Kafrelsheikh University - Faculty of Engineering			
Course	Communication Systems	Date	30/5/2017
Time	3 Hours	Mark	70
Students	3rd year Electronics and Electrical Communications		

Answer all the following questions:

Clarify your answer with the suitable diagrams.

Q.1 Define the following terms: (5 Marks)

a- **Tonal Gradation** b-**Brightness** c- **Resolution**

d- **Aspect Ratio** e- **Hue**

ANS: Tonal Gradation is the variation of values between adjacent pixels.

Brightness: is the average intensity of light from the TV.

Resolution: is the number of pixels per square inch.

Aspect Ratio: is the Ratio between the height and width of the TV screen.

Hue: represents the wavelength of the color reaching the eye.

Q.2 Drive the relation between the total number of scanning lines (N_t) required with respect to the viewing distance (D) and the TV height (h). (8 Marks)

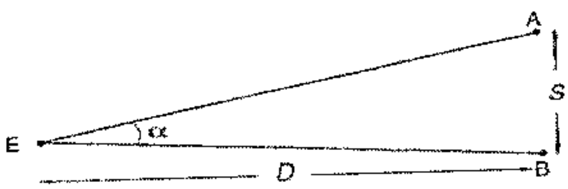

Fig. 1.2 *Angle Subtended at the Eye*

Let the two closely spaced but distinct objects be A and B.

Angle α subtended by A and B at the eye E = S/D radians

As 1 radian $= \frac{180}{\pi}$ degrees, angle $\alpha = \frac{180}{\pi} \times \frac{S}{D}$ degrees

For clear resolution, this angle should be = 1/60 degree.

Hence $\frac{180 \times S}{\pi \times D} = \frac{1}{60}$ or $\frac{S}{D} = \frac{\pi}{180 \times 60}$ (1.1)

Q.3 Determine the color and its saturation if 1 lumen each of red and blue and 0.2 of green are impressed on the eye (Note that the sensitivity of the human eye for the Red, Green and Blue colors are 0.3, 0.59 and 0.11 respectively). (8 Marks)

ANS: (1-0.2) Red + (1-0.2) Blue + (0.2x0.3) Red + (0.2 x 0.59) Green + (0.2x0.11) Blue

0.8 Red + 0.8 Blue + 0.2 white

0.8x0.3 Red + 0.8 x 0.11 Blue +0.2 white

0.328 Magenta +0.2 white (unsaturated Magenta)

Saturation=0.328/0.528=62%

Q.4 Explain and Compare between Additive and Subtractive mixing of colors. (7 Marks)

Additive mixing is the result of seeing light emitting form the source. The color seen by the eye is the result of adding the three primary colors (Red, green and Blue). This system is widely used n TVs.

Subtractive mixing is the result of seeing the light emitted by an object. This object absorbs some wave length and reflect the rest which we see as the color of the object. The primary colors of this mixing are Yellow, cyan and magenta. This system is widely used in printers as CYMK which K here represents black. Note here that in printers we need t used inks that absorbs all lights and reflect no light which we see as black. But on TVs, to generate black simply turn the pixel off.

Q.5 Explain with the aid of drawings the color transmitter and receiver systems. (8 Marks)

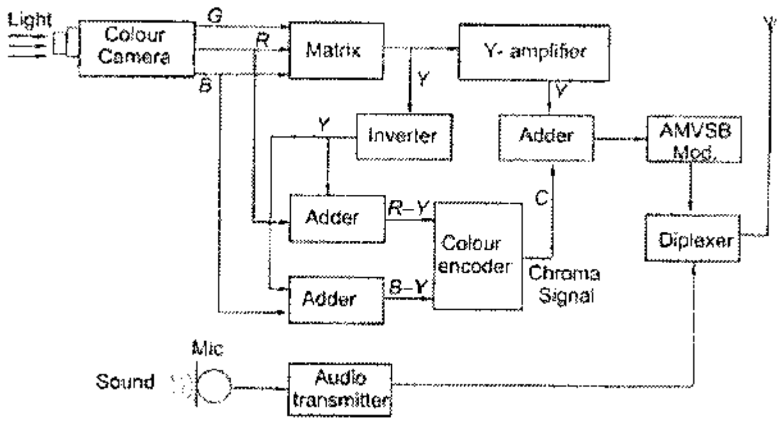

Fig.1.13 *Basic Blocks of a Colour Transmitter*

For colour transmission, colours from a picture are separated into three primary colours, red green and blue with the help of prisms or dichroic mirrors and colour filters. The brightness present in each colour is converted by colour camera tubes into three electrical signals.

The three colour signals are passed through a resistive matrix to obtain resultant luminance signal (called *Y* signal), using Grassman's law. Colour signals are sent in the form of colour difference signals.

A colour sub-carrier (4.43 MHz in European system and 3.58 MHz in American system) is modulated by two colour difference signals (*B–Y* and *R–Y*), using synchronous quadrature modulation. This is called *colour encoder*. Its output is called *chroma signal* (or *C* signal).

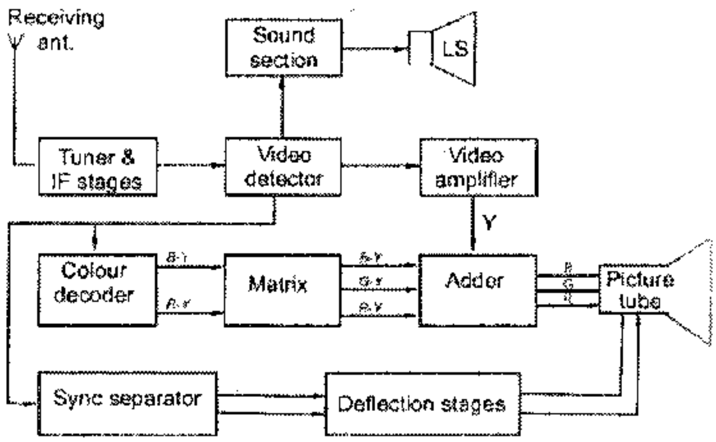

Fig.1.14 *Basic Blocks of a Colour Receiver*

Sound is reproduced from the loudspeaker in the same manner as in case of a monochrome receiver.

Q.6 How the interlaced scanning works in the transmitter and receiver? What will happen if the both the transmitter and receivers were out of synchronization? (7 Marks)

2.5 INTERLACED SCANNING

In interlaced scanning, there are two sequences of scanning for each frame. Scanning lines of one sequence occur in between the lines of the other sequence. It is illustrated in Fig. 2.4. The numbers in the figure are for 625 lines per frame and blanking period for each sequence is equal to 20 lines.

Figure 2.4 shows that in interlaced scanning, the first sequence of scanning starts from point A (leftmost point on the first line), ends on point B (middle point of the bottommost line) after completing 292¼ lines (shown by thick solid lines). The vertical retrace (shown by dotted line) takes the scanning spot from point B to point C at the middle of the line above the topmost line of the first scanning. 1280 μs (equal to 20 scanning lines) are lost (blanked) in taking the retrace from B to C. The second sequence of scanning starts from this middle point at the top and ends finally at the rightmost point D on the bottom after completing 605th line. The lines of the second sequence are shown by thin lines in Fig. 2.4. This way, the lines of the second sequence fall in between the lines of the first sequence. The third sequence then starts from the leftmost point (A) on the top coinciding with the scanning of the first sequence. Similarly the fourth sequence will coincide with the second sequence, and so on.

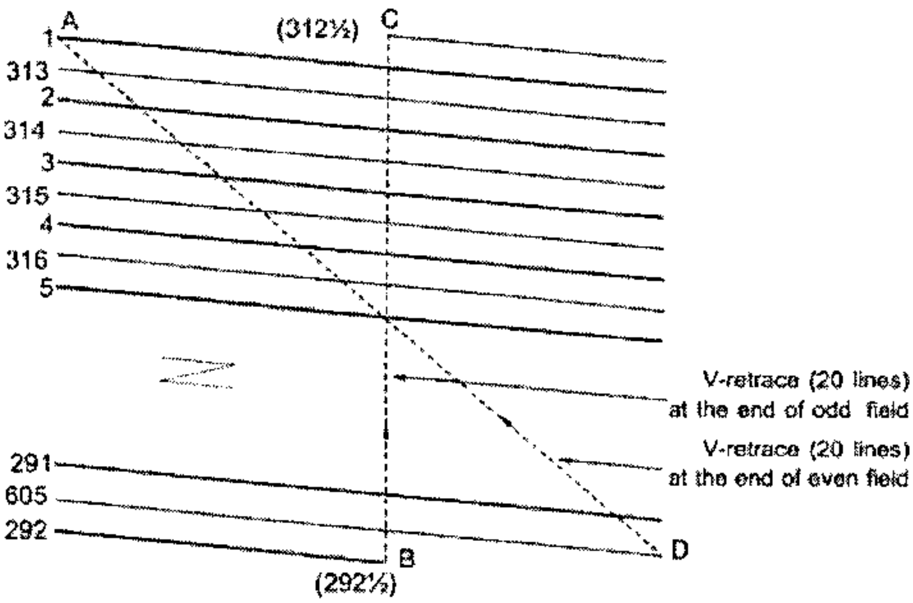

Fig. 2.4 *Interlaced scanning*

Q.7 Explain the concept of video objects in MPEG-4 encoding systems. (7 Marks)

The MPEG-4 Visual standard supports the video representation of objects of natural or artificial origin. These video objects are encoded as separate entities within the bit stream, allowing users to access and manipulate them (cut, paste, zoom, etc.). In MPEG-4, a video object can also be the traditional rectangular video sequences composed of pixels. However, a video object can also correspond to a set of arbitrary and random shapes, possibly with an associated semantic meaning. The audio-visual representation based on objects is the main difference between the MPEG-4 standard and the previous standards, adding unprecedented features to the process of media encoding.

I 8 Explain with Drawings the Encoding process of JPEG. **(10 Marks)**

Step 1 of encoding an image with JPEG is block preparation. For the sake of specificity, let us assume that the JPEG input is a 640 x 480 RGB image with 24 bits/pixel, as shown in Fig. (5.4-a). Since using luminance and chrominance gives better compression we first compute the luminance, Y, and the two chrominances , I and Q (for NTSC), according to the following formulas:

- Y = 0.30R + 0.59G + 0.11B
- I = 0.60R - 0.28G - 0.32B
- Q = 0.21R -0.52G +0.31B
- For PAL, the chrominances are called U and V and the coefficients are different, but the idea is the same. SECAM is different from both NTSC and PAL.
- Step 2 of JPEG is to apply a discrete cosine transformation to each of the 7200 blocks, separately. The output of each DCT is an 8 x 8 matrix of DCT coefficients. DCT element (0, 0) is the average value of the block. The other elements tell how much spectral power is present at each spatial frequency. In theory, a DCT is lossless, but in practice using floating-point numbers and transcendental functions always introduces some roundoff error that results in little information loss. Normally, these elements decay rapidly with distance from the origin, (0, 0).

Once the DCT is complete, JPEG moves on to step 3, called quantization, in which the less important DCT coefficients are wiped out. This (lossy) transformation is done by dividing each of the coefficients in the 8 x 8 DCT matrix by a weight taken from a table. If all the weights are 1, the transformation does nothing. However, if the weights increase sharply from the origin, higher spatial frequencies are dropped quickly.

Step 4 reduces the (0, 0) value of each block (the one in the upper left-hand corner) by replacing it with the amount it differs from the corresponding element in the previous block. Since these elements are the averages of their respective blocks, they should change slowly, so taking the differential values should reduce most of them to small values. No differentials are computed from the other values. The (0, 0) values are referred to as the DC components; the other values are the AC components.

Step 5 linearizes the 64 elements and applies run-length encoding to the list. Scanning the block from left to right and then top to bottom will not concentrate the zeros together, so a zig zag scanning pattern is used. In this example, the zig zag pattern ultimate produces 38 consecutive 0s at the end of the matrix. This string can be reduced to a single count saying there are 38 zeros. Now we have a list of numbers that represent the image (in transform space).

Step 6 Huffman encodes the numbers for storage or transmission.

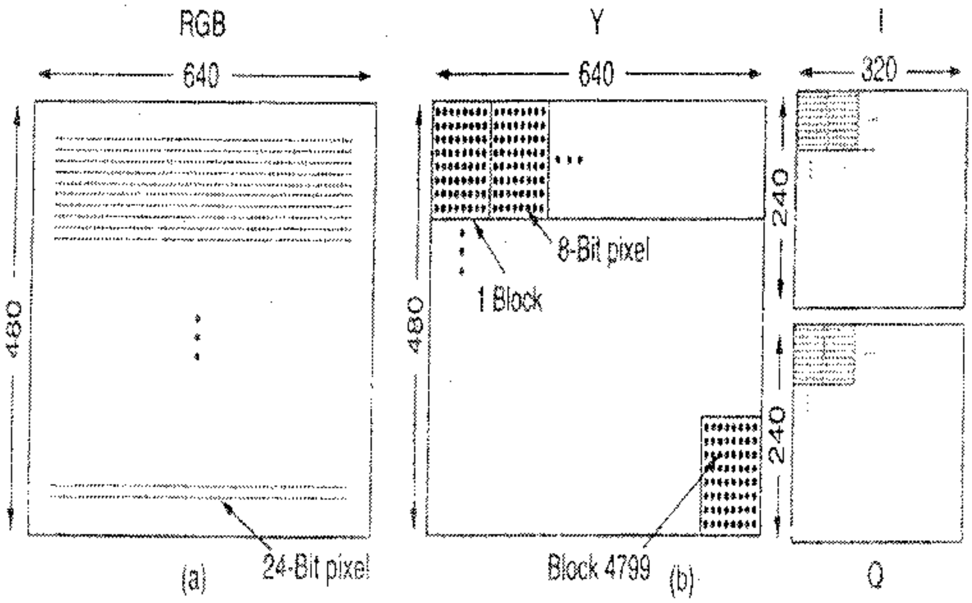

Fig.(5.4). (a) input data. (b) After block preparation.

Q.9 A Multi parity check code Block (63,57) is received from a TV frame. The parity bits are in the locations 31, 47, 55, 59, 61, 62. Explain how this block will be corrected at the receiver if the bit at location 7 was received in error. (10 Marks)

Using the rules of parity checking:

P1=0 because bit on 7 is in error.

P2=0 because bit on 7 is in error.

P3=P4=P5=1

P1P2P3P4P5=00111 which is the position of the bit no 7.

Good Luck and Best Wishes ***Dr. Ibrahim Elashry***