**Important Note**

Show all work.  
Use of programmable calculator is not allowed.  
Mobiles and paging devices should not be carried during examination.

Instructor: F. D. Zaman
Q 1) Find the Laplace transform of following functions (2+3)
(a) \( f(t) = te^{-2t} \sin 3t \)

(b) \( f(t) = \begin{cases} t^2 - 1, & 0 < t < 1 \\ 2t^2, & 1 \leq t < 2 \\ 0, & t \geq 2 \end{cases} \)
Q2) Find Inverse Laplace transform

(a) \( F(s) = \frac{e^{-2s}}{s^2(s^2 + 1)} \)

(b) \( F(s) = \frac{1}{s(s^2 + 4s + 13)} \)
Q3) Solve the initial value problem using the Laplace transform

\[ y'' + 4y' + 4y = e^{-3t} + 2\delta(t - \pi), \]

\[ y(0) = 0, \quad y'(0) = 2. \]
Q 4) Find the **Fourier sine series** and **Fourier cosine series** of the following function 

\[
f(x) = \begin{cases} 
0, & 0 \leq t < 1 \\
x, & 1 \leq t < 2 \\
0, & 2 \leq t < 3 
\end{cases}
\]