King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics
Math301 Major Exam II (Term 163)
Duration 120 minutes

Name:.....ID:.....Serial:... Section:..

- Mobiles and calculators are not allowed
- Write all the steps clearly

Exercise #	Mark	Max Marks
1		10
2		15
3		15
4		15
5		12
6		15
7		18
Total		100

Exercise #1 (10 pts) Find the Laplace transform of

$$f(t) = e^{-t}\sin^2(3t)$$

Exercise #2 (15 pts) Find the inverse Laplace transform of

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

Exercise #3 (15 pts) Use the Laplace transform to solve the initial value problem

$$y'' + y' - 6y = 3e^{-t} \ , \ y(0) = 0 \ , \ y'(0) = 0$$

Exercise #4 (15 pts) Use the Laplace transform to solve for f , the integral equation

$$f(t) = t - \int_0^t f(t-\tau)\sin(\tau)d\tau$$

Exercise #5 (12 pts) Use the Laplace transform to solve the initial value problem

$$y'' + 2y' + 5y = \delta(t-2) \ , \ y(0) = 2 \ , \ y'(0) = 0$$

Exercise #6 (15 pts) Are there values of the parameters a and b which make the functions

$$f_1(x) = x + a \ , \ f_2(x) = x^2 + bx$$

orthonormal on the interval $[-1, 1]$, if yes, find them.

Exercise #7 (18 pts)

a) Find the Fourier series expansion of

$$f(x) = \begin{cases} 0, & -\pi < x < 0 \\ x^2, & 0 \leq x < \pi \end{cases}$$

b) Use the result from (a) to show that

$$\frac{\pi^2}{12} = \sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{k^2}$$