i*sin(-pi*25/3)

= **-9.58 + 3.61i**

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b) As the result shown in part (a), F4 is the complex conjugate of F2, F5 is the complex conjugate of F1; we see when n exceed 3, everything start repeating since the radian of Fn is $n\pi/3$, and that means any n greater 3 or less 0, the value will repeat.

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c) L={10, 40, 20, 90, 5, 30} N={-2, -1, 0, 1, 2, 3}

F-2 = (10e^(-i2*pi*(-2)*0/6) + 40e^(-i2*pi*(-2)*1/6) + 20e^(-i2*pi*(-2)*2/6) +

90e^(-i2*pi*(-2)*3/6) + 5e^(-i2*pi*(-2)*4/6) + 30e^(-i2*pi*(-2)*5/6))/6

= 10 + 40*cos(pi*4/3) + 40i*sin(pi*4/3) + 20*cos(pi*8/3) + 20i*sin(pi*8/3) +

90*cos(pi*2) + 90i*sin(pi*2) + 5*cos(pi*8/3) + 5i*sin(pi*8/3) + 30*cos(pi*10/3) + 30i*sin(pi*10/3)

= **8.75 - 0.72i**

F-1 = 10e^(-i2*pi*(-1)*0/6) + 40*e^(-i2*pi*(-1)*1/6) + 20*e^(-i2*pi*(-1)*2/6) +

90*e^(-i2*pi*(-1)*3/6) + 5*e^(-i2*pi*(-1)*4/6) + 30*e^(-i2*pi*(-1)*5/6)

= 10 + 40*cos(pi*1/3) + 40i*sin(pi*1/3) + 20*cos(pi*2/3) + 20i*sin(pi*2/3) +

90*cos(pi) + 90i*sin(pi) + 5*cos(pi*4/3) + 5i*sin(pi*4/3) + 30*cos(pi*5/3) + 30i*sin(pi*5/3)

= **-9.58 + 3.61i**

F0 = 10*e^(-i2*pi*0*0/6) + 40*e^(-i2*pi*0*1/6) + 20*e^(-i2*pi*0*2/6) +

90*e^(-i2*pi*0*3/6) + 5*e^(-i2*pi*0*4/6) + 30*e^(-i2*pi*0*5/6)

= (10 + 40 + 20 + 90 + 5 + 30)/6

= **32.5 + 0i**

F1 = 10*e^(-i2*pi*1*0/6) + 40*e^(-i2*pi*1*1/6) + 20*e^(-i2*pi*1*2/6) +

90*e^(-i2*pi*1*3/6) + 5*e^(-i2*pi*1*4/6) + 30*e^(-i2*pi*1*5/6)

= 10 + 40*cos(-pi/3) + 40i*sin(-pi/3) + 20*cos(-pi*2/3) + 20i*sin(-pi*2/3) +

90*cos(-pi) + 90i*sin(-pi) + 5*cos(-pi*4/3) + 5i*sin(-pi*4/3) + 30*cos(-pi*5/3) + 30i*sin(-pi*5/3)

= **-9.58 - 3.61i**

F2 = 10*e^(-i2*pi*2*0/6) + 40*e^(-i2*pi*2*1/6) + 20*e^(-i2*pi*2*2/6) +

90*e^(-i2*pi*2*3/6) + 5*e^(-i2*pi*2*4/6) + 30*e^(-i2*pi*2*5/6)

= 10 + 40*cos(-pi*2/3) + 40i*sin(-pi*2/3) + 20*cos(-pi*4/3) + 20i*sin(-pi*4/3) +

90*cos(-pi*2) + 90i*sin(-pi*2) + 5*cos(-pi*8/3) + 5i*sin(-pi*8/3) + 30*cos(-pi*10/3) + 30i*sin(-pi*10/3)

= **8.75 + 0.72i**

F3 = 10*e^(-i2*pi*3*0/6) + 40*e^(-i2*pi*3*1/6) + 20*e^(-i2*pi*3*2/6) +

90*e^(-i2*pi*3*3/6) + 5*e^(-i2*pi*3*4/6) + 30*e^(-i2*pi*3*5/6)

= 10 + 40*cos(-pi) + 40i*sin(-pi) + 20*cos(-pi*2) + 20i*sin(-pi*2) +

90*cos(-pi*3) + 90i*sin(-pi*3) + 5*cos(-pi*4) + 5i*sin(-pi*4) + 30*cos(-pi*5) + 30i*sin(-pi*5)

= **-20.83 + 0i**