

20) Demostrar que:

$$\left| \frac{\operatorname{Re}(z) + i\operatorname{Im}(z)}{\sqrt{2}} \right| \leq \|z\| \leq \|\operatorname{Re}(z)\| + \|\operatorname{Im}(z)\|$$

Solución:

Sea $z = x + iy \rightarrow \|z\| = \sqrt{x^2 + y^2}$
 $\operatorname{Re}(z) = x, \operatorname{Im}(z) = y$
 Debemos probar:

$$\left| \frac{x + iy}{\sqrt{2}} \right| \leq \sqrt{x^2 + y^2} \leq |x| + |y|$$

En efecto:

S.g. $(x - y)^2 \geq 0, \forall x, y \in \mathbb{R}$
 $x^2 + y^2 \geq 2xy$
 $x^2 + y^2 + x^2 + y^2 \geq x^2 + 2xy + y^2$
 $2(x^2 + y^2) \geq (x + y)^2$
 $x^2 + y^2 \geq \left(\frac{x + y}{\sqrt{2}} \right)^2$

ie.

$$\left| \frac{x + iy}{\sqrt{2}} \right|^2 \leq x^2 + y^2$$

$$\left| \frac{x + iy}{\sqrt{2}} \right| \leq \sqrt{x^2 + y^2} \dots \langle I \rangle$$

• $\sqrt{x^2 + y^2} \leq |x| + |y|$
 En efecto:

S.g. $2|x||y| \geq 0, \forall x, y \in \mathbb{R}$
 $x^2 + y^2 + 2|x||y| \geq x^2 + y^2$
 $|x|^2 + |y|^2 + 2|x||y| \geq x^2 + y^2$
 $(|x| + |y|)^2 \geq x^2 + y^2$
 $|x| + |y| \geq \sqrt{x^2 + y^2} \dots \langle II \rangle$

de $\langle I \rangle$ y $\langle II \rangle$:

$$\left| \frac{x + iy}{\sqrt{2}} \right| \leq \sqrt{x^2 + y^2} \leq |x| + |y|$$

ie.

$$\left| \frac{\operatorname{Re}(z) + i\operatorname{Im}(z)}{\sqrt{2}} \right| \leq \|z\| \leq \|\operatorname{Re}(z)\| + \|\operatorname{Im}(z)\|$$

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