KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
Department of Mathematics & Statistics

Math 301                   Methods of Applied Mathematics

Major Exam # 2                                                       Term 071

Time Allowed 90 minutes

Name __________________        ID #  _______  Section # _____

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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
**Q1(a)** Find the Laplace transform \( f(t) = e^{-2t} (1 - t^2 + \sin(\frac{t}{4})) \)

**Q1(b)** Find the inverse Laplace transform

(i) \( F(s) = \frac{2s + 5}{s^2 + 6s + 34} \)

(ii) \( F(s) = \frac{(1 + e^{-s})^2}{s + 1} \)
Q2) Solve the initial value problem using the Laplace transform

\[ y'' + 4y = f(t), \quad y(0) = 1, \quad y'(0) = 0 \]

\[ f(t) = \begin{cases} 0, & 0 \leq t < \pi \\ \sin t, & \pi \leq t \end{cases} \]
Q 3) Find the Fourier series in \((-2,2)\)

\[ f(x) = \begin{cases} 
0, & -2 < x < -1 \\
-1, & -1 \leq x < 0 \\
1, & 0 \leq x < 1 \\
0, & 1 \leq x < 2.
\end{cases} \]
Q4) Find the **Fourier cosine and Fourier sine series**

\[ f(x) = \begin{cases} 
2, & 0 < x < \pi/2 \\
-2, & \pi/2 \leq x < \pi 
\end{cases} \]
Q 5) Write the given Sturm Liouville problem in the self adjoint form and state the orthogonality relation. Then find the eigenvalues and eigenfunctions of the problem

\[ x^2 y^{\prime\prime} + xy' + \lambda y = 0, \quad y(1) = 0, \; y(3) = 0. \]