

**Foundations of Multimedia technologies Midterm exam. 2022.05.05.**

Please give the answers in the blank space below the questions and on further additional blank papers *with indicating the name, Neptun ID and the no. of the given question!*

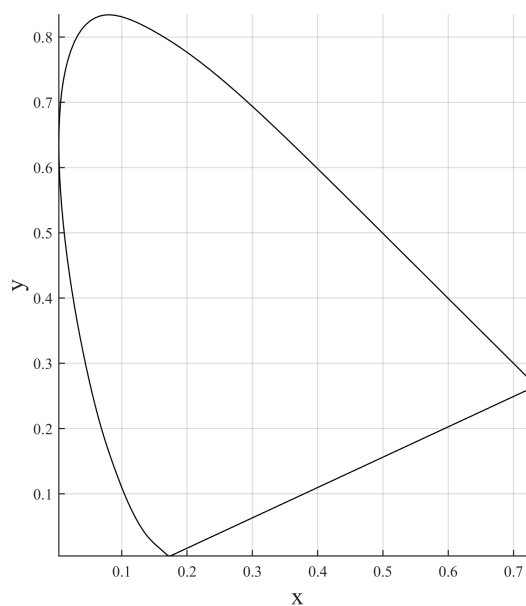
**Total: 40 points** 0-19 points: failure (1), 20-24 points: poor (2), 25-29 points: satisfactory (3), 30-34 points: good (4), 35-40 points: excellent (5)

Name: \_\_\_\_\_  
Neptun ID: \_\_\_\_\_

1. 15 point The RGB  $\rightarrow$  XYZ transform matrix for the ITU-709 HDTV system is defined as:

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0.4124 & 0.3576 & 0.1805 \\ 0.2126 & 0.7152 & 0.0722 \\ 0.0193 & 0.1192 & 0.9505 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}_{ITU-709}$$

- (a) 8 point Calculate the  $xy$  chromaticity coordinates of the RGB primaries and the white point! Mark the location of these points in the horse-shoe diagram below, and illustrate the gamut of the color space (i.e. the location of the reproducible colors)!



- (b) 7 point The ITU-709 RGB coordinates of an arbitrary color  $C$  are given as

$$C = \begin{bmatrix} 0 \\ 0.635 \\ 0.635 \end{bmatrix}.$$

Calculate the luminance and the color difference components ( $Y, R - Y, B - Y$ ) of this color, illustrate its location in the  $B - Y, R - Y$  coordinate system and calculate the hue and saturation of the given color point!

2. 10 point What is chroma-subsampling, why was it introduced and what does the chroma subsampling scheme notation indicate? Describe the chroma subsampling schemes, used in the SD studio standard (ITU-601), in MPEG-1 and in MPEG-2!

3. 5 point Calculate the active bitrate of a  $1920 \cdot 1080/30/P$  format HD video stream if the chroma components are subsampled with a sampling scheme 4:2:2 and components are represented in 10 bits/sample!
4. 5 point What was the common motivation behind creating the HDTV and UHDTV standards? List some improvements of UHDTV compared to HDTV!
5. 5 point Calculate the optimal viewing distance for a HDTV display with the aspect ratio of 16:9 and the diameter being 60 inches (153 cm) in case of watching a full HD content with 1080 active lines!