S J P N Trust's

HirasugarInstitute ofTechnology, Nidasoshi.

Inculcating Values, Promoting Prosperity

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E&C Engg. Dept.
Exam.
Internal Assessment
Odd Sem(2017-18)

SECOND INTERNAL ASSESSMENT

Sem :V | Sub: Information Theory and Coding | Sub. Code: 15EC54

Date:16/10/2017 | Time:3:00pm-4:0pm | Max. Marks: 25

Note: Answer two full questions, draw sketches wherever necessary.

Q. No		Discription of Question	Marks	CO
1	a	Define source coding. Give detailed classification of source codes	4	~~CO304. 1~~, CO304. 2
	b	State and prove Kraft-McMillan Inequality. Test the KMI for S_1=0, S_2=100, S_3=110, and S_4=111.	8	CO304. 2
		OR		
2	a	What is the need for source coding? Explain the prefix property of a code with suitable examples.	4	~~CO304. 1~~, CO304. 2
	b	State and prove noiseless source coding theorem	8	CO304. 2
3	a	Give detailed steps to devise codewords using Shanon's first encoding technique.	5	CO304. 2
	b	Find the codewords for the source with S=(A, B, C, D) with probabilities P=(0.4, 0.3, 0.1, 0.2) using Shanons first encoding technique. Calculate coding efficiency and redundancy.	8	CO304. 2
		OR		
4	a	Explain the Shanon-Fano encoding algorithm.	5	CO304. 2
	b	Find the codewords using Shanon-Fano algorithm for the source S=(a, b, c, d, e, f) with probabilities P=(0.15, 0.25, 0.35, 0.10), (Assume suitable data) e → 0.10, f → 0.05	8	CO304. 2

HOD

- IA SCHEME OF EVALUATION

Sem : V	Subject : Information Theory & Coding	Sub Code : 15EC54	Date : 16/10/17

Q. No.	Bit	Description	Marks	Mapped CO's
1	(a)	Let S be the source alphabet and X be the code alphabet Then $S=\{S_1, S_2, \cdots S_n\}$ with $P=\{P_1, P_2, \cdots P_n\}$ & $X=\{0,1\}$ $\Rightarrow S \to X$ mapping of each and every symbol with code alphabet combinations e.g. $S \to 0$, $S_1 \to 10$, $S_2 \to 110$ etc is called source coding. Classification: Block codes → Non instantaneous; Instantaneous → Non linear; Linear → Non optimal; optimal	04	
	(b)	Proof of KMI $\sum_{\forall i} r^{-l_i} \leq 1$ for binary $\sum_{\forall i} 2^{-l_i} \leq 1$ $l_1=1, l_2=3, l_3=3, l_4=3$ $\Rightarrow 2^{-1}+2^{-3}+2^{-3}+2^{-3} = 0.875 \leq 1$ is satisfied	08	
2	(a)	Source coding is required for: → compression of raw data → conversion of data to digital form prefix property: no code word must be prefix of other e.g. s1 0, s2 01, s3 010, s4 01011 without prefix: $s_1 \to 0$, $s_2 \to 10$, $s_3 \to 110$, $s_4 \to 1111$	04	

PTO

Course Coordinator   Module Coordinator   HOD

- IA SCHEME OF EVALUATION

Sem : V		Subject : ITC	Sub Code : 15EC54	Date : 16/10/17	
Q. No.	Bit	Description		Marks	Mapped CO's
2	(b)	proof of source coding theorem (noiseless) Let $S \to$ source symbols set Then $H(S)$ be its entropy. $\Rightarrow$ Lower & upper bound of $H(S)$ is governed by Shannon's source coding theorem $H(S) \leq \bar{L} \leq H(S)+1$ Where $\bar{L}$ is the average length of the code.		08	
3	(a)	Algorithm (Shannon's Encoding) $\to$ Arrange probabilities in decreasing order $\to$ find the $l_i \geq \log_2 \frac{1}{P_i}$ (to next integer) $\to$ Define $q_1 = 0$ $q_2 = 0 + P_1 = q_1 + P_1$ $q_3 = P_1 + P_2 = q_2 + P_2$ $q_n = P_1 + P_2 + \cdots P_n = q_{n-1} + P_n = 1.0$ $\Rightarrow$ convert q_1 to q_{n-1} into binary ~~digits~~ bits truncated to l_i places $\Rightarrow$ discard decimal points & take code only $\Rightarrow$ find $H(S)$, $\bar{L}$ & η and R P.T.O			

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Q. No.	Bit	Description	Marks	Mapped CO's
3	(b)	A 0.4 ⇒ $l_1 \geq \log \frac{1}{P_A}$ ⇒ 2 B 0.3 ⇒ $l_2 \geq \log \frac{1}{P_B}$ ⇒ 2 D 0.2 ⇒ $l_3 \geq \log \frac{1}{P_D}$ ⇒ 3 C 0.1 ⇒ $l_4 \geq \log \frac{1}{P_C}$ ⇒ 4 $q_1 = 0 \rightarrow 0.00$ $q_2 = 0.4 \rightarrow$ ~~0.00~~ 0.01 $q_3 = 0.7 \rightarrow 0.101$ $q_4 = 0.9 \rightarrow 0.1110$ 0.5+0.25 0.125 $q_5 = 1.0$ ⇒ A → 00 B → 10 D → 101 C → 1110 $\bar{L} = 2 \times 0.4 + 2 \times 0.3 + 3 \times 0.2 + 4 \times 0.1$ $= 0.8 + 0.6 + 0.6 + 0.4 = 2.4$ & $H(S) = 1.845$ $\therefore \eta = \frac{1.845}{2.4} = 0.7687 \approx 76.87\%$ $R = 1 - \eta = 23.12\%$		

- IA SCHEME OF EVALUATION

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Q. No.	Bit	Description	Marks	Mapped CO's
4	(a)	Algorithm (Shanon-Fano) → Arrange probabilities in decreasing order → Divide into two groups such that probabilities are more or less equal → Assign bit 0 to upper group & 1 to lower group → repeat above steps till no further division is possible → Readout the codes		
	(b)	c → 0.35 0 0 b → 0.25 0 1 a → 0.15 1 0 0 d → 0.10 1 0 1 e → 0.10 1 1 0 f → 0.05 1 1 1 assuming P(e) = 0.10, P(f) = 0.05 c → 00 b → 01 a → 100 d = 101 e → 110 f → 111		