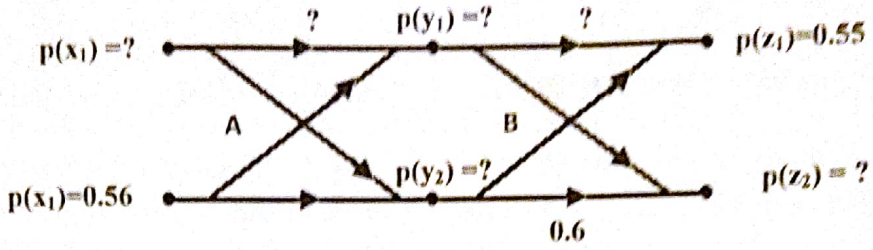
Q1. (12 Marks) For the **two Binary Symmetrical Channels (A & B)** connected in cascade as shown below, Find the **input, output** and **channels forward probabilities**.



Q2. (8 Marks) Consider a **DMS** Source with symbols **Si, i=1,2,3,4**. Table below lists 6 possible binary codes

Table of Codes of the source S						
Si	Code 1	Code 2	Code 3	Code 4	Code 5	Code 6
S1	00	11	0	111	10	0
S2	01	00	1	10	100	1110
S3	01	10	00	110	1000	110
S4	00	01	11	0	1	10

a) Find which of them **distinct** codes are? **(2 Marks)**
b) Find which of them **prefix-free** codes are? **(2 Marks)**
c) Find weather **instantaneous** codes are existence for these codes? **(2 Marks)**
d) Can you decide which code is **the best code** for this source, and **why**? **(2 Marks)**

Q3. (24 Marks, 3 each) Consider the **Systematic Linear Block Code** with the following **syndrome look-up table.**

Error Pattern (e)	Syndrome (S)
0000000	000
0000001	110
0000010	011
0000100	101
0001000	111
0010000	001
0100000	010
1000000	100

a) Find the **Generator matrix** of the code?
b) Find all the **Code Words** and the **Minimum Hamming Distance?**
c) Find **code bits, message bits, parity bits, code rate,** the **error-detection** and **error-correction capabilities** of the code?
d) Write down **the Parity Check Equations** and **draw the Encoder?**
e) Are the generator vectors **linearly independent? (Justify your answer)**
f) Is this code a **linear code? (Justify your answer)**
g) **Encode** the bit stream, **m= 11011110001001…?**
h) If r_1 = **1101011** and r_2= **0101101** were received, what are the **transmitted code-words** and **original messages? (*clearly show the recovery steps*)**

Q4. (16 Marks) Given a Binary Convolutional Encoder with **K=3, rate 1/3,** and **Impulse Response 101011010.**

a) **Encode** the input sequence bits **m = 10101?** **(5 Marks)**
b) **Draw** the encoder? **(show your answer)** **(6 Marks)**
c) **Draw** the **Trills diagram** of the encoder? **(5 Marks)**