Reg. No. : | | | | | | | | | | | |

**R 3290**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2007.

Fourth Semester

(Regulation 2004)

Electronics and Communication Engineering

EC 1252 — SIGNALS AND SYSTEMS

(Common to B.E. (Part-Time) Third Semester Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Find average power of the signal $u(n) - u(n-N)$.

2. If the discrete time signal $x[n] = x(n) = \{0, 0, 0, 3, 2, 1, -1, -7, 6\}$, then find $y[n] = x[2n-3]$.

3. Find the inverse Fourier transform of $X(\omega) = 2\pi\delta(\omega)$.

4. Determine whether the system described by the following input-output relationship is linear and causal $y(t) = x(-t)$.

5. State Sampling theorem.

6. Write any two properties of the region of convergence of the $Z$ transform.

7. State and prove time shift property of DTFT.

8. Prove that for the causal LSI system the impulse response $h[n] = 0$, for $n < 0$.

9. Realize the following system using direct form II method.

   $$y[n] - \frac{1}{2}y[n-1] = x[n] + \frac{1}{2}x[n-1].$$

10. The unit sample response of an FIR filter is $h[n] = \alpha^n \{u[n] - u[n-2]\}$, draw direct form realization of this system.

PART B — (5 × 16 = 80 marks)

11. (a) A trapezoidal pulse $x(t)$ is defined by

$$x(t) = \begin{cases} 5 - t, 4 \leq t \leq 5 \\ 1, -4 \leq t \leq 4 \\ t + 5, -5 \leq t \leq -4. \end{cases}$$

(i) Determine total energy of $x(t)$. (4)

(ii) Sketch $x(2t - 3)$. (6)

(iii) If $y(t) = \dfrac{dx(t)}{dt}$, determine the total energy of $y(t)$. (6)

Or

(b) (i) State and prove any three properties of continuous time Fourier series. (9)

(ii) Obtain the Fourier series expansion of a half wave sine wave. (7)

12. (a) (i) State and prove any two properties of continuous time Fourier transform. (6)

(ii) Using the properties of continuous time Fourier transform, determine the time domain signal $x(t)$, if the frequency domain signal $X(j\omega) = j\dfrac{d}{d\omega}\left\{\dfrac{e^{j2\omega}}{1 + i\omega/3}\right\}$. (10)

Or

(b) (i) State and prove convolution in time and convolution in frequency properties of Laplace transform. (8)

(ii) A system has the transfer function $H(s) = \dfrac{3s - 1}{(s + 3)(s - 2)}$. Find the impulse response assuming the system is stable, and the system is causal. (8)

13. (a) Prove sampling theorem with necessary relations explain how original signal can be recovered from its sampled version. (16)

Or

(b) (i) Briefly explain the relationship between $Z$ transform and Fourier transform. (6)

(ii) Determine the inverse $Z$ transform of $X(Z) = \log(1 - 2Z)$, $|Z| < \frac{1}{2}$ by using the power series $\log(1 - x) = -\sum_{i=1}^{\infty} \frac{x^i}{i}$, $|x| < 1$ and by first differentiating $X(Z)$ and then using this to recover $x[n]$. (10)

14. (a) The input to a causal linear time invariant system is $x[n] = u[-n-1] + \left(\frac{1}{2}\right)^n u[n]$, the $Z$ transform of the output of the system is $Y(Z) = \frac{-\frac{1}{2}Z^{-1}}{\left(1 - \frac{1}{2}Z^{-1}\right)\left(1 + Z^{-1}\right)}$. Determine $H(Z)$, the $Z$ transform of the impulse response and also determine the output $y[n]$. (16)

Or

(b) (i) Consider the following linear constant coefficient difference equation.

$y[n] - \frac{3}{4}y[n-1] + \frac{1}{8}y[n-2] = 2x[n-1]$. Determine $y[n]$ when $x[n] = \delta[n]$ and $y[n] = 0$, $n < 0$. (10)

(ii) Prove that order of convolution is unimportant, that is $x_1[n] * x_2[n] = x_2[n] * x_1[n]$. (6)

15. (a) Consider the causal linear shift invariant filter with system function $H(Z) = \frac{1 + 0.875Z^{-1}}{\left(1 + 0.2Z^{-1} + 0.9Z^{-2}\right)\left(1 - 0.7Z^{-1}\right)}$. Draw the following realization structures of the system.

(i) Direct form II. (6)

(ii) A parallel form connection of first and second order systems realized in direct form II. (10)

Or

(b) (i) The system function of a discrete time system is

$$H(Z) = \frac{\left(1 + Z^{-1}\right)^4}{\left(1 - Z^{-1} + \frac{7}{8}Z^{-2}\right)\left(1 + 2Z^{-1} + \frac{3}{4}Z^{-2}\right)}$$. Realize this system using a cascade of second order systems in direct form II. (10)

(ii) Find a transposed direct form II realization for the system described by the difference equation $y[n] = \frac{3}{4}y[n-1] - \frac{3}{4}y[n-2] + x[n] - \frac{1}{3}x[n-1]$. (6)