King Fahd University of Petroleum & Minerals
Department of Mathematics & Statistics
Math 301 Major Exam 2
The First Semester of 2012-2013 (121)
Time Allowed: 120 Minutes

Name: _____ ID#: _____

Instructor: _____ Sec #: _____ Serial #: _____

- Mobiles and calculators are not allowed in this exam.
- Write all steps clear.

Question #	Marks	Maximum Marks
1		12
2		16
3		16
4		12
5		14
6		16
7		14
Total		100

Q:1 (12 points) Let $\overrightarrow{F} = x^3\hat{i} + y^3\hat{j} + z^3\hat{k}$ be a vector field and S the surface of the region bounded by the hemisphere $z = \sqrt{4 - x^2 - y^2}$ and the plane $z = 0$. Use divergence theorem to evaluate $\int\int_S (\overrightarrow{F} \cdot \hat{n}) dS$.

Q:2 (4+6+6 points) Find the following:

(a) $\mathcal{L}\{e^{-t}\cosh t\}$,

(b) $\mathcal{L}^{-1}\left\{\dfrac{s-1}{s^2+2s}\right\}$,

(c) $\mathcal{L}^{-1}\left\{\dfrac{s+1}{(s-1)(s^2+1)}\right\}$.

Q:3 (4+5+7 points) Find the following:

(a) $\mathcal{L}\{te^{-t}\cos t\}$,

(b) $\mathcal{L}\{f(t)\}$, where $f(t) = \begin{cases} t, & 0 \le t < 1 \\ 2, & t \ge 1 \end{cases}$.

(c) $\mathcal{L}^{-1}\left\{\dfrac{s^2}{(s^2+1)^2}\right\}$.

Q:4 (12 points) Solve the initial value problem using Laplace transform $y'' - y' - 2y = \delta(t - \pi)$ with $y(0) = 1$, $y'(0) = 1$.

Q:5 (14 points) Show that the set of functions $\left\{\frac{\sqrt{2}}{2}, \cos\frac{n\pi}{2}x\right\}$, $n = 1, 2, 3, \cdots$ is orthogonal on $[0, 2]$. Also find norm of each function.

Q:6 (16 points) Find the Fourier series of the function $f(x) = \begin{cases} 1-x & -1 < x < 0 \\ 1 & 0 \leq x < 1 \end{cases}$.

Q:7 (8+6 points) **(a)** Find the half-range Fourier cosine expansion of $f(x) = \sin 2x, \;\; 0 \leq x < \frac{\pi}{4}$.

(b) Show that $\sum_{n=1}^{\infty} \frac{1}{4n^2 - 1} = \frac{1}{2}$.