ANSWER SCRIPT COVER PAGE

NED University of Engineering & Technology

Online Fall Semester Examinations - 2020

Seat No. BM17040_____ Batch _2017_____

Course Title Biomedical Imaging_____ Course Code _BM406_____

Enrol No. _NED/1382/2017_____ Date 6 Feb 2021_____

Question No.	Award	
	First Examiner/ Internal	Second/ External Examiner/ ERC
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
Total in figures		
Total in words		

PLEASE READ THESE INSTRUCTIONS CAREFULLY

1) Download and print this cover page (separately for each exam).
2) Fill the above mentioned particulars before attempting the questions.
3) Students are not allowed to use red or green ink. Solve the questions on A4 size paper using blue or black pen ONLY.

First / Internal Examiner's Signature

Second / External Examiner's / ERC Signature

Biomedical Imaging

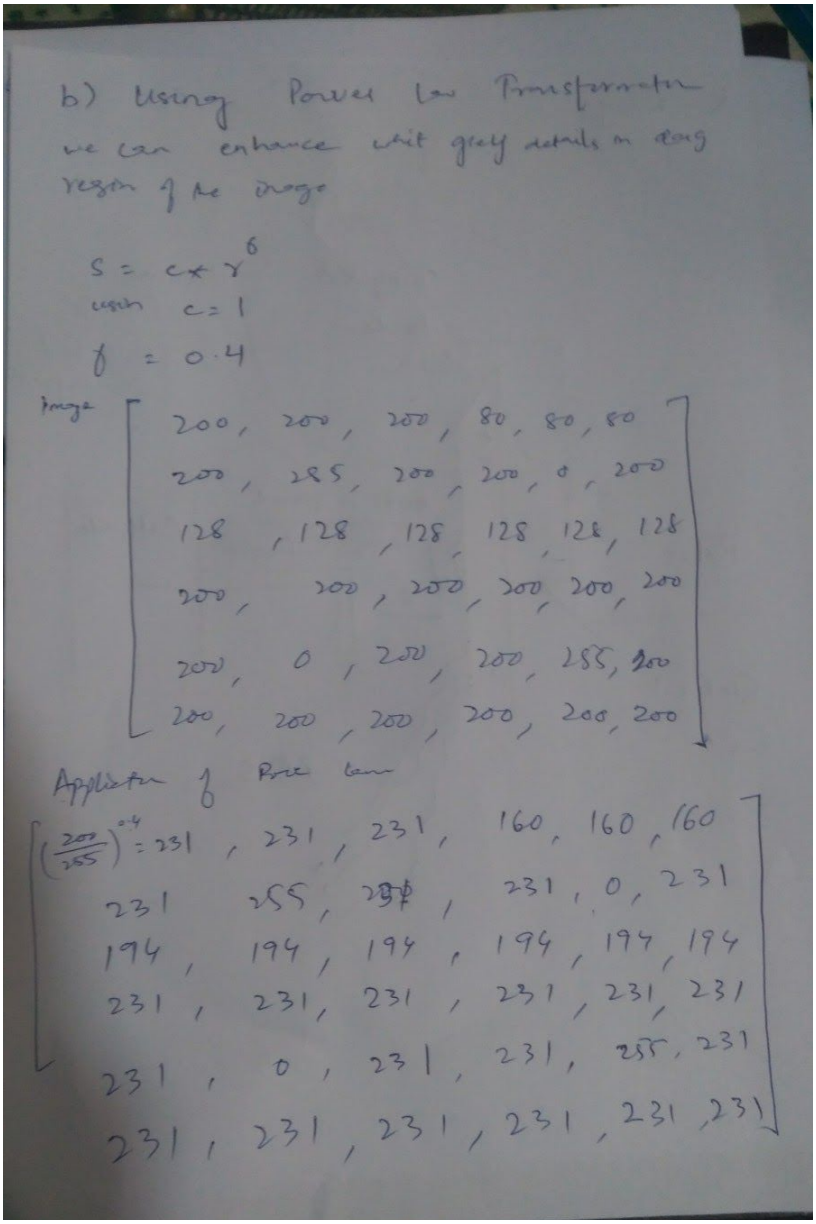
Question # 1

a) Hard X- Rays
    i) Hard X-Rays are used for Radiological Examinations. X-Rays are ionizing radiation with energies ranging from 10KeV to 120KeV
b) Gaussian Noise
    i) Human Hard Tissue blocks or absorbs X-Rays from reaching the X-Ray Detector producing a bright silhouette on the detector and X- Rays that pass through cause dark signals.
c) Absorption of x-rays
    i) Human Hard Tissue absorbs X-Rays from reaching the X-Ray Detector producing a bright silhouette on the detector and X- Rays that pass through cause dark signals. The Amount of X-Rays absorbed reflects the tissue density.
d) Anatomical
    i) X-Rays can be used to distinguish anatomical features that interact with X-Rays
e) Shadow Image
    i) X-Rays produce bright silhouette when incident on the parts of Human Body that absorb X-Rays, the detector detect X- Rays and produce dark signal where X-Rays pass through the soft body.
f) Histogram equalization
    i) Histogram Equalization means spreading the Gray Value which in turn enhances the contrast of the Image.
g) 2nd order derivative
    i) Laplacian Filter is a Type of 2nd Order Derivative Filter used for sharpening images
h) X-rays
    i) X-Rays are used for radiological Examination where as Gamma Radiation is usually used for treatment of Cancer and UV Radiation is usually used for disinfection.
i) 16 levels
    i) 2^4 = 16,
j) Non-invasive diagnostic
    i) X-Rays are commonly used for Diagnostic purposes and it is non-invasive i.e does not require any incision into the human body.

Question # 2

a) R1: 200, 200, 200, 80, 80, 80,
R2: 200, 255, 200, 200, 0, 200,
R3: 128, 128, 128, 128, 128, 128,
R4: 200, 200, 200, 200, 200, 200,
R5: 200, 0, 200, 200, 255, 200,
R6: 200, 200, 200, 200, 200, 200,

b) R1: 231, 231, 231, 160, 160, 160,
R2: 231, 255, 231, 231, 0, 231,
R3: 194, 194, 194, 194, 194, 194,
R4: 231, 231, 231, 231, 231, 231,
R5: 231, 0, 231, 231, 255, 231,
R6: 231, 231, 231, 231, 231, 231,



c) R1: 255, 255, 255, 0 , 0, 0,
R2: 255, 255, 255, 255, 0, 255,
R3: 255, 255, 255, 255, 255, 255,
R4: 255, 255, 255, 255, 255, 255,
R5: 255, 0, 255, 255, 255, 255,
R6: 255, 255, 255, 255, 255, 255,

C) Thresholding

$r = 100$

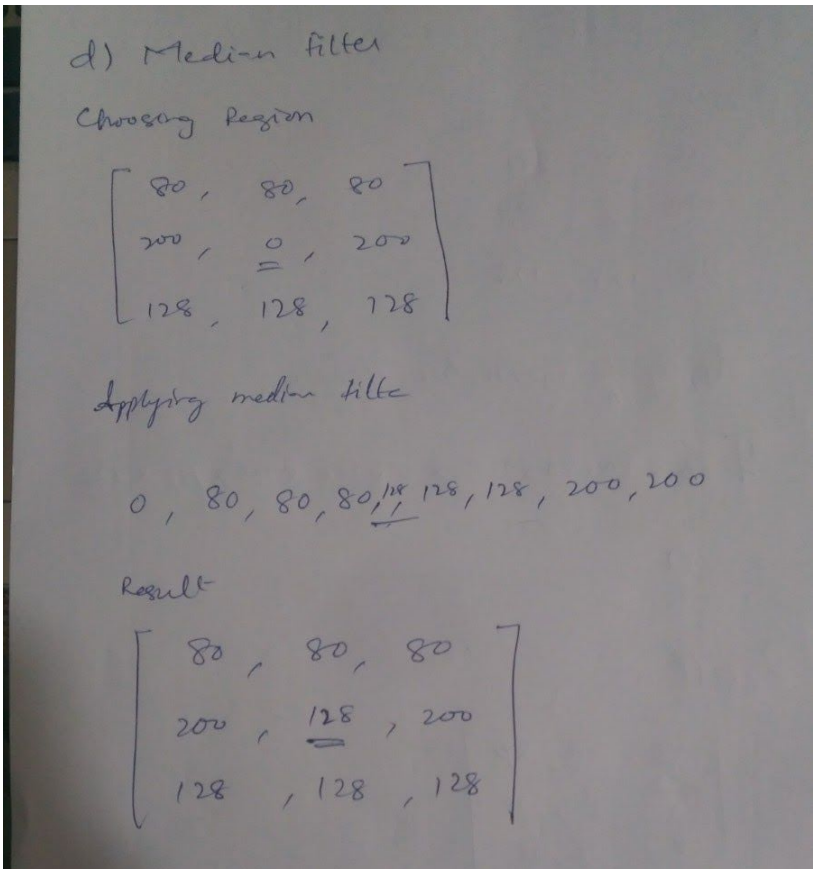
image = $\begin{bmatrix} 200, 200, 200, 80, 80, 80 \\ 200, 255, 200, 200, 0, 200 \\ 128, 128, 128, 128, 128, 128 \\ 200, 200, 200, 200, 200, 200 \\ 200, 0, 200, 200, 255, 200 \\ 200, 200, 200, 100, 200, 200 \end{bmatrix}$

$$S = \begin{cases} 255, & r > 100 \\ 0, & r <= 100 \end{cases}$$

$\begin{bmatrix} 255, 255, 255, 0, 0, 0 \\ 255, 255, 255, 255, 0, 255 \\ 255, 255, 255, 255, 255, 255 \\ 255, 255, 255, 255, 255, 255 \\ 255, 0, 255, 255, 255, 255 \\ 255, 255, 255, 255, 255, 255 \end{bmatrix}$

d) Region
R1: 80, 80, 80,
R2: 200, 0, 200,
R3: 128, 128, 128,

Application of Median Filter
R1: 80, 80, 80,
R2: 200, 128, 200,
R3: 128, 128, 128,



e) Region
R1: 80, 80, 80,
R2: 200, 0, 200,
R3: 128, 128, 128,

Application of Geometric Mean Filter
R1: 80, 80, 80,
R2: 200, 0, 200,
R3: 128, 128, 128

Conclusion:
Geometric Mean filter has no effect on the region of interest whereas median filter is able to significantly improve the quality of the image.

c) Geometric mean

Region

80, 80, 80

200, 0, 200

128, 128, 128

Applying Geometric Mean.

$$\sqrt[9]{80 \times 80 \times 80 \times 200 \times 0 \times 200 \times 128 \times 128 \times 128}$$

$= 0$

Result

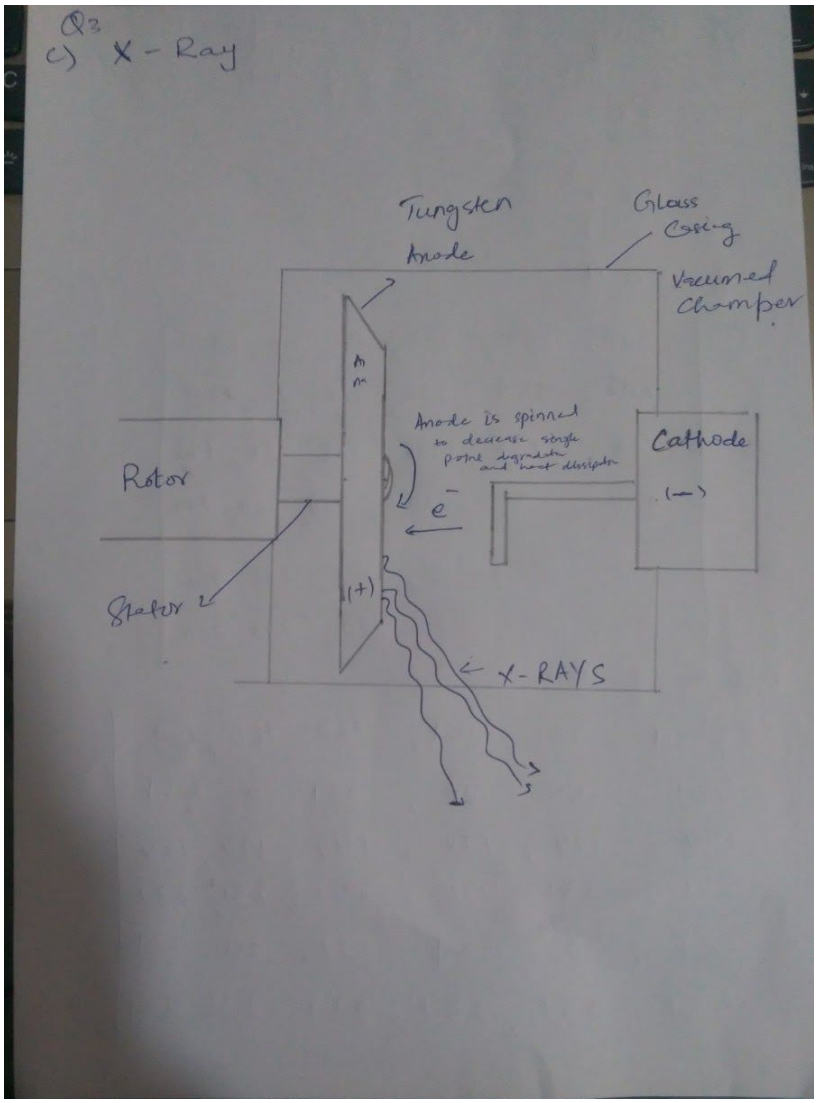
$$\begin{bmatrix} 80, & 80, & 80 \\ 200 & 0, & 200 \\ 128, & 128, & 128 \end{bmatrix}$$

Conclusion

Geometric mean filter has no affect on the region whereas median filter is able to significantly improve the quality of the image.

Question # 3

1. Computerized Tomography
2. Voltage : 25KV - 150KV
   Current: 400 - 1000 A
   Frequency : 30 petahertz - 30 exahertz
   Energy : ~ in 100KeV
   Wavelengths: 10 picometers -10 nanometers
3. X-Rays are generated by bombarding high energy electrons from cathode onto a spinning Tungsten Anode, the electrodes can have a potential difference from 25 to 150 KeV. Spinning Anode is used to minimize single point of degradation from high energy electrons. 99% of energy is lost as heat therefore spinning anode also helps in the dissipation of heat.



4. We Chain Multiple Filters to enhance the image suiting our need
   Example
   i) Applying Enhancement Filter Like 2nd Order Differential Filter like Laplacian Filter
   ii) Followed by a Median Smoothing Filter and then,
   iii) Power Law Transformation
5. Contraharmonic Mean Filter with a Positive Order can be used to eliminate Pepper Noise from an Image

Question # 4

a) CT Scan
b) High Radiation Exposure 100 Times more than a X-Ray, Distortion
c) By Making the patient calm and still, image quality can be improved.
   Using a circular Array.
   Anti Scatter Grid
d) Anode is an an circular Array of detectors
e) CT scan uses X-Rays but produces many slices to construct a 3D Image. It Uses circular array of detectors to capture X-Rays.