

Transform Calculus

(MA 20202)

Assignment-2

1. Show that

$$1 \times 1 \times \dots \times 1 \text{ (n-times)} = \frac{e^n - 1}{(n-1)!}$$

2. Using the convolution theorem, show that

$$\int_0^t \sin u \cos(t-u) du = \frac{1}{2} t \sin t.$$

3. Find the inverse Laplace transform of $F(x) =$

i) $\frac{x-1}{(x+3)(x^2+2x+2)}$

ii) $\frac{x e^{-2x}}{x^2+3x+2}$

iii) $\frac{2x+5}{(x^2+8x+10)^2}$

iv) $\ln\left(\frac{x+2}{x+1}\right)$

v) $\frac{1}{(x+3)(x-1)^2}$

vi) $\frac{x}{(x^2-a^2)^2}$

4. If the Laplace transform of $f(t)$ is $F(x)$, then prove that the inverse Laplace transform of $\frac{F(x)}{x}$ is

$$\int_0^t \left\{ \int_0^{\tau} f(r) dr \right\} dt.$$

- (ii) If the Laplace transform of $f(t)$ is $F(s)$, then show that the Laplace transform of $t^2 f''(t)$ is $s^2 F''(s) + 4s F'(s) + 2F(s)$.

5. i) Find the Laplace transform of the Bessel function $\mathcal{J}_0(t)$ of order 0, which is defined by the following infinite series

$$\mathcal{J}_0(t) = 1 - \frac{t^2}{2^2} + \frac{t^4}{2^2 \cdot 4^2} - \frac{t^6}{2^2 \cdot 4^2 \cdot 6^2} + \dots$$

Then find the Laplace transform of $\mathcal{J}_0(at)$.

- ii) Find the Laplace transform of the function $\sin \sqrt{t}$.

6. Evaluate the following integrals using the Laplace transform method:

i) $\int_0^{\infty} t e^{-2t} \cos t dt$

ii) $\int_0^{\infty} \frac{e^{-2t} - e^{-3t}}{t} dt$

----- end -----

Transform Calculus With An Introduction To Comp

United States Naval Academy



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