EMEC/EMTR-2434 Assignment #1

Due: 8:00PM, ~~Tuesday, Jan. 21~~ Thursday, Jan. 23

Q1: Compute the Laplace transform (LT) using the LT properties and transform pairs.

(a) $x(t) = 1 + 3t + e^{2t}$

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

(c) $f(t) = \dfrac{d^2x(t)}{d^2t} + 2\dfrac{dx(t)}{dt}$

(d) $v(t) = 2\int x(t)dt$

Q2. How many measurements in a data set subject to random errors lie outside deviation $\pm 2\sigma$ and $\pm 3\sigma$, respectively.

Q3. (Q2-28)

The time response of a liquid-in-glass thermometer was tested by plunging it into a container of boiling water and recording the temperature at intervals of 10 s over a period of 2 min. The thermometer was initially at a temperature of 0 °C and the following readings were recorded.

Time (s)	0	10	20	30	40	50	60	70	80	90	100	110	120
Temperature (°C)	0	31	52	67	77	84	89	92	95	96	97	98	99

Draw a graph of the output readings against time. Using this graph, estimate the time constant of the thermometer.

Q4. (Q4-15)

A set of 25 measurements have the following values:
9.4 10.1 9.1 12.3 10.3 10.0 10.5 9.0 10.8 10.0 11.1 9.8 7.6 9.2 10.7 8.4 11.0 9.7 11.3 8.7 9.9 11.5 10.0 9.5 11.9

The mean value and standard deviation of these measurements $x_{mean} = 10.072$ and standard deviation $(\sigma) = 1.1108$.

By applying error function tables to the mean and standard deviation values given, estimate

(a) How many measurements are <11.05?

(b) How many measurements are >9.55?

(c) How many measurements are between 9.95 and 10.95?

Check your answers against the real data.

Q5. (Q4-19)

In a survey of 12 owners of a certain model of car, the following values for average fuel consumption were reported.

25.5 31.1 29.6 32.4 39.4 28.9 33.3 31.4 29.5 30.5 31.7 29.2

Calculate the mean value, the standard deviation, and the standard error of the mean with the reported consumption values. Express the mean consumption value and the possible error in the mean expressed to 95.4% confidence level.

Q6. (Q4.22)

The temperature-controlled environment in a hospital intensive care unit is monitored by an intelligent instrument which measures temperature every minute and calculates the mean and standard deviation of the measurements. If the mean is 75 °C and the standard deviation is 2.15,

(a) what percentage of the time is the temperature less than 70 °C?

(b) what percentage of the time is the temperature between 73 °C and 77 °C?