Step-1

We have to find what matrix represents multiplication by $2+3t$ from the cubics $\mathbf{P}_3$ to the fourth degree polynomials $\mathbf{P}_4$.

Step-2

We know that the standard basis of $\mathbf{P}_3$ is $1,t,t^2,t^3$ and the standard basis of $\mathbf{P}_4$ is $1,t,t^2,t^3,t^4$.

Therefore,

$$\begin{aligned} 1(2+3t) &= 2+3t \\ &= 2.1+3.t+0.t^2+0.t^3+0.t^4 \end{aligned}$$

$$\begin{aligned} t(2+3t) &= 2t+3t^2 \\ &= 0.1+2.t+3.t^2+0.t^3+0.t^4 \end{aligned}$$

Step-3

And

$$\begin{aligned} t^2(2+3t) &= 2t^2+3t^3 \\ &= 0.1+0.t+2.t^2+3.t^3+0.t^4 \end{aligned}$$

$$\begin{aligned} t^3(2+3t) &= 2t^3+3t^4 \\ &= 0.1+0.t+0.t^2+2.t^3+3.t^4 \end{aligned}$$

Therefore, the required matrix is $\begin{bmatrix} 2 & 0 & 0 & 0 \\ 3 & 2 & 0 & 0 \\ 0 & 3 & 2 & 0 \\ 0 & 0 & 3 & 2 \\ 0 & 0 & 0 & 3 \end{bmatrix}$.

Hence the matrix that represents the multiplication by $2+3t$ in $\mathbf{P}_4$ is $\boxed{\begin{bmatrix} 2 & 0 & 0 & 0 \\ 3 & 2 & 0 & 0 \\ 0 & 3 & 2 & 0 \\ 0 & 0 & 3 & 2 \\ 0 & 0 & 0 & 3 \end{bmatrix}}$