$$= \frac{e^{aiz}(ai)(z+bi)^2 - e^{aiz}\cdot 2(z+bi)}{(z+bi)^4} \Rightarrow F'(bi) = \frac{e^{-ab}\cdot(ai)(-4b^2) - e^{-ab}2\cdot(2bi)}{(2bi)^4} =$$

$$= -\frac{e^{-ab}\, i\,(ab+1)}{4b^3} \Longrightarrow \int_C \frac{e^{iaz}}{(z^2+b^2)^2}\,dz = 2\pi i\cdot \mathrm{Res} = \boxed{\frac{\pi\cdot e^{-ab}(ab+1)}{2b^3}}.$$

$$\left|\int_{C_R} \frac{e^{aiz}}{(z^2+b^2)^2}\,dz\right| \le \int_{C_R} \frac{|e^{aiz}|}{(R^2-b^2)^2}\,ds = \frac{\pi R}{(R^2-b^2)^2}\cdot \underbrace{e^{-a\cdot \mathrm{Im} z}}_{\le 1} \longrightarrow 0 \text{ as } R\to\infty.$$

$$\int_C = \int_{-R}^{R} \frac{e^{aiz}}{(z^2+b^2)^2}\,dz + \underbrace{\int_{C_R} \frac{e^{aiz}}{(z^2+b^2)^2}\,dz}_{\downarrow \text{ as } R\to\infty \text{, } 0} = \frac{\pi}{2b^3}\, e^{-ab}(ab+1) \xRightarrow{\text{take real part}}$$

$$\Rightarrow \lim_{R\to\infty}\int_{-R}^{R} \frac{\cos az}{(z^2+b^2)^2}\,dz = \frac{\pi}{2b^3}\, e^{-ab}(ab+1) \Rightarrow \boxed{\int_0^{\infty} \frac{\cos(az)}{(z^2+b^2)^2}\,dz = \frac{\pi}{4b^3}\, e^{-ab}(ab+1)}$$

$\boxed{12}$ Let $f(z)=3z^3$; $g(z)=3z^3-e^z$. We claim that $|f|>|f-g|$ on the boundary of R $\Longleftrightarrow 3|z|^3 > |e^z|$. on the boundary of R. If z is on the boundary, $\mathrm{Re}\, z \le 1$, $|z|\ge 1$.

$\Rightarrow 3|z|^3 \ge 3 \ge e \ge e^{\mathrm{Re} z} = |e^z|$ proving the claim. Thus, by Rouché, g must have 3 zeroes inside R, because f has 3 zeroes inside R (counted with multiplicities).

Assume a is not a simple zero of g. $\Rightarrow g(a)=g'(a)=0 \Longleftrightarrow 3a^3 - e^a = 9a^2 - e^a = 0$ $\Longleftrightarrow 3a^3 = 9a^2 = e^a \Longleftrightarrow a=0$ or 3; but $g(0), g(3) \ne 0$ contradiction! The three zeroes of g must therefore be simple.