Gate Assignment

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GATE-EC 1997 Q.1.5

The Laplace Transform of $e^{\alpha t}cos(\alpha t)$

1) $\frac{s-\alpha}{(s-\alpha)^2+\alpha^2}$

2) $\frac{s+\alpha}{(s-\alpha)^2+\alpha^2}$

3) $\frac{1}{(s-\alpha)^2}$

4) None of these

SOLUTION

let h(t) = $e^{\alpha t}cos(\alpha t)$

$$h(t) = e^{\alpha t}cos(\alpha t) \qquad (0.0.1)$$

$$= e^{\alpha t}\left(\frac{e^{i\alpha t} + e^{-i\alpha t}}{2}\right) \qquad (0.0.2)$$

$$= \frac{e^{(i+1)\alpha t} + e^{(1-i)\alpha t}}{2} \qquad (0.0.3)$$

Taking Laplace transform for h(t)

$$\mathcal{L}\{h(t)\}(s) = \frac{1}{2}\left(\mathcal{L}\left(e^{(i+1)\alpha t}\right)(s) + \mathcal{L}\left(e^{(i+1)\alpha t}\right)(s)\right)$$
$$(0.0.4)$$

$$\text{We know that, } \mathcal{L}\{e^{at}\}(s) = \frac{1}{s-a}$$
$$(0.0.5)$$

$$= \frac{1}{2}\left(\frac{1}{s-(i+1)\alpha} + \frac{1}{s-(1-i)\alpha}\right)$$
$$(0.0.6)$$

$$= \frac{(s-\alpha)}{(s-\alpha)^2 + \alpha^2}$$
$$(0.0.7)$$

Answer is **option 2**