ESE 406/505 & MEAM 513 – 2012-Apr-23 – Quiz – Name:_____

- Choose the one best answer for each question by circling the letter.
- A correct answer is worth 2 points.
- No answer is worth 0 points.
- An incorrect answer is worth -1 point. Random guessing will lower your score, on average.

1. The Nyquist frequency of a discrete-time process is...
   A. ...the maximum frequency at which a given digital computer can execute the necessary commands.
   B. ...the maximum frequency present in the process and is equal to half the sampling frequency.
   C. ...the frequency at which the amplitude of a sampled analog signal has been reduced by 3dB.
   D. ...the frequency at which the gain of a digital compensator is 0dB (unity gain).

2. Which of the following is LEAST CORRECT concerning our study of discrete-time dynamic systems?
   A. The discrete-time equivalent of a linear differential equation is a linear difference equation.
   B. The discrete-time equivalent of the Laplace Transform is the Z-transform.
   C. When a continuous-time signal is converted to discrete-time by sampling, the Laplace-transform pole is exactly mapped to a Z-transform pole according to $z=\cos(\pi Ts)$.
   D. The stability boundary for poles of discrete-time systems is the unit circle.

3. Which of the following is LEAST CORRECT concerning "Tustin's Method"?
   A. It is a useful way to convert a continuous-time transfer function into a discrete-time transfer function.
   B. It preserves the exact discrete-time stability boundary.
   C. It exactly matches continuous-time frequencies.
   D. It can be derived by considering trapezoidal integration as an approximation to "1/s".

4. Which of the following is LEAST CORRECT concerning "controllability" of the system $\dot{\underline{x}} = A\underline{x} + B\underline{u}$?
   A. If the system is controllable, control can be used to achieve any desired final state vector in finite time. That is, control can be used to make $\underline{x}(t_f) = \underline{x}_f$ for any $t_f > 0$ and any $\underline{x}_f$.
   B. If the system is controllable, proportional state feedback, $\underline{u} = -K\underline{x}$, can be used to place the closed-loop eigenvalues.
   C. The system is controllable if the matrix exponential, e^{tA}, has n eigenvalues.
   D. The system is controllable if the matrix $\begin{bmatrix} B & AB & \cdots & A^{n-1}B \end{bmatrix}$ has rank n (has n linearly independent columns).

5. Which of the following is LEAST CORRECT concerning the linear estimator / observer $\dot{\hat{\underline{x}}} = A\hat{\underline{x}} + B\underline{u} + L\left(y - C\hat{\underline{x}}\right)$?
   A. If (A, C) is observable, the gain matrix L can be used to place the closed-loop eigenvalues of the estimator.
   B. The output of the estimator can be used in a proportional state-feedback design to achieve the same closed-loop eigenvalues as would be obtained with feedback of the state itself (Separation Principle).
   C. It has the advantage of being a "static observer" and so requires no Z transforms for digital implementation.
   D. It requires knowledge of the plant control input, $\underline{u}$.