



## Open your mind. LUT.

Lappeenranta University of Technology

LUT Mathematics and Physics

2015-1-7

### BM40A1200 Digital Imaging and Image Preprocessing

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Exam 2015-01-13

Material allowed in the exam: a calculator.
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Other instructions: i) justify your answers well and ii) if there are any appendices given with this exam paper, they must be returned with your answers.
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1. Understanding of concepts (10 p): Explain briefly the following terms related to digital imaging and image processing. In the case of more than one term (... vs. ...), explain also the differences of the mentioned terms. The maximum length of the answer to the whole task, which will be taken into account, is **1 page**.

- (a) Binning
- (b) Microlens
- (c) Photometry
- (d) Signal-to-noise ratio (SNR)
- (e) Thresholding

2. Light interaction with matter (10 p): Describe silicon as a semiconductor material and its interaction with light in photosensing and imaging.
3. Optics (10 p): Tell about lens aberrations.
4. Illumination (10 p): Find out the irradiance at a point of a flat surface when the beam of light is coming from a point source at the angle of 45 degrees. The light source is at the height of 1.0 m from the surface and its radiant flux is 1.0 W.

*Relevant equations:* 1.

$$d\omega = \frac{\cos \theta_i}{R^2} dA; \quad I = \frac{d\Phi}{d\omega}; \quad E = \frac{d\Phi}{dA}; \quad M = \frac{d\Phi}{dA}; \quad L = \frac{d^2\Phi}{(dA \cos \theta_r) d\omega} \quad (1)$$

5. Image concepts (10 p): The  $n$ -neighbourhood  $N_n$  of a pixel can be defined as a set of pixels dependent on the pixel location.
  - a) Define mathematically  $N_4(x, y)$  and  $N_8(x, y)$ , that is, the 4-neighbourhood and 8-neighbourhood of a pixel at location  $(x, y)$ .
  - b) Which are the 4-neighbours and 8-neighbours of point  $r$  at location  $(3, 2)$  of the image shown in Fig. 1?

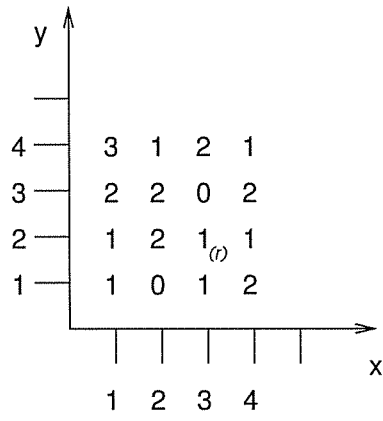


Figure 1: An image.