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# EM-III- Tutorial-1 (CMPN)

**Dr. Uday Kashid**

## Module-1- Laplace Transform

(**University Que. Paper Weightage Appx. 20 Marks)**

1. Find $L[g(t)]$ If $g(t) = \begin{cases} \sin\left(\frac{2k-3t}{3}\right) & , t > \frac{2k}{3} \\ 0 & , \quad 0 < t < \frac{2k}{3} \end{cases}$
2. Find Laplace Transform of $t\sqrt{1+\sin t}$ **(Dec-10,12,15,May -09,13,15,16,19)**
3. Find Laplace Transform of $\dfrac{e^{-at} - \cos(at)}{t}$ **(Dec-08,13,16,May -13,18)**
4. Find Laplace Transform of $e^{-t}\int_0^t \frac{\sin u}{u} du$ **(Dec-14,May -15)**
5. IF $\int_0^\infty e^{-2t}\sin(t+\alpha)\cos(t-\alpha)dt = \frac{3}{8}$ then find α **(Dec 09,14, May -12,16)**
6. Evaluate the integral $I = \int_{t=0}^{t=\infty} \frac{\sin(\sqrt{3}t)}{te^t}dt$ using Laplace Transform **(Dec-12)**
7. Find Laplace Transform of $f(t) = e^{-4t}\int_{u=0}^{u=t} u\sin(3u)du$ **(Dec-16, May -12,15)**
8. Prove that $L[erf(\sqrt{t})] = \frac{1}{s\sqrt{s+1}}$ , hence find $L[erf_c(\sqrt{t})]$
9. Find $L[f(t)]$ if $f(t) = |t-1| + |t+1|$ for $t \geq 0$ **(NIT Kurukshetra 03, IITD 10)**
10. Find $L[f(t)]$ if $f(t) = \int_t^\infty \frac{cosu}{u} du$
11. Answer the following MCQs with proper Justification.

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|---|---|
| 11.1 | The Sufficient conditions for Existence of Laplace transform of $f(t)$ are |
| Option A | If $f(t)$ , $t \geq 0$ be Piecewise discontinuous on $[0,\infty)$ and of Exponential order $a$ , then $L[f(t)] = f(s)$ exists for $s > a \geq 0$ |
| Option B | If $f(t)$ , $t \geq 0$ be Piecewise continuous on $[0,\infty)$ and of Exponential order $a$ , then $L[f(t)] = f(s)$ exists for $s > a \geq 0$ |
| Option C | If $f(t)$ , $t \geq 0$ be Piecewise continuous on $[0,\infty)$ and of non-Exponential order $a$ , then $L[f(t)] = f(s)$ exists for $s > a \geq 0$ |

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|---|---|
| Option D | If $f(t)$ , $t \geq 0$ be Piecewise discontinuous on $[0, \infty)$ and of non-Exponential order $a$ , then $L[f(t)] = f(s)$ exists for $s > a \geq 0$ |
| 11.2 | If $f(t)$ is an exponential order of $'a'$, means that |
| Option A | $\lvert f(t) \rvert \leq ae^{kt}$ , $\forall\ t \geq 0$ , where a, k $> 0$ and constants |
| Option B | $\lvert f(t) \rvert \geq ke^{at}$ , $\forall\ t \geq 0$ , where a, k $> 0$ and constants |
| Option C | $\lvert f(t) \rvert \geq ae^{kt}$ , $\forall\ t \geq 0$ , where a, k $> 0$ and constants |
| Option D | $\lvert f(t) \rvert \leq ke^{at}$ , $\forall\ t \geq 0$ , where a, k $> 0$ and constants |
| 11.3 | If $L\,[f(t)] = f(s)$ Then, Laplace transform of $\frac{d^3}{dt^3} f(t) =$ |
| Option A | $s^3\, f(s) - s^2\, f(0) - s\, f'(0) - f'(0)$ |
| Option B | $s^3\, f(s) - s^2\, f(0) - s\, f'(0) - f''(0)$ |
| Option C | $s^3\, f(s) - s^2\, f(0) - s\, f\ (0) - f''(0)$ |
| Option D | $s^3\, f(s) - s^2\, f(0) - sf\ (0) - f'(0)$ |
| 11.4 | Which of the following function $f(t)$ satisfies the sufficient conditions for Existence of Laplace transform. |
| Option A | $f(t) = e^{t^2}$ |
| Option B | $f(t) = \frac{e^{-at}}{t}$ |
| Option C | $f(t) = \frac{sin(t)}{t}$ |
| Option D | $f(t) = \frac{cos(t)}{t}$ |
| 11.5 | $If\ \ L\{f(t)\} = \frac{1}{s+1}\ , then\ value\ of\ f(0)\ \&\ f(\infty)\ \ will\ be$ |
| Option A | $1\ , 0\ respectively$ |
| Option B | $-1\ , 0\ respectively$ |
| Option C | $1\ , -1\ respectively$ |
| Option D | $2\ , 0\ respectively$ |