3. To prove

$$\mathcal{T}\{e^{j2\pi t_0 t}\} = \delta(\mu - t_0)$$

Using inverse FT:

$$= \int_{-\infty}^{\infty} \delta(\mu - t_0)\, e^{j2\pi\mu t}\, d\mu$$

We know impulse f^n $\delta(0) = 1$

$$= \int_{-\infty}^{\infty} \delta(t_0 - t_0)\, e^{j2\pi t_0 t}\, d\mu$$

$$= e^{j2\pi t_0 t} \int_{-\infty}^{\infty} \delta(0)\, d\mu$$

$\therefore$ Proved.

4. a) $\mathcal{T}\{\cos(2\pi\mu_0 t)\} = \frac{1}{2}[\delta(\mu-\mu_0) + \delta(\mu+\mu_0)]$

Using inverse FT.

$$= \int_{-\infty}^{\infty} \frac{1}{2}[\delta(\mu-\mu_0) + \delta(\mu-\mu_0)]\, e^{j2\pi\mu t}\, d\mu$$

We know impulse is $\delta(0) = 1$ & via shifting property

$$= \frac{1}{2}\Big[\underbrace{\int_{-\infty}^{\infty} \delta(\mu-\mu_0)\, e^{j2\pi\mu t}}_{\mu = \mu_0}\, d\mu + \underbrace{\int_{-\infty}^{\infty} \delta(\mu+\mu_0)\, e^{j2\pi\mu t}}_{2\mu = -\mu_0}\, d\mu\Big]$$

$$\frac{1}{2}\left[e^{j2\pi\mu_0 t} + e^{-j2\pi\mu_0 t}\right]$$

$$\Rightarrow \cos(j2\pi\mu_0 t)$$

b) $\mathcal{T}\{\sin(2\pi\mu_0 t)\} = \frac{1}{j2}[\delta(\mu-\mu_0) - \delta(\mu-\mu_0)]$

$$\Rightarrow \int_{-\infty}^{\infty} \frac{1}{2j}[\delta(\mu-\mu_0) - \delta(\mu+\mu_0)]\, e^{j2\pi\mu t}\, d\mu$$

We know impulse f^n is 1 & shifting property use

$$\frac{1}{2j}\Big[\Big(\int_{-\infty}^{\infty} \underbrace{\delta(\mu-\mu_0)}_{\mu = \mu_0}\, e^{j2\pi\mu t}\, d\mu - \int_{-\infty}^{\infty} \underbrace{\delta(\mu-\mu_0)}_{\mu = -\mu_0}\, e^{j2\pi\mu t}\, d\mu\Big]$$

$$\Rightarrow \frac{1}{2j}\left[e^{j2\pi\mu t} - e^{j2\pi\mu_0 t}\right] \Rightarrow \sin(j2\pi\mu_0 t)$$