ME318L Midterm – S08

Part 1. Select the right answer (5 points total). More than one answer may apply.

1.1. Given that a data sample of 50 measurements has a mean of 42, a standard deviation of 2, and no other data is provided, the proper way to refer to this sample using the convention agreed upon in our course is...
   a) 42 ± 2
   b) 42 ± 3.92
   c) 42 ± 0.55

1.2. An intrusive probe is characterized by...
   a)   the probe physically intruding into the medium
   b)   the probe loading error requiring to be accounted for
   c)   the probe loading error being negligible

1.3. An operational amplifier has a gain of 125. This corresponds to a decibel gain of...
   a)   21
   b)   42
   c)   100

1.4. Filtering your signal can help...
   a)   suppress noise
   b)   condition the signal to avoid aliasing
   c)   all of the above
   d)   none of the above

1.5. When constructing a discrete Fourier series of a function $f(x)=x^2$ in the form
$f(x) = a_0 + a_1 \cos(\omega_0 x) + a_2 \cos(2\omega_0 x) + ... + b_1 \sin(\omega_0 x) + b_2 \sin(2\omega_0 x) + ...$,
   you can safely assume that
   a)   coefficients $a_i = 0$, $i=1,2,...$
   b)   coefficients $b_i = 0$, $i=1,2,...$
   c)   coefficient $a_0 = 0$

Part 2. Solve the problems (5 points each).

2.1. You are required to construct a circuit that will amplify the input AC signal by a factor of 200 and filter out frequencies higher than 5 kHz. Provide the schematic of the circuit (assume it will be based on a 741 op-amp chip), define the values of the elements (resistors, capacitors), the bandwidth, and the impedance.

2.2. Airlines commonly overbook their flights. Consider a flight with 175 seats available for which 180 tickets are sold. Find the probability that one or more passengers will be stranded in the airport due to overbooking, assuming that the probability of any individual ticketed passenger showing up for the flight is 95%.

Part 3. Solve the problem (5 points of extra credit, will only be credited if parts one and two are solved correctly).

3.1.A rubber backing material is put between a concrete compression sample and the platen of a testing machine. Below are the results of six tests with and without the backing. Does the backing material have any statistical effect at 99% confidence level?

Sample no.	Tensile strength with backing, MN/m²	Tensile strength without backing, MN/m²
1	2.48	2.18
2	2.76	2.48
3	2.96	2.38
4	2.72	2.00
5	2.62	2.10
6	2.65	2.28