

QUIZ I REVIEW

COVERAGE :

* SYSTEMS

- linearity
- time-invariance
- causality
- convolution
- deconvolution
- unit sample/step response

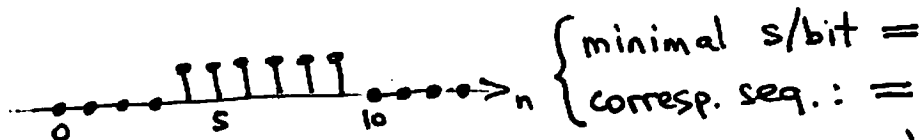
* PROBABILISTIC MODELS

- PDF/ • Gaussian/Normal
- CDF • piecewise-linear
- δ -functions
- SCALING / SHIFTING OF RANDOM variables
- computing derived probabilities

* "COMMUNICATION TRICKS"

- modulation principles (samples/bit, threshold detect)
- eye diagrams
- BERs

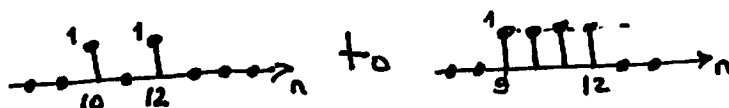
Ex. 1
#1,6



(A question on "modulation principles")

Ex. 2
#2,5

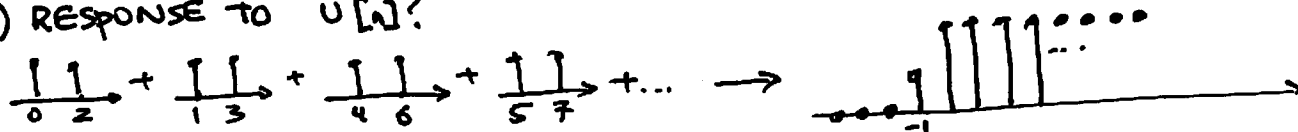
LTI system maps



(a) IS IT CAUSAL? ☐

BECAUSE LTI transmits $[0] \rightarrow [0]$
SINCE $IN \neq 0$ for $n < 10$, would have
 $OUT = 0$ for $n < 10$ if CAUSAL

(b) RESPONSE TO $U[n]$?



(c) unit sample response?

(A QUESTION ON "LTI models")

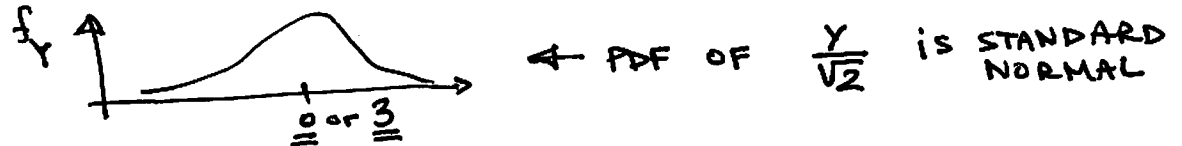
Ex. 3
#3,7

SEND 0/1 (PROBABILITY RATIO 2/3)

RECEIVE $y = V_h \cdot \text{bit} + w$, $V_h = 3$, $w \sim N(0, 2)$ Normal variance = STD^2
meanASSUME INDEPENDENCE of bit AND wUSE THRESHOLD a TO DETECTEXPRESS $P(\text{err})$ AS A FUNCTION OF a

$$w = \sqrt{2} v$$

$$v \sim N(0, 1)$$

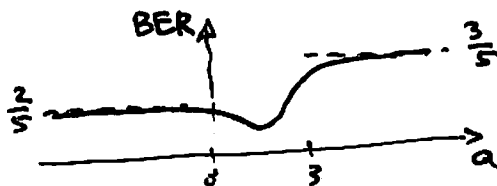
WHEN $\text{bit} = 0$: ($P(\text{bit} = 0) = 2/5$)

$$P(\hat{\text{bit}} = 1, \text{bit} = 0) = P(\sqrt{2}v > a, \text{bit} = 0)$$

$$= P(v > \frac{a}{\sqrt{2}}) \cdot P(\text{bit} = 0) = [1 - \Phi(\frac{a}{\sqrt{2}})] \cdot \frac{2}{5}$$

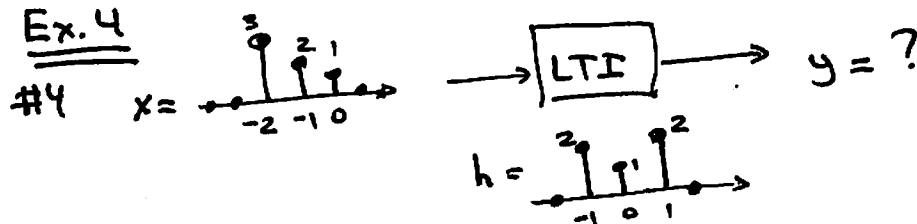
$$P(\hat{\text{bit}} = 0, \text{bit} = 1) = P(\sqrt{2}v + 3 < a, \text{bit} = 1)$$

$$= P(v < \frac{a-3}{\sqrt{2}}) \cdot P(\text{bit} = 1) = \Phi(\frac{a-3}{\sqrt{2}}) \cdot \frac{3}{5}$$



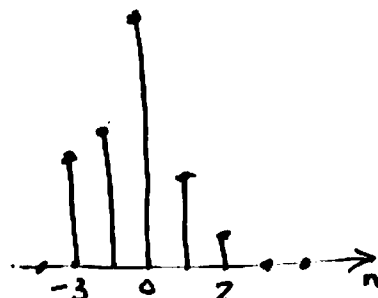
$$\text{BER}(a) = \frac{3}{5} \Phi(\frac{a-3}{\sqrt{2}}) + \frac{2}{5} [1 - \Phi(\frac{a}{\sqrt{2}})]$$

(A "COMPUTING DERIVED PROBABILITIES" QUESTION)

Ex. 4
#4

2.	3	2	1	0	0	0
1.	0	3	2	1	0	0
2.	0	0	3	2	1	0
	3	5	6	3	1	

6	4	2	0	0
0	3	2	1	0
0	0	6	4	2
6	7	10	5	2



$$-3 = (-2) + (-1)$$

(A "CONVOLUTION/LTI SYSTEMS" QUESTION)

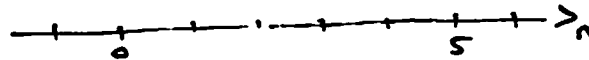
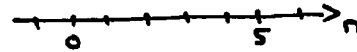
Ex. 5

#8



$$y[n] = 2x[n-1] + x[n-3]$$

- (a) LINEAR?
- (b) TIME INVARIANT?
- (c) CAUSAL?
- (d) UNIT SAMPLE RESPONSE?
- (e) UNIT STEP RESPONSE?

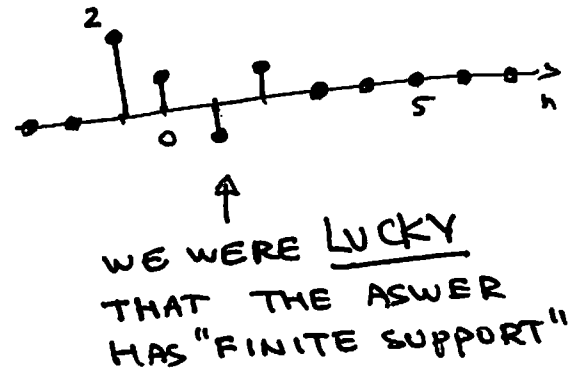


(f) if $y =$ what is x?

DECONVOLUTION: $x[n] = \frac{1}{2} \cdot (y[n+1] - x[n-2])$

ASSUMING $x[n] = 0$ FOR $n \rightarrow -\infty$:

$$\begin{aligned} x[-1] &= \frac{1}{2} (4 - 0) = 2 \\ x[0] &= \frac{1}{2} (2 - 0) = 1 \\ x[1] &= \frac{1}{2} (0 - 2) = -1 \\ x[2] &= \frac{1}{2} (3 - 1) = 1 \\ x[3] &= \frac{1}{2} (-1 - (-1)) = 0 \\ x[4] &= \frac{1}{2} (1 - 1) = 0 \\ x[5] &= \frac{1}{2} (0 - 0) = 0 \\ &\vdots \end{aligned}$$



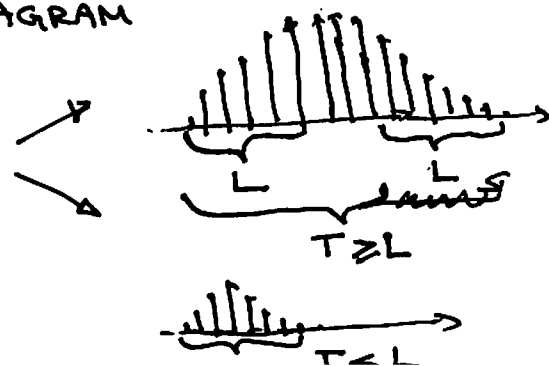
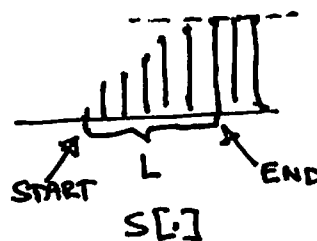
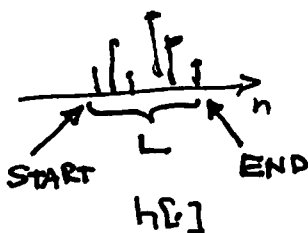
("f" WAS A DECONVOLUTION / LTI SYSTEMS QUESTION)

Ex. 6

#9, 10, 12

UNIT SAMPLE RESPONSE $\rightarrow$ UNIT STEP RESPONSE

$\rightarrow$ "BIT RESPONSE" $\rightarrow$ EYE DIAGRAM

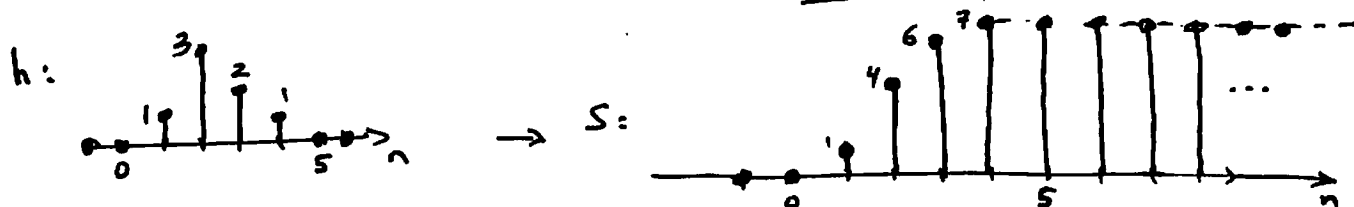


SAMPLES ON THE EYE DIAGRAM = SUMS OF "BIT RESPONSE" SAMPLES, SHIFTED BY MULTIPLES OF T

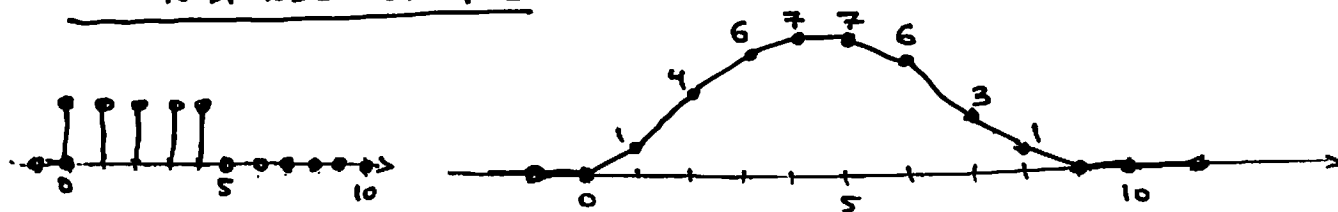
STEEPEST LINE BOTTOM $\rightarrow$ TOP ON THE EYE DIAGRAM

= UNIT STEP RESPONSE (POSSIBLY SHIFTED)

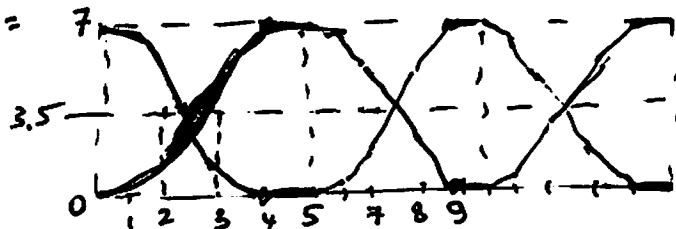
(ASSUMING $h[n] \geq 0$ FOR ALL n)



"BIT" RESPONSE FOR $T=5$:

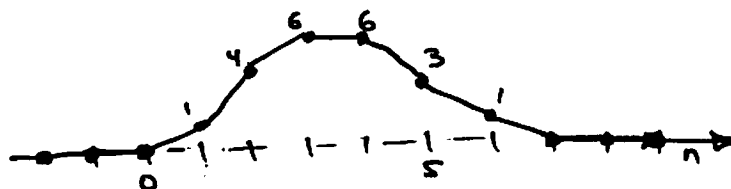


EYE DIAGRAM FOR $T=5$:

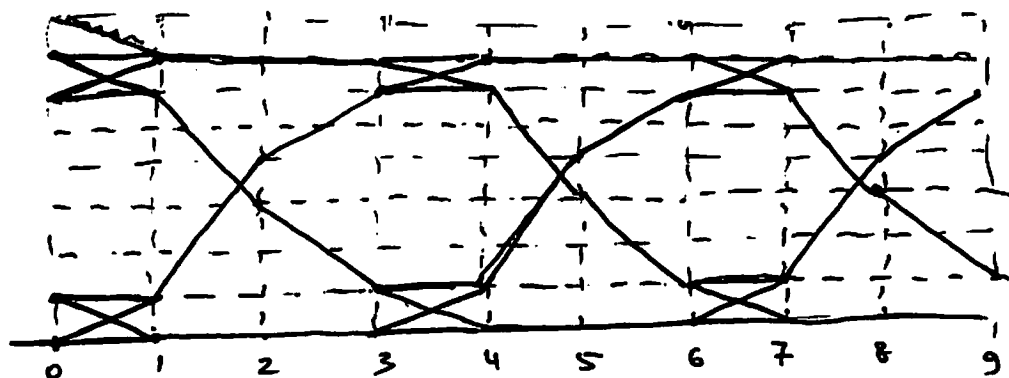


Symmetric with respect to this axis!

"BIT" RESPONSE FOR $T=3$:



EYE DIAGRAM FOR $T=3$:



"RESEARCHERS" WHO CLAIM = "RESEARCHERS WHO SAY" OR "RESEARCHERS
 WHO SAY" OR "RESEARCHERS
 WHO SAY" OR "RESEARCHERS"

4575, 4614, 4618, 4620, 4622, 4624, 4626, 4628, 4630, 4632, 4634, 4636, 4638, 4640, 4642, 4644, 4646, 4648, 4650, 4652, 4654, 4656, 4658, 4660, 4662, 4664, 4666, 4668, 4670, 4672, 4674, 4676, 4678, 4680, 4682, 4684, 4686, 4688, 4690, 4692, 4694, 4696, 4698, 4700, 4702, 4704, 4706, 4708, 4710, 4712, 4714, 4716, 4718, 4720, 4722, 4724, 4726, 4728, 4730, 4732, 4734, 4736, 4738, 4740, 4742, 4744, 4746, 4748, 4750, 4752, 4754, 4756, 4758, 4760, 4762, 4764, 4766, 4768, 4770, 4772, 4774, 4776, 4778, 4780, 4782, 4784, 4786, 4788, 4790, 4792, 4794, 4796, 4798, 4800, 4802, 4804, 4806, 4808, 4810, 4812, 4814, 4816, 4818, 4820, 4822, 4824, 4826, 4828, 4830, 4832, 4834, 4836, 4838, 4840, 4842, 4844, 4846, 4848, 4850, 4852, 4854, 4856, 4858, 4860, 4862, 4864, 4866, 4868, 4870, 4872, 4874, 4876, 4878, 4880, 4882, 4884, 4886, 4888, 4890, 4892, 4894, 4896, 4898, 4900, 4902, 4904, 4906, 4908, 4910, 4912, 4914, 4916, 4918, 4920, 4922, 4924, 4926, 4928, 4930, 4932, 4934, 4936, 4938, 4940, 4942, 4944, 4946, 4948, 4950, 4952, 4954, 4956, 4958, 4960, 4962, 4964, 4966, 4968, 4970, 4972, 4974, 4976, 4978, 4980, 4982, 4984, 4986, 4988, 4990, 4992, 4994, 4996, 4998, 5000, 5002, 5004, 5006, 5008, 5010, 5012, 5014, 5016, 5018, 5020, 5022, 5024, 5026, 5028, 5030, 5032, 5034, 5036, 5038, 5040, 5042, 5044, 5046, 5048, 5050, 5052, 5054, 5056, 5058, 5060, 5062, 5064, 5066, 5068, 5070, 5072, 5074, 5076, 5078, 5080, 5082, 5084, 5086, 5088, 5090, 5092, 5094, 5096, 5098, 5100, 5102, 5104, 5106, 5108, 5110, 5112, 5114, 5116, 5118, 5120, 5122, 5124, 5126, 5128, 5130, 5132, 5134, 5136, 5138, 5140, 5142, 5144, 5146, 5148, 5150, 5152, 5154, 5156, 5158, 5160, 5162, 5164, 5166, 5168, 5170, 5172, 5174, 5176, 5178, 5180, 5182, 5184, 5186, 5188, 5190, 5192, 5194, 5196, 5198, 5200, 5202, 5204, 5206, 5208, 5210, 5212, 5214, 5216, 5218, 5220, 5222, 5224, 5226, 5228, 5230, 5232, 5234, 5236, 5238, 5240, 5242, 5244, 5246, 5248, 5250, 5252, 5254, 5256, 5258, 5260, 5262, 5264, 5266, 5268, 5270, 5272, 5274, 5276, 5278, 5280, 5282, 5284, 5286, 5288, 5290, 5292, 5294, 5296, 5298, 5300, 5302, 5304, 5306, 5308, 5310, 5312, 5314, 5316, 5318, 5320, 5322, 5324, 5326, 5328, 5330, 5332, 5334, 5336, 5338, 5340, 5342, 5344, 5346, 5348, 5350, 5352, 5354, 5356, 5358, 5360, 5362, 5364, 5366, 5368, 5370, 5372, 5374, 5376, 5378, 5380, 5382, 5384, 5386, 5388, 5390, 5392, 5394, 5396, 5398, 5400, 5402, 5404, 5406, 5408, 5410, 5412, 5414, 5416, 5418, 5420, 5422, 5424, 5426, 5428, 5430, 5432, 5434, 5436, 5438, 5440, 5442, 5444, 5446, 5448, 5450, 5452, 5454, 5456, 5458, 5460, 5462, 5464, 5466, 5468, 5470, 5472, 5474, 5476, 5478, 5480, 5482, 5484, 5486, 5488, 5490, 5492, 5494, 5496, 5498, 5500, 5502, 5504, 5506, 5508, 5510, 5512, 5514, 5516, 5518, 5520, 5522, 5524, 5526, 5528, 5530, 5532, 5534, 5536, 5538, 5540, 5542, 5544, 5546, 5548, 5550, 5552, 5554, 5556, 5558, 5560, 5562, 5564, 5566, 5568, 5570, 5572, 5574, 5576, 5578, 5580, 5582, 5584, 5586, 5588, 5590, 5592, 5594, 5596, 5598, 5600, 5602, 5604, 5606, 5608, 5610, 5612, 5614, 5616, 5618, 5620, 5622, 5624, 5626, 5628, 5630, 5632, 5634, 5636, 5638, 5640, 5642, 5644, 5646, 5648, 5650, 5652, 5654, 5656, 5658, 5660, 5662, 5664, 5666, 5668, 5670, 5672, 5674, 5676, 5678, 5680, 5682, 5684, 5686, 5688, 5690, 5692, 5694, 5696, 5698, 5700, 5702, 5704, 5706, 5708, 5710, 5712, 5714, 5716, 5718, 5720, 5722, 5724, 5726, 5728, 5730, 5732, 5734, 5736, 5738, 5740, 5742, 5744, 5746, 5748, 5750, 5752, 5754, 5756, 5758, 5760, 5762, 5764, 5766, 5768, 5770, 5772, 5774, 5776, 5778, 5780, 5782, 5784, 5786, 5788, 5790, 5792, 5794, 5796, 5798, 5800, 5802, 5804, 5806, 5808, 5810, 5812, 5814, 5816, 5818, 5820, 5822, 5824, 5826, 5828, 5830, 5832, 5834, 5836, 5838, 5840, 5842, 5844, 5846, 5848, 5850, 5852, 5854, 5856, 5858, 5860, 5862, 5864, 5866, 5868, 5870, 5872, 5874, 5876, 5878, 5880, 5882, 5884, 5886, 5888, 5890, 5892, 5894, 5896, 5898, 5900, 5902, 5904, 5906, 5908, 5910, 5912, 5914, 5916, 5918, 5920, 5922, 5924, 5926, 5928, 5930, 5932, 5934, 5936, 5938, 5940, 5942, 5944, 5946, 5948, 5950, 5952, 5954, 5956, 5958, 5960, 5962, 5964, 5966, 5968, 5970, 5972, 5974, 5976, 59

Figure 1 is a line graph showing the dependence of the rate of polymerization (R_p) on the pH of the medium. The x-axis is labeled 'pH' and ranges from 4 to 10. The y-axis is labeled ' R_p ' and ranges from 0 to 1.0. The curve shows a peak around pH 7.5. Data points are plotted at various pH values, with some points having vertical error bars.