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ABP/CCM-26/XIV

2015

ELECTRONICS

SECOND PAPER

Full Marks : 200

Time : 3 Hours

The figures in the margin indicate full marks for the questions

(Answer any ten Questions)

1. (a) Define "power signal" and "energy signal". Sketch the following signals involving unit step function and determine whether the signals are power or energy signals
- (i) $v(t) = A[u(t+z) - u(t-z)] \forall T > 0$ 10
- (ii) $v(t) = t u(t)$ 10
- (b) Define Dirac Delta function $\delta(t)$ and unit step function $u(t)$. 4

Contd.

(c) Identify the periodic signals and calculate their fundamental periods for the following signals

(i) $x_1(t) = 2\cos 2\pi t + 3\sin 6\pi t$

(ii) $x_2(t) = e^{-st} u(t)$ 6

2. (a) Show that $\frac{d^2y(t)}{dt^2} + y(t) \frac{dy(t)}{dt} + y(t) = x(t)$ is non-linear. 7

(b) Using Paley-Wiener criterion, show that $|H(j\omega)| = e^{-\omega^2}$ is not a suitable amplitude response for a Causal LTI system. 7

(c) Find the magnitude and phase responses for the system characterize by the difference equation $y(n) = \frac{1}{6}x(n) + \frac{1}{3}x(n-1) + \frac{1}{6}x(n-2)$. 6

3. (a) Prove the following Fourier Transform theorem

$$x(t) \xleftrightarrow{F.T} X(\omega)$$

$$\text{then } x(t)\cos \omega_0 t \xleftrightarrow{F.T} \frac{1}{2}X(\omega - \omega_0) + \frac{1}{2}X(\omega + \omega_0)$$

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(b) Define unit step function $u(t)$ and signum function $sgn(t)$. What is the relationship between them? Also find the Fourier Transform of $u(t)$ and $sgn(t)$.

14

4. (a) Draw the components of an image processing system and briefly mention functions of each component. Why is digital image processing finding wide applications? 6+4=10
- (b) Write in detail about image sampling and image quantization. 5+5=10
5. (a) What do you mean by Huffman coding? Discuss about Huffman Template algorithm. 2+8=10
- (b) Discuss elaborately the Lempel-Ziv source coding algorithm. 10
6. (a) Define Block code. Discuss about the Block code parameters. 2+8=10
- (b) Discuss in details about two techniques for constructing prefix code. 10
7. (a) What is region based image segmentation? Describe any one region based segmentation method. 3+7=10

(b) How an image compression-achieved in JPEG image compression standard? Explain in detail. 10

8. Evaluate the 8-point DFT of the following sequence $x(n)$ using decimation-in-time FFT algorithm.

$$x(n) = \{1, -1, -1, -1, 1, 1, 1, -1\} \quad 20$$

9. (a) Obtain the field expressions for TM modes in a rectangular waveguide. 12

(b) What is cavity resonator? How do the dimensions of a rectangular cavity resonator determine the frequencies of oscillation of the resonator? 2+6=8

10 (a) Define radiation resistance of an antenna. Show that for a half wave dipole in freespace radiation resistance is 73Ω . 2+13=15

(b) Give the directional pattern for power density for a half-wave dipole. What information do you get from this pattern? 2+3=5

11. (a) What would be the impact if the two mobile subscribers were operating in two adjacent channels? Assume out of band radiation that is 40dB below the main lobe. 12

- (b) A cellular system operator is allocated a total spectrum of 5MHz for deployment of an analog cellular system based on the FDMA technique, with each simplex channel occupying 25kHz bandwidth. Compute the number of simultaneous calls possible in the system. 8
12. (a) Explain *three* laws of Kepler that govern the motion of a planet and other heavenly bodies. 3+3+3=9
- (b) What is the need of altitude control for a satellite? Discuss about *any one* method to stabilize a satellite in its orbit. 3+8=11
13. (a) Describe the *two* approaches followed for calculation of the power received by an Earth Station from a satellite transmitter. 12
- (b) What are the main types of antennas used on spacecraft? Write briefly on each. 8
14. (a) Give the block diagram of a typical single-conversion transponder used on Intelsat spacecraft for 6/4 GHz band. Explain the function of each unit. 7

(b) Does the same single-frequency conversion scheme is normally used in transponders of 4/11 GHz bands? Describe, giving block diagram, functioning of this transponder.

1+6=7

(c) The Earth subtends as an angle of 17° when viewed from geostationary orbit. What are the dimensions and gain of a horn antenna that will provide global coverage at 4GHz.

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15. Write short notes on **any two** of the following :

2×10=20

(i) Spread Spectrum Technique

(ii) Multipath fading

(iii) Fast Fourier Transform

(iv) Poynting Vector.