

VIETNAM NATIONAL UNIVERSITY
University of Engineering and Technology

FINAL EXAMINATION
 2nd semester, Academic year 2019 – 2020
 Class: Image Processing
 Class code: INT 3404 20
 Examination time: 90 minutes

Notes:

- (1) **ONLY handwritten materials** are allowed during the exam.
- (2) Exchanging any materials during the exam is forbidden.
- (3) Answers can be in English, or Vietnamese, (or Japanese).

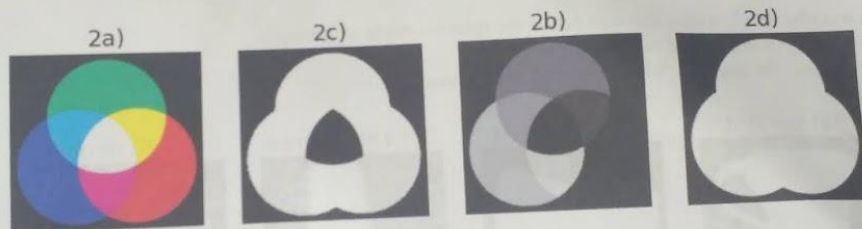
Problem 1 (1.5 points):

- a) (0.5 pt) Which of the following statement is correct?
 A: Opening morphological operation can eliminate regions narrower than the structuring element.
 B: One can apply multiple openings of the same structure element in order to obtain further effect of Opening.
- b) (1 pt) Explain the answer in (a).

Problem 2 (1.5 points):

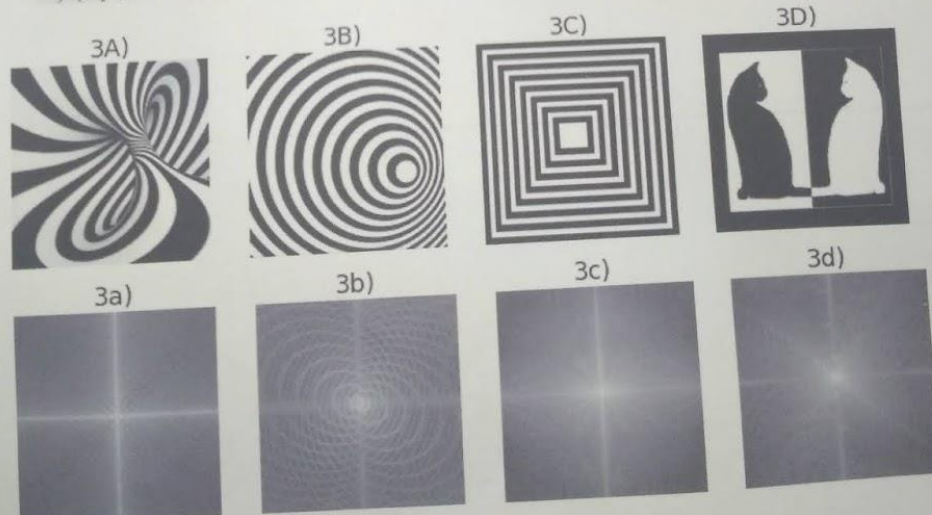
Image 2a) is an RGB image of primary and secondary colors. Convert it to HSV color space and display each channel by one image, we have images 2b-d).

- a) (0.5 pt) Which image of 2b-d) corresponds to Hue, Saturation, Value, respectively?
- b) (1 pt) Explain the answer in (a)



Problem 3 (2 points):

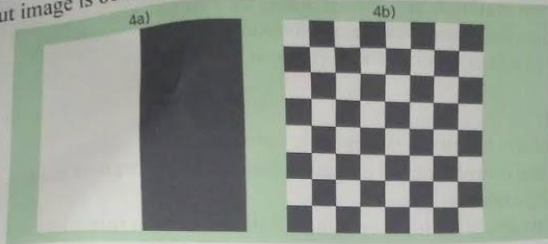
- a) (1 pt) Match each Fourier spectrum image (3a-d) to its corresponding 2D image (3A-D).
- b) (1 pt) Explain the answer in (a)



Problem 4 (3 points):

Two images 4a) and 4b) are quite different, but their histograms are the same. Suppose that each image is blurred with a 3×3 average filter.

- a) (0.5 pt) Would the histograms of the blurred images still be equal?
- b) (1.5 pt) Explain the answer in a)
- c) (1 pt) Sketch the histogram of 4a). Hint: Show bin values and number of pixels. Given the size of the input image is 80×80 pixels and the image is padded by 0s with mode "same".



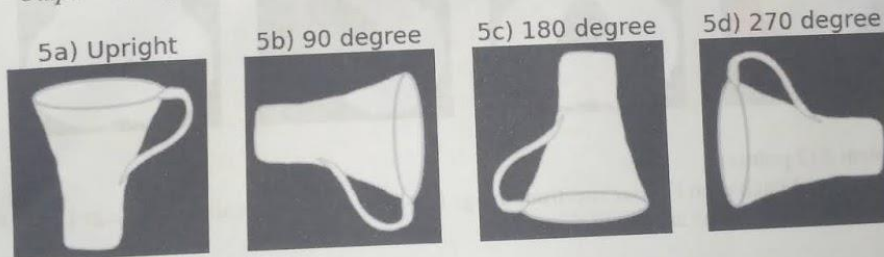
Problem 5 (2 points):

We're building a robot, named CoMug, that can hold a mug by its handle and fill it with coffee. In order to do so, CoMug uses a camera to check the view of the mug: must be upright and the handle is on the right-hand side, as shown in image 5a).

If the mug is in other view such as in images 5b-d), CoMug needs to know the rotation angle (90, 180 or 270 degrees).

Describe an algorithm that can detect the rotation angle of a mug.

- *Input*: An image of a mug (like in 5a-d)
- *Output*: the angle by which the mug was rotated



-----end-----