Total No. of Printed Pages—5

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43

2011

ELECTRONICS

SECOND PAPER

Full Marks : 200

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. *(a)* Draw the block diagram of a general purpose digital image processing system and discuss briefly the function of each block. 6

   (b) How do humans perceive the information contained in an image? Mention two characteristics of human vision. 6

   (c) What is region-based image segmentation? Describe any one region-based segmentation method. 4+4=8

   (d) Briefly explain about how images are compressed using DCT. 5

2. *(a)* From the Maxwell's curl equations, without deducing wave equations, existence of electromagnetic waves can be predicted. Justify. 10

(b) What is the antenna efficiency factor for a dipole of length $0{\cdot}1\lambda$ operating at 1 GHz and constructed using 1 mm diameter copper core of conductivity 6×10^{-9} S/m? 15

3. (a) Explain the concept of convolution. 5

(b) Check the system described by

$$y(t) = 1 + x(t+2)$$

for linearity, time invariance, causality and stability. 3+3+3+3=12

(c) Prove that if

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

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

then $v(t) * w(t) \leftrightarrow V(f) \cdot W(f)$. 8

4. (a) There is a rectangular hole of 5 cm diameter through which a rectangular waveguide carrying dominant mode at 10 GHz is to be passed. What should be the waveguide dimension, so that the maximum power is transmitted through the waveguide and the peak electric field does not exceed 1 kV/m? 15

(b) Explain why TEM waves cannot exist in waveguides. 5

(Continued)

(c) Why are circular waveguides rather than rectangular waveguides used for rotary joints? What type of mode should be used with circular waveguides if a rotary joint is involved? Why? 5

5. A rectangular waveguide of 4 cm × 3 cm cross-section carries the dominant mode at 6 GHz. The maximum peak electric field measured inside the waveguide is 50 V/m. Find the expression for the electric and magnetic fields inside the waveguide and the power carried by the waveguide. 15+10=25

6. (a) Derive the expression for the induction and radiation fields due to a Hertzian dipole in spherical polar coordinate system. 12

(b) An 875 MHz signal is to be transmitted over a 1 km distance using half-wave dipole antenna. The transmitter has 1 W of power available at the input terminal of the antenna, to which it is perfectly matched. Find the signal strength at the terminals of the receiving antenna. 13

7. (a) What do you mean by the term 'fading of a radio signal'? Differentiate between general fading and selective fading. Enumerate the steps to be taken to reduce selective fading. 10

(b) A satellite at a distance of 40000 km from a point on the Earth's surface radiates a power of 2 W from an antenna with a gain of 17 dB in the direction of the observer. Find the flux density at the received point and the power received by an antenna with an effective area of 10 m^2. 10

(c) How can we differentiate between active and passive satellite systems? 5

8. (a) The G/T ratio for the INTELSAT IV–A global beam is $-17{\cdot}6$ dB K^{-1}. An Earth station transmits a carrier with RF bandwidth of 7·5 MHz and an EIRP of 80·6 dBw at 6 GHz. The receiving Earth station has a system noise temperature of 70 K and is to contribute 4210 pW to the system noise budget. Assuming that the transponder is linear, calculate the thermal noise contribution from the transponder if the Earth station receiver C/N is 18 dB due to thermal noise alone. 10

(Continued)

(b) Explain the concept of frequency reuse in cellular mobile networks. How is SDM typically realized and combined with FDM/TDM in GSM? Why does frequency reuse lead to an increase in capacity of a cellular system? 10

(c) Write a short note on any *one* of the following : 5

(i) Fuzzy Logic System

(ii) Huffman Coding

(iii) Satellite Communication

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