Step-1

$q_1, q_2, \ldots, q_n$ are orthogonal.

By definition $q_i^T q_i = 1$ for every $1 \le i \le n$ â€¦â€¦ (1) and

$q_i^T q_j = 0$ for every $1 \le i \ne j \le n$ â€¦â€¦ (2)

$b = c_1 q_1 + c_2 q_2 + \ldots + c_n q_n$

$\Rightarrow c_1 q_1 = b - c_2 q_2 - c_3 q_3 - \ldots - c_n q_n$
$\Rightarrow c_1 q_1^T q_1 = b q_1^T - c_2 q_1^T q_2 - c_3 q_1^T q_3 - \ldots - c_n q_1^T q_n$

$\Rightarrow c_1 \cdot 1 = q_1^T b - c_2 \cdot 0 - \ldots - c_n \cdot 0$ while from (1) and (2)

Therefore, $c_1 = q_1^T b$.

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