



**QUESTION I: ANSWER THE FOLLOWING QUESTIONS:**

**[10 MARKS]**

1. GIF and JPEG are two commonly used image representations. What images are suitable to be represented as GIF and JPEG? Do they usually use lossless or lossy compression?
2. Briefly explain why we need to have less than 24-bit colour representations (typically down to 8-bit) and why this is sometimes a problem. Give one example where 8-bit colour representation has an advantage in terms of image/video processing?
3. With respect to additive color mixing and subtractive color mixing:
  - a) When are additive color mixing and subtractive color mixing used
  - b) In the CMY model, an additional black channel, K, is used. Briefly explain the reason.
4. Given a colour represented in RGB colour space as  $R = 0.2$ ,  $G = 0.6$ ,  $B = 0.3$ , what is its representation in the CMYK colour model?

**QUESTION II: ANSWER THE FOLLOWING QUESTIONS:**

**[10 MARKS]**

1. Compare between bandpass filter and bandreject filter?
2. JPEG is a popular image compression technique.
  - a) Draw the block diagram of the DCT-based compression scheme and explain the role of each block. Indicate what kind of redundancy is addressed by each step.
  - b) Why using DCT instead of some other transform, for example, DFT?
  - c) Explain why JPEG would not be a good choice of compression algorithm to use to compress the images sent by a fax machine

**QUESTION III: ANSWER THE FOLLOWING QUESTIONS**

**[5 MARKS]**

1. Consider a 3-bit grayscale image ( $L=8$ ) of size  $6 \times 3$  pixels has the intensity distribution shown in following table.
  - a) Draw the histogram corresponding to these grey levels
  - b) Perform histogram equalization and draw the histogram after equalization.
  - c) Get the histogram equalization transformation function.

Gray level	0	1	2	3	4	5	6	7
Number of Pixels	3	8	3	0	0	1	2	1

2. Design a new look-up table to store 24 bit color in 8 bit index, then find the corresponding index for RGB color pixel value(18,77,160)

**QUESTION IV: ANSWER THE FOLLOWING QUESTIONS**

**[10 MARKS]**

1. What are the differences between analog audio recording and digital audio recording?
2. A computer is to be used to add effects to analog audio signals. What two types of devices in general are needed? Describe their functionalities in the processing pipeline.
3. Audio signals are often sampled at different rates. CD quality audio is sampled at 44.1kHz rate while telephone quality audio sampled at 8kHz. What are the maximum frequencies in the input signal that can be fully recovered for these two sampling rates? Briefly describe the theory you use to obtain the results.

4. A video file of duration of 10 sec, frame size of 640 x 480 and frame rate 25 fps. Compute the video size?
  - a) using a 4:4:4 sampling
  - b) using a 4:2:2 chroma sampling
  - c) using a 4:2:0 chroma sampling

**QUESTION V: STATE WHETHER THE FOLLOWING SENTENCES ARE TRUE OR FALSE, AND CORRECT THE FALSE SENTENCES [10 MARKS].**

1. Sharpening spatial filters is low pass filter that "passes over" the low frequency components and reduce or eliminates high frequency components
2. Fourier transform of an image will clearly indicate how much bright or dark the image is.
3. The harmonic mean filter works well for pepper noise but fails for salt noise.
4. To remove coding redundancy, the shortest code are assigned to the least frequent (low probability) gray levels
5. In Component video, color ("chrominance") and intensity ("luminance") signals are mixed into a *single* carrier wave
6. JPEG2000 compression standard is based on discrete cosine transform.
7. Mono sounds require twice the space as compared to stereo recordings
8. Quantization divides the horizontal time axis and Sampling divides the vertical amplitude axis
9. In DFT, if we do not drop any frequency components, the inverse transform will give us the original function with no loss.
10. Gaussian Noise appears as concentrated bursts of energy in the Fourier transform, at locations corresponding to the frequencies of the periodic interference

**QUESTION VI: COMPLETE THE FOLLOWING SENTENCES [15 MARKS]**

1. In ----- process, shades of grey can be simulated by creating varying patterns of black and white dots.
2. ----- color model is used in digital TV broadcasting.
3. ----- is a measure that tells how many bits we need to code the image data
4. The ratio of the power of the correct signal to the noise is called -----
5. ----- is a sound file developed by Apple, is mostly used by Macintosh machines.
6. The digital video display interfaces -----, -----, -----
7. Compression ratio = -----, and relative redundancy= -----
8. ----- is a technique where the histogram of resultant image is flat as possible.
9. HSV color model stands for -----
10. The potential fidelity of an analog audio recording depends on -----
11. The type of image used for photo-realistic images and for complex drawings requiring fine detail is the -----
12. The file size of a five-second recording sampled at 22 kHz, 16-bit stereo (two tracks) would be about -----
13. Television screens use a process of building a single frame from two fields to help prevent flicker on CRTs in a technique called -----
14. If a signal is **band-limited** with a lower limit "7 KHZ" and an upper limit "22 KHZ" of frequency components in the signal, the sampling rate should be at least -----
15. The type of image used for lines, boxes, circles, polygons, and other graphic shapes that can be mathematically expressed in angles, coordinates, and distances is the -----