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Department of Electronics & Communication Engg.
Continuous Internal Evaluation – I

Course Name : **Digital Communication Systems**	Date :	6/10/2020
Course Code : **18EC5DCDCS**	Day :	Tuesday
Semester : 5	Timings :	9.30-11.00am
Max Marks : 50 M	Duration :	1½ Hrs.

No.		Question Description	Mks	CO & Levels
Q1	(a)	When X and Y are statistically independent, then I (x,y) is_____ (i) 1 (ii) 0 iii) ln2 iv) Cannot be determined.	1	CO1 CO2
	(b)	According to Shannon Hartley theorem i) The channel capacity becomes infinite with infinite bandwidth ii) The channel capacity does not become infinite with infinite bandwidth iii) Has a tradeoff between bandwidth and Signal to noise ratio iv) Both b and c are correct	1	
	(c)	For M equally likely messages, M>>1, if the rate of information $R \le C$, the probability of error is_____ i) Arbitrarily small ii) Close to unity iii) Not predictable iv) Unknown	1	
	(d)	When r=s, the transition probabilities (b_s/a_r) represents conditional probability of correct reception and when $r \ne s$, it represents a conditional probabilities of error. i)Agree ii) Disagree iii) Can't say iv) None	1	
	(e)	In channel coding theorem, channel capacity decides the _____permissible rate at which error free transmission is possible. i)Maximum ii)Minimum iii) Constant iv) None	1	
	(f)	Given a ternary source X=$\{x_1, x_2, x_3\}$ with probability of occurrence of $x_1, x_2 \, and \, x_3$ given by 0.25, 0.25 and 0.5 respectively. What is the average information content of X (in Nats)? i)1.039 iii)1.5 iii)1.443 iv)2.2	1	
	(g)	To verify linearity of the code, which operation of the following is performed on any 2 code vector, where resultant is a code belonging to same (n,k) code. i)Or ii)Xor iii)And iv)Not	1	
	(h)	For a (7, 4) block code, 7 is the total number of bits and 4 is the number of _____ i) Information bits ii) Redundancy bits iii) Total bits- information bits iv) None of the above.	1	
	(i)	The redundant check bits in error control coding are used for_____ i) To make fixed length code ii) Error detection and correction iii) Security iv) Jamming	1	
	(j)	The zero syndrome vector indicates _____ i) No errors ii) All bits are in error iii) 0th position in error iv)None	1	
Q2		Apply Shannon's binary Encoding and binary Huffman coding procedure to construct code for the set of 5 symbols each occurring with probability of 1/5. Calculate the variance in each case and comment on the result.	10	CO1/L3
Q3		For a systematic (7,4) linear block code, the parity matrix is given by $$P=\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$ a) Generate all possible valid code vectors b) Detect and correct error for the following received vector.	10	CO2/L4

		i) R= [1111100]. ii) R= [1110010]. Comment on the result.		
Q4	a)	For a facsimile transmission of a picture, there are 4 x 10^6 pixels /frame. For a good reconstruction of the image at least 8 brightness levels are necessary. Assuming all these levels are equally likely to occur. Find the average information rate if one picture is transmitted every 4s.	04	CO1/L1
	b)	The international Morse code uses a sequence of symbols of dots and dashes to transmit letters of English Alphabet. The dash is represented by a current pulse of duration 2ms and dot of 1ms. The probability of dash is half as that of dot. Consider 1ms duration of gap is given in between the symbols. Determine i) Self-Information of a dot and a dash. ii) Average information content of a dot-dash code. iii) Average rate of information.	06	CO1/L4
		OR		
Q5		Illustrate the implications of Shannon-Hartley law for channel capacity. Comment on the implications in your words	10	CO1/L3
Q6		An analog signal having bandwidth of 9 KHz is sampled at twice the Nyquist rate with each sample quantized into one of 365 equally likely levels. i]. Assess the information rate of this source. ii] Is it possible for this source to transmit without error over an AWGN Channel with Bandwidth of 15 KHz and SNR of 25dB? iii]. Estimate the SNR required for error free transmission for part (i) considering bandwidth as 15KHz iv]. Determine the Bandwidth required for AWGN channel for error free transmission of this source if SNR happens to be 25dB.	10	CO1/L4
		OR		
Q7		For the channel matrix shown below for which $P(x_1)=1/2$, $P(x_2)=P(x_3)=1/4$ and $r_s=10000$/sec. Find H(x), H(y), H(y/x), H(x,y), I(x,y) and channel capacity. $$P(y/x)=\begin{bmatrix} 0.8 & 0.2 & 0 \\ 0.1 & 0.8 & 0.1 \\ 0 & 0.2 & 0.8 \end{bmatrix}$$	10	CO1/L1