Drexel University
Office of the Dean of the College of Engineering
ENGR 232 – Dynamic Engineering Systems

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first *last*

Lab 7 Answer Template: Laplace Workshop: Summer 2022

Part A: Definition of the Laplace Transform.

Grading: TA will randomly pick one part from each of questions 1 – 5 and award 1 point if correct.

Question 1:

a. $f(t) = t$

$L\{t\} = \frac{1}{s^2}$

b. $f(t) = t^2$

$L\{t^2\} = \frac{2}{s^3}$

c. $f(t) = 3e^{5t}$

$L\{3e^{5t}\} = \frac{3}{s-5}$

Record answers in the boxes above.

Question 2: Find each of the following Laplace transforms.

2a. $f(t) = t^n$

$L\{t^n\} = \frac{n!}{s^{n+1}}$

2b. $f(t) = \sin(at)$

$L\{\sin(at)\} = \frac{a}{s^2 + a^2}$

2c. $f(t) = e^{at}$

$L\{e^{at}\} = \frac{1}{s-a}$

Record answers in the boxes above. Also, include any assumptions you needed to present the answer in the "clean" form seen in the Tables.

Question 3: Find these transforms using `laplace()`.

3a. $f(t) = 3\cosh 5t$

$L\{3\cosh 5t\} = \frac{3s}{s^2-25}$

3b. $f(t) = (t-3)^2 \cdot u(t-3)$

$L\{(t-3)^2 \cdot u(t-3)\} = \frac{2e^{-3s}}{s^3}$

3c. $f(t) = \sqrt{t}$

$L\{\sqrt{t}\} = \frac{\sqrt{\pi}}{2s^{\frac{3}{2}}}$

Record answers in the boxes above.

Question 4: Find the **inverse** Laplace transform for each of the following functions defined in the *s*-domain.

4a. $F(s) = 1$

$f(t) = \delta(t)$

4b. $F(s) = \frac{5s+8}{s^2+16}$

$f(t) = 5\cos(4t) + 2\sin(4t)$

4c. $F(s) = \frac{1}{s^{3/2}}$

$f(t) = \frac{2\sqrt{t}}{\sqrt{\pi}}$

Record answers in the boxes above.

Part B: Partial fraction expansions.

Question 5: Find the partial fraction expansion for each of the following functions in the *s*-domain. Use `partfrac()`.

5a. $F(s) = \frac{16}{s^2-8s}$ **5b.** $F(s) = \frac{9s^2-52s+72}{(s-2)(s-3)(s-4)}$ **5c.** $F(s) = \frac{3s^2-14s+20}{(s-3)^3}$

5a.	5b.	5c.
$\frac{2}{s-8} - \frac{2}{s}$	$\frac{2}{s-2} + \frac{3}{s-3} + \frac{4}{s-4}$	$\frac{3}{s-3} + \frac{4}{(s-3)^2} + \frac{5}{(s-3)^3}$

Grading: TA will randomly pick one part from each of questions 1 – 5 above and award 1 point if correct.

Part C: Solving a Differential Equation using the Laplace Transform.

Question 6: **DE**: $y'' + y = 6\sin 2t$ and initial conditions: **IC**: $y(0) = 0, \quad y'(0) = 6$

Question 6: Record the exact solution for $y(t)$ found using dsolve:

$y(t) = 10\sin(t) - 2\sin(2t)$

Question 7: Record **both** the solution $Y(s)$ in partial fraction form and the solution $y(t)$ in the time-domain that were just found using the Laplace technique here. Did you get the same answer for $y(t)$?

Question 7:

$Y(s) = \frac{10}{s^2+1} - \frac{4}{s^2+4}$ (must be in partial fraction form)

$y(t) = 10\sin(t) - 2\sin(2t)$ Yes, same answer!

Part D: Solve a new DE using the Laplace transform technique. **(3 points)**

The last three points will be earned by using code similar to that given above to solve the new differential equation:

DE: $y'' + y' + \frac{5}{4}y = 13 \cdot e^{-2t}$ **IC**: $y(0) = 4, \; y'(0) = 2$

Points 8-10: Solve this new DE using the Laplace technique and past these three answers below.

Questions 8-10:

8: $Y(s) = \frac{16s^2+56s+100}{4s^3+12s^2+13s+10}$ Must be a quadratic over a cubic for points.

9: $Y(s)$ as a partial fraction $= \frac{4}{s+2} + \frac{10}{\left(s+\frac{1}{2}\right)^2+1}$

10: $y(t) = 4e^{-2t} + 10e^{-\frac{t}{2}} * \sin(t)$

Ready to Submit?

Be sure all ten questions are answered. When your lab is complete, be sure to submit three files:

1. Your **completed Answer Template** as a PDF file
2. A copy of your **MATLAB Live Script**
3. A **PDF** copy of your **MATLAB Live Script** (Save-Export to PDF…)

The due date is the day after your lab section by **11:59pm** to receive full credit. You have one more day, to submit the lab (but with a small penalty), and then the window closes for good and your grade will be zero.