

Indian Institute of Technology, Kharagpur

Date: 20.02.2012 (AN), Time: 02 Hrs; Full Marks: 30, Deptt: E&ECE

No. of Students: 111, Mid-Semester Examination, Spring 2011-12

Sub. No. EC31002, Sub. Name: Digital Communications, 3rd Year B.Tech.

Instructions: Answer ALL questions. Answer of a question should be at one place. Make and state suitable assumptions wherever necessary.

1. Let the output voltage $v_o(t)$ of a voltage amplifier be: $v_o(t) = g_0 \cdot v_i(t) + g_1 \cdot v_i^2(t) + g_2 \cdot v_i^3(t)$, where $v_i(t)$ is the input voltage. If $v_i(t) = 5 \cos \omega_c t$ and $g_0 = 10g_1 = 100g_2$, determine and sketch the magnitude spectrum of $v_o(t)$. Now, draw a block schematic diagram of a digital wireless transmitter and indicate which block may include an amplifier with a transfer characteristic as above. Discuss the disadvantages and advantages of such an amplifier characteristic in practical digital communication systems. 2+1+2 = 5
2. Let the sample space X for a discrete memoryless source be $\{a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8\}$ where $p(a_1) = 0.1$, $p(a_2) = 0.125$, $p(a_3) = 0.125$, $p(a_4) = 0.2$, $p(a_5) = 0.3$, $p(a_6) = 0.04$, $p(a_7) = 0.06$ and $p(a_8) = 0.05$. Determine $H(X)$. Now, encode the letters of X using Huffman coding scheme and determine the average length of a codeword. 3
3. Explain with a diagram the types of channels that may be defined in the context of a digital communication system and mention their features. 2
4. Define 'average mutual information' over a joint ensemble and derive an expression of average mutual information over a binary symmetric channel with channel transition probability ' ϵ ' when the inputs to the channel are equally probable. 3
5. Draw the block diagram of a digital communication system from an information theoretic point of view and explain the function of each block. 3
6. Define a narrowband signal and justify why treatment and understanding of complex lowpass equivalent signal is usually sufficient for understanding a real narrowband signal. 4
7. Derive an expression for SQNR of a linear quantizer while stating the underlying assumptions. 4
8. Write short notes and explain with an example each on (any **THREE**): (i) DMC, (ii) Interference, (iii) ARQ scheme, (iv) Various physical media and their characteristics. 6