Total No. of Printed Pages—5

PAR/CCM-28/13

2014

ELECTRONICS

SECOND PAPER

Full Marks : 200

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. *(a)* How does discrete time signal differ from digital signal? Define the shifted unit sample sequence $\delta(n-3)$ and draw the graph of the same. 3+2=5

(b) What is linear time invariant system? The output $y(t)$ and input $x(t)$ of a system are related as

$$y(t) = 3x(t) + 5$$

Is the system linear? 3+2=5

(c) Define Dirac delta function $\delta(t)$ and unit-step function $u(t)$. List their properties. 4+3=7

(d) Evaluate the following integrals : 4+4=8

(i) $\int_{-\infty}^{\infty} \delta(t)(t^2+1)dt$

(ii) $\int_{3}^{5} \delta(t-1)(t^3+4t+2)dt$

2. (a) Define DFT and IDFT. 5

(b) Show that DTFT of a discrete signal $x(n)$ is periodic. 5

(c) Prove the following convolutions : 3+3=6

(i) $\delta(t) * \delta(t) = \delta(t)$

(ii) $u(t) * u(t) = tu(t)$

(d) Find the convolution of $x_1(t)$ and $x_2(t)$, where $x_1(t) = \sin t.\, u(t)$ and $x_2(t) = u(t)$. 4

(e) Define causality and stability of a system. Determine the conditions for causality and stability in terms of impulse response of the system $h(t)$. 5

3. (a) Prove the following Fourier transform theorems :

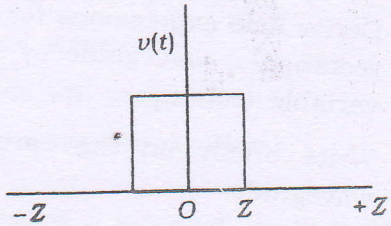
If $v(t) \leftrightarrow V(f)$

and $w(t) \leftrightarrow W(f)$

then $v(t) * w(t) \leftrightarrow V(f)\, W(f)$

and $v(t) \cdot w(t) \leftrightarrow V(f) * W(f)$ 5+5=10

(b) Given single rectangular pulse $v(t)$ as shown in figure below :



Find its energy and Fourier transform. Also plot the spectrum. 15

4. (a) Define edge pixel and edge. Mention the basic edge model and draw their intensity profiles. 2+3=5

(b) Describe a region-based image segmentation method. 5

(c) Suggest an algorithm based on fuzzy concept for boundary extraction. 5

(d) What is the difference between image enhancement and image restoration? What are the sources of noises in image? 3+2=5

(e) Mention the fundamental steps performed in edge detection and briefly describe a method for edge detection. 5

5. (a) Derive field expressions for TE modes in rectangular waveguide by separation of variable technique. 20

(b) Write briefly on the earth-ionosphere waveguide. 5

6. (a) Define the terms 'gain', 'directivity' and 'effective length' of an antenna. Show that the directivity of a current element is 1·76 dB. 10

(b) Distinguish between the radiation pattern of isotropic, directional and omnidirectional antenna. 5

(c) A television transmitting antenna mounted on a height of 120 m radiates 15 kW of power equally in all directions in azimuth at a frequency of 50 MHz. Calculate—

(i) the maximum line of sight range;

(ii) the field strength at a receiving antenna mounted at a height of 16 m at a distance of 12 km. 5+5=10

7. (a) Derive the general link design equation for a satellite. 7

(b) Compare the performance characteristics of FDMA, TDMA and CDMA. 9

(Continued)

(c) Explain what is meant by—

(i) ground wave;

(ii) surface wave;

(iii) space wave propagation. 9

8. A mobile is located 5 km away from a base station and uses a vertical $\frac{\lambda}{4}$ monopole antenna with a gain of 2·55 dB to receive cellular radio signals. The E-field at 1 km from the transmitter is measured to be 10^{-3} V/m. The carrier frequency used for this system is 900 MHz.

(a) Find the length and the effective aperture of the receiving antenna. 5+5=10

(b) Find the received power at the mobile using the two-ray ground reflection model assuming the height of the transmitting antenna to be 50 m and receiving antenna 1·5 m above ground. 15

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