

1. Which of the following functions are periodic?
  - a.  $x(t) = 3 \sin(t) + 2 \sin(2t) + \sin(3t)$
  - b.  $x(t) = 3 \sin(t) + 2 \sin(2t) + \sin(\pi t)$
  - c.  $x(t) = 3 \sin(4t) + 2 \sin(5t) + \sin(6t)$
  - d.  $x(t) = \exp(-t) \sin(t)$
  
2. A stationary process must
  - a. Be discrete
  - b. Be continuous
  - c. Be ergodic
  - d. Have ensemble averaged properties independent of time
  - e. Have time averaged properties that are equal to ensemble averaged properties
  
3. A single sample function can be used to find all statistical properties of a random process if the process is
  - a. Deterministic
  - b. Ergodic
  - c. Stationary
  - d. All of the above
  
4. The auto-correlation function of a stationary random process
  - a. Must decrease as  $|t|$  increases
  - b. Is a function of time difference only
  - c. Must approach a constant as  $|t|$  increases
  - d. Must always be non-negative
  
5. How does the answer to problem 4. change if the stationary random process does not contain any periodic components?
  
6. What is the Fourier series expansion of the periodic function whose definition for one period is  $x(t) = 0$  for  $-\pi < t < 0$  and  $x(t) = \sin(t)$  for  $0 < t < \pi$ ?
  
7. Use the results of 6. to show that  $\pi/2 = 1 + 2(1/3 - 1/15 + 1/35 - 1/63 + \dots)$
  
8. Find the Fourier transform  $X(f)$  of the function  $x(t) = b \exp(-\alpha t)$  for  $t > 0$  and  $x(t) = 0$  for  $t < 0$  ( $\alpha > 0$ ).
  
9. Take the inverse Fourier transform of your answer in 8. to show that  $X(f)$  and  $x(t)$  are indeed Fourier transform pairs.

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Questions 1-5 are taken from Bendat and Piersol (1986), easiest to answer those by marking up this sheet, questions 6-9 may require a separate sheet of paper.