 Prob 1 (3 points)
For \( u(x, t) \) defined on the infinite domain, \(-\infty < x < \infty\), and \( t \geq 0 \), use the Fourier transform method to solve the PDE

\[
\frac{\partial u}{\partial t} = \frac{\partial^3 u}{\partial x^3},
\]

with the boundary conditions

(I) \( u(x, t) \) and all of its partial derivatives in \( x \) vanish as \( x \to \pm \infty \)
(II) \( u(x, 0) = \exp(-x^2) \).

Plot the solution, \( u(x, t) \), as a function of \( t \) at \( t = 0, 0.1, \) and \( 0.3 \). Collect all three curves in one plot. It is recommended that the plot be made to cover the interval of \(-10 \leq x \leq 10\). For this problem, it is acceptable that your solution be expressed as an integral. The values of \( u(x, t) \) that are needed to make the plot can be obtained by numerical integration.

 Prob 2 (2 points)
For \( u(x, t) \) defined on the infinite domain, \(-\infty < x < \infty\), and \( t \geq 0 \), use the Fourier transform method to solve the PDE

\[
\frac{\partial u}{\partial t} = \frac{\partial u}{\partial x} - 2u,
\]

with the boundary conditions

(I) \( u(x, t) \) and all of its partial derivatives in \( x \) vanish as \( x \to \pm \infty \)
(II) \( u(x, 0) = \exp(-x^2) \).

For this problem, the goal is to obtain a closed-form analytic solution. All integrals that appear in the intermediate steps should be evaluated analytically.

**Hint:** For both problems, you may find the following formula useful:

\[
\int_0^\infty e^{-x^2} \cos(2bx) \, dx = \frac{\sqrt{\pi}}{2} e^{-b^2}.
\]

More precisely, it is useful for carrying out the Fourier transform in Prob 1, and both the F.T. and inverse F. T. in Prob 2.