

Prelab-5

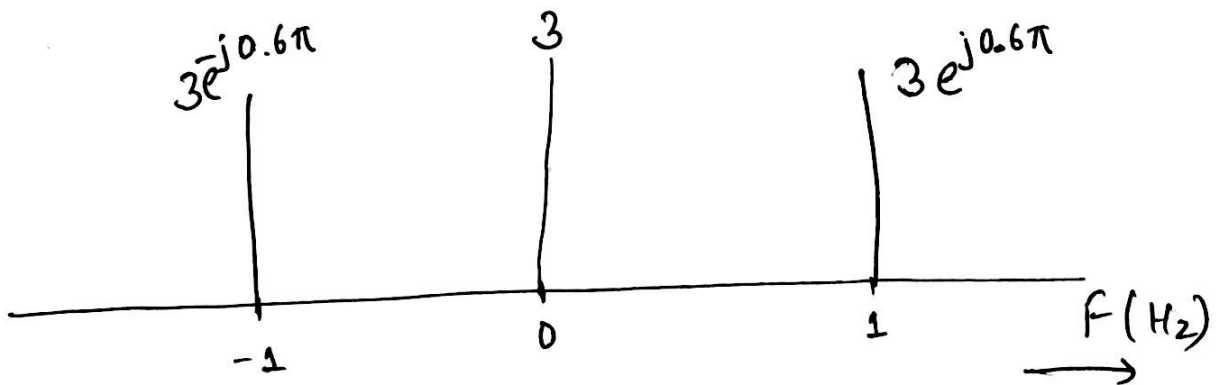
Ravitaashaw Bathla
(86369)

1) a) Amplitude of DC Component = 3

Frequency of Cosine Component = $\frac{1}{T} = \frac{1}{1} = 1 \text{ Hz}$

b) $x(t) = 3 + 6 \cos(2\pi \cdot 1 \cdot (t + 0.3))$
 $= 3 + 6 \cos(2\pi t + 0.6\pi)$

(c) $x(t) = 3 + \frac{6}{2} \left(e^{j2\pi t} e^{j0.6\pi} + e^{-j2\pi t} e^{-j0.6\pi} \right)$
 $= 3 + 3e^{j2\pi t} e^{j0.6\pi} + 3e^{-j2\pi t} e^{-j0.6\pi}$



2) a) fundamental frequency = $\gcd(72, 108) = \underline{\underline{36 \text{ Hz}}}$

b) $x(t) = 10 \cos(2\pi \cdot 72 \cdot t - 2\pi/5) + 8 \cos(2\pi \cdot 108 \cdot t - 3\pi/5)$
 $= \underline{\underline{10 \cos(144\pi t - 2\pi/5) + 8 \cos(216\pi t - 3\pi/5)}}$

$$(c) \quad x_2(t) = x(t - 0.1)$$

$$x_2(t) = 10 \cos(144\pi(t - 0.1) - 0.4\pi)$$

$$+ 8 \cos(216\pi(t - 0.1) - 0.6\pi)$$

$$= 10 \cos(144\pi t - 14.8\pi) + 8 \cos(216\pi t - 22.2\pi)$$

$$= 10 \cos(144\pi t - 0.8\pi - 2\pi \times 7)$$

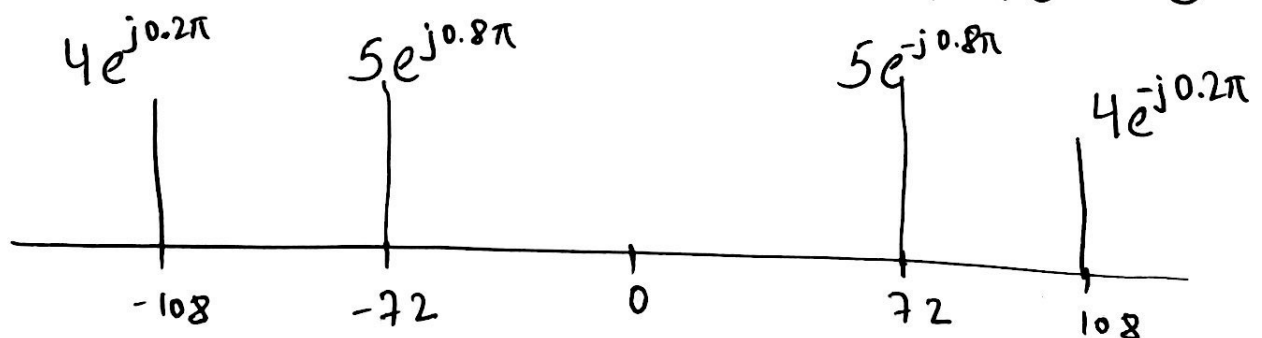
$$+ 8 \cos(216\pi t - 0.2\pi - 2\pi \times 11)$$

$$\therefore \cos(\theta - 2\pi) = \cos \theta$$

$$= \underline{10 \cos(144\pi t - 0.8\pi) + 8 \cos(216\pi t - 0.2\pi)}$$

$$= 5 e^{-j0.8\pi} e^{j2\pi \cdot 72 \cdot t} + 5 e^{j0.8\pi} e^{-j2\pi \cdot 72 \cdot t}$$

$$+ 4 e^{-j0.2\pi} e^{j2\pi \cdot 108 \cdot t} + 4 e^{j0.2\pi} e^{-j2\pi \cdot 108 \cdot t}$$



$$d) \quad x_3(t) = x_2(t) \cdot e^{j216\pi t}$$

$$= \left(5e^{-j0.8\pi} e^{j144\pi t} + 5e^{j0.8\pi} e^{-j144\pi t} + 4e^{-j0.2\pi} e^{j216\pi t} + 4e^{j0.2\pi} e^{-j216\pi t} \right) e^{j216\pi t}$$

$$= 5e^{-j0.8\pi} e^{j360\pi t} + 5e^{j0.8\pi} e^{j72\pi t} + 4e^{-j0.2\pi} e^{j512\pi t} + 4e^{j0.2\pi} e^0$$

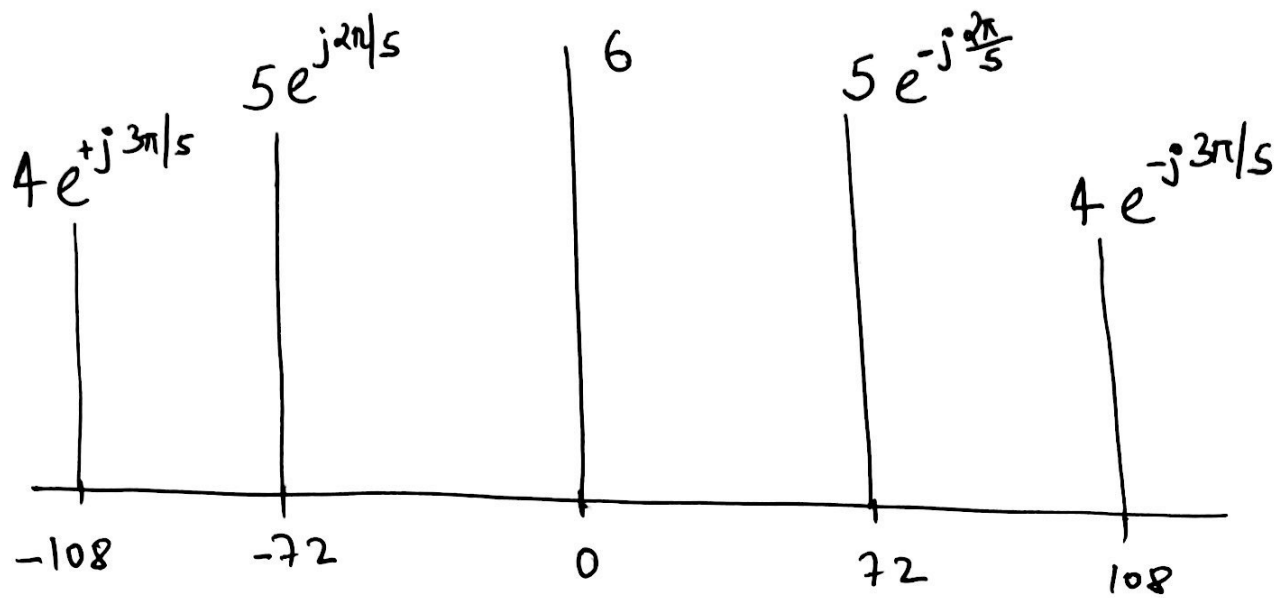
\therefore The dc component of $x_3(t) = 4e^{j0.2\pi}$

$$= \cancel{4 \cos(0.2\pi)} \\ = 4 \cos(0.2\pi) + j4 \sin(0.2\pi) \\ = \underline{\underline{3.24 + 2.35j}}$$

$$3) (a) \quad y(t) = x(t) + 6$$

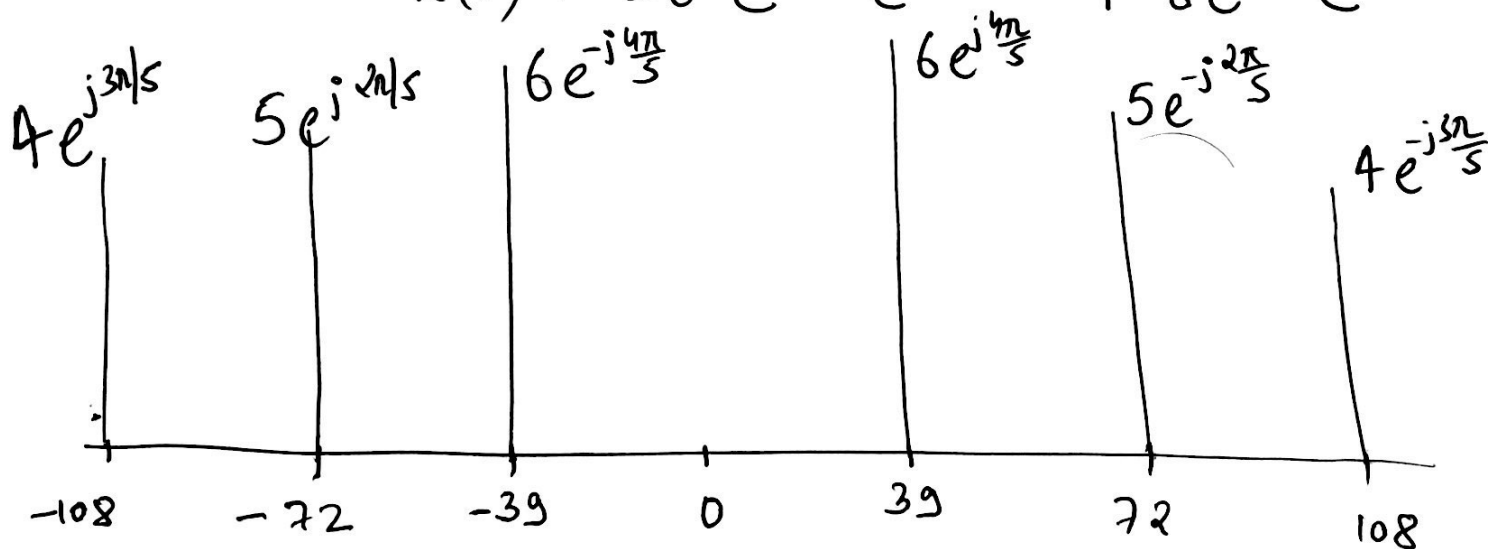
$$= 6 + 10 \cos(144\pi t - 2\pi/5) + 8 \cos(216\pi t - 3\pi/5)$$

$$= 6 + 5e^{-j0.4\pi} e^{j2\pi 72t} + 5e^{j0.4\pi} e^{-j2\pi 72t} \\ + 4e^{-j0.6\pi} e^{j2\pi 108t} + 4e^{j0.6\pi} e^{-j2\pi 108t}$$



$$(b) \quad z(t) = x(t) + 12 \cos(78\pi t + 4/5\pi)$$

$$= x(t) + 6 e^{j\frac{4\pi}{5}} e^{j2\pi \cdot 39 \cdot t} + 6 e^{-j\frac{4\pi}{5}} e^{-j2\pi \cdot 39 \cdot t}$$



$$(c) \quad \text{fundament frequency of } z(t) = \gcd(39, 72, 108)$$

$$= \underline{\underline{1 \text{ Hz}}}$$

$$(2) \quad q(t) = \frac{d}{dt} y(t)$$

$$= \frac{d}{dt} \left(6 + 10 \cos(144\pi t - 2\pi/5) + 8 \cos(216\pi t - 3\pi/5) \right)$$

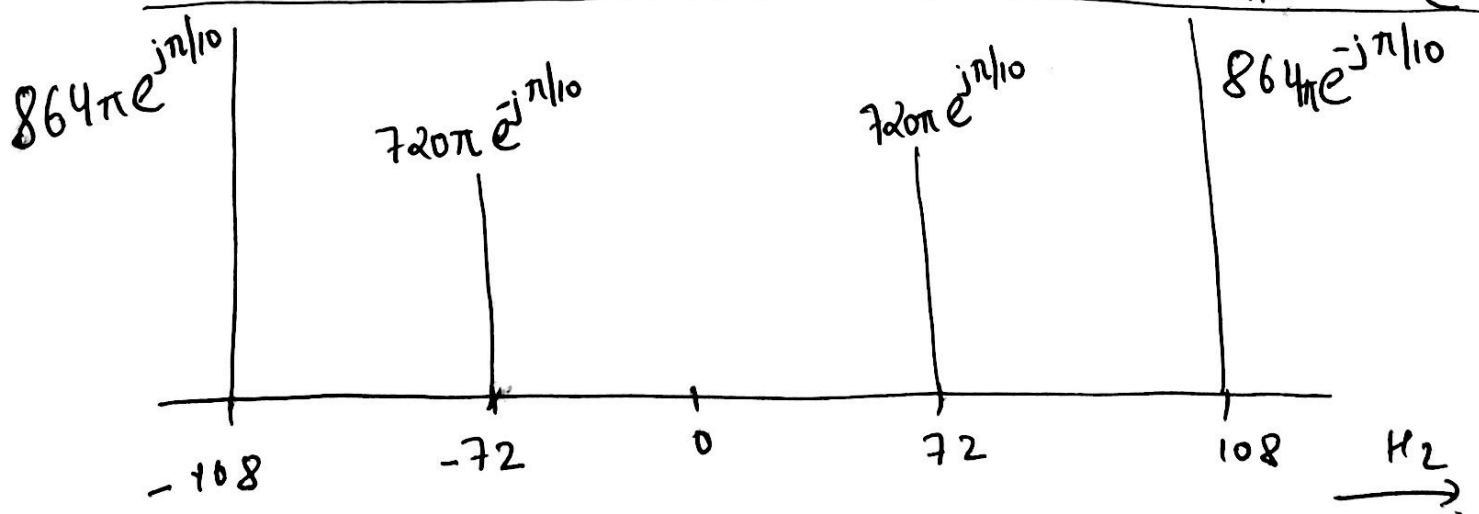
$$= 0 + (10)(144\pi)(-1) \sin(144\pi t - 2\pi/5) + (8)(216\pi)(-1) \sin(216\pi t - 3\pi/5)$$

$$= 1440\pi \sin(-144\pi t + 2\pi/5) + 1728\pi \sin(-216\pi t + 3\pi/5)$$

$$= 1440\pi \cos\left(144\pi t + \frac{\pi}{2} - \frac{2\pi}{5}\right) + 1728\pi \cos\left(216\pi t + \frac{\pi}{2} - \frac{3\pi}{5}\right)$$

$$= 1440\pi \cos(144\pi t + \pi/10) + 1728\pi \cos(216\pi t - \pi/10)$$

$$= 720\pi e^{j2\pi \cdot 72t} e^{j\pi/10} + 720\pi e^{-j2\pi \cdot 72t} e^{-j\pi/10} + 864\pi e^{j2\pi \cdot 108t} e^{-j\pi/10} + 864\pi e^{-j2\pi \cdot 108t} e^{j\pi/10}$$



4)

1 \longrightarrow (e)

$$4 \cos(4\pi t + \pi) + 4 \cos(6\pi t + \pi/2)$$

2 \longrightarrow (c)

$$2 \cos(4\pi t + \pi/4) + 4 \cos(6\pi t - \pi/3)$$

3 \longrightarrow (a)

$$-3 + 2 \cos(4\pi t + \pi/4)$$

4 \longrightarrow (b)

$$-2 + 4 \cos(4\pi t + \pi)$$

5 \longrightarrow (d)

$$4 \cos(2\pi t + \pi) + 4 \cos(4\pi t + \pi)$$

5)

(a) \longrightarrow 4 , $f = 125\text{ Hz}$

(b) \longrightarrow 3 , $f_1 = 50$, $f_2 = 200$

(c) \longrightarrow 2 , $f = 500 - 125\text{ Hz}$

(d) \longrightarrow 6 , $f_1 = \frac{100+400}{2} = 250$
 $f_2 = \frac{400-100}{2} = 150$

(e) \longrightarrow 1 , $f = 100\text{ Hz}$

(f) \longrightarrow 5 , $f = (30/2\pi) e^{2t/t}$