Part I. (18 pts) Do three (3) of the following four problems:

1. Find the Laplace transform of \( f(t) = \begin{cases} t+1 & 0 \leq t < 3 \\ -2 & 3 \leq t < \infty \end{cases} \)

2. Find the Laplace transform of \( f(t) = (e^{-3t} - 5t^2)^2 \)

3. Find the Laplace transform of \( f(t) = te^{-5t} \cos 5t \)

4. Find the Laplace transform of \( f(t) = (t^2 - 5t)u(t-3) \)

Part II. (18 pts) Do three (3) of the following four problems:

5. Find the following inverse Laplace transform \( \mathcal{L}^{-1}\left\{ \frac{5}{s^2} - \frac{1}{s^3} \right\} \)

6. Find the following inverse Laplace transform \( \mathcal{L}^{-1}\left\{ \frac{5s - 9}{s^2 + 2} \right\} \)

7. Find the following inverse Laplace transform \( \mathcal{L}^{-1}\left\{ \frac{3s + 13}{s^2 + 8s + 52} \right\} \)

8. Find the following inverse Laplace transform \( \mathcal{L}^{-1}\left\{ \frac{e^{-5s}}{s^2(s + 2)} \right\} \)
Part III. (65 pts) Do five (5) of the following six problems:

9. Use the method of Laplace transforms to solve the following linear differential equation
   \[ y' + 3y = 5t \]
   \[ y(0) = -2 \]

10. Use the method of Laplace transforms to solve the following linear differential equation
    \[ y'' - 3y' - 10y = 0 \]
    \[ y(0) = 2, \ y'(0) = -1 \]

11. Use the method of Laplace transforms to solve the following linear differential equation
    \[ y'' - 10y' + 25y = t \]
    \[ y(0) = 0, \ y'(0) = -3 \]

12. Use the method of Laplace transforms to solve the following linear differential equation
    \[ y'' - 6y' + 8y = u(t - 2) \]
    \[ y(0) = 0, \ y'(0) = -1 \]

13. Use the method of Laplace transforms to solve the following linear differential equation
    \[ y'' + 16y = \cos 3t \]
    \[ y(0) = 0, \ y'(0) = -5 \]

14. Use the method of Laplace transforms to solve the following linear differential equation
    \[ y'' - 2y' + y = \delta(t - \pi) \]
    \[ y(0) = 1, \ y'(0) = -1 \]