**Madan Mohan Malaviya University of Technology Gorakhpur**

**SUBJECT: Digital Communication (BEC-301) ECE-VTH SEM**

**ASSIGNMENT -4**

**Q.1** What is Hamming distance? Give relation between minimum distance and error detecting and correcting capability. Describe a Hamming code. Also define Hamming sphere and Hamming bound.

**Q.2** A DMS *X* has five symbols ,,, and with P()=0.4, *P*()=0.19, *P*()=0.16,=0.15 and =0.1, Construct a Shannon-Fano code for X and calculate the efficiency of the code.

**Q.3** What is convolution code? Write the advantages & Disadvantages of convolutional codes.

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| **Q.4** Explain cyclic code. Consider a (7,4) cyclic code with generator polynomial let data word d=(1111), find the correspond systematic code word. |

**Q.5** Design binary Huffman code for a distance source of fire independent symbols A,B,C,D and E with probabilities 0.4, 0.2, 0.8, 0.08 and 0.02 respectively such that the variance of code word lengths of minimum.

**Q.6** An analog signal having 4-kHz bandwidth is sampled at 1.25 times the Nyquist rate, and each sample is quantized into one of 256 equal levels. Assume the successive samples are statistically independent.

1. What is the information rate of this source?
2. Can the output of this source be transmitted without error over an AWGN channel with a bandwidth of 10kHz and an S/N ratio of 20 dB?
3. Find the S/N ratio required for error-free transmission for part (ii).

(iv) Find the bandwidth required for an AWGN Channel for error-free transmission of the output of this source if the S/N ratio is 20dB.

**Q.7** Define entropy with mathematical expressions. An analog signal is bandlimited to B Hz, sampled at the Nyquist rate, and the samples are quantized into four levels. The quantization levels 𝑄1, 𝑄2, 𝑄3, 𝑄4 (messages) are assumed independent and occur with probabilities 𝑝1 = 𝑝4 =1/8 and 𝑝2= 𝑝3 = 3/8. Find the information rate of the source.

**Q.8** Explain why information measure is logarithmic and inversely proportional to the probability. What are the units of information measures? Calculate the amount of information if binary digit (binits) occurs with equal likelihood in a binary PCM system.

**Q.9** Explain Cyclic codes. What is meant by systematic and non-systematic codes?

**Q.10** Explain Huffman coding with proper example.

**Q.11** Write the short notes on

**(i)** Tree diagram

**(ii)** Trellis diagram

**Q.12** The generator polynomial of a (7, 4) cyclic code is *g*(x) = 1+ x+x3. Find the codeword for the message vector (1010) in the following ways. **(i)** By forming the code polynomial using *c*(x) = *d*(x) *g*(x), where *d*(x) is the message polynomial (Non-systematic form). **(ii)** By using the systematic form. Where message vector (1110).