Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	PHYSICS OF DIAGNOSTIC RADIOLOGY
COURSE CODE	:	BWC 40803
PROGRAMME CODE	:	BWC
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

TERBUKA

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) What is the ratio of energy converted into heat and energy converted into photon in the X-ray production?

(4 marks)

(b) Distinguish the effect of increasing the X-ray parameter between voltage and current on the continuum radiation.

(4 marks)

(c) The filament inside the X-ray tube is normally made from various type of elements such as tungsten, rhenium and molybdenum. Why this particular element used as cathode material?

(6 marks)

(d) Two of X-ray tube are made from tungsten (W=74) and molybdenum (Mo=42). Which X-ray tube will produce higher intensity as both are applied with 100 keV of voltage? Explain your answer and draw roughly the shape a continuum X-ray spectrum for both X-ray tube

(6 marks)

Q2 (a) Distinguish the function of the collimator and focusing cup in X-ray generator component.

(4 marks)

(b) Explain how "target angle" give influence on the size of focus spot for X-ray tube.

(4 marks)

(c) Define the term of "anode heel effect" and explain in detail why this particular effect can reduce the X-ray intensity.

(6 marks)

(d) **Figure Q2(d)** show a graph of transmitted intensity versus thickness of absorber. Based on this graph, determined

(i) the material absorption coefficient, μ.
(ii) the intensity of transmitted intensity at 16 cm.

(6 marks)

Q3 (a) A radiography image from one object is formed on the film as shown in **Figure Q3(a)**. X-ray is passed through a collimator with the effective size, a of 1 mm. The distance between collimator aperture to object, d_1 and the distance between object to the film, d_2 are 1 m and 10 cm respectively. Calculate the following parameter;

(i) the image magnification, m

(ii) geometric unsharpness value, U_g

(8 marks)

(b) Define the term of X-ray tube rating charts and state the rule of using these charts.

(4 marks)

(c) (i) In radiography process, 10 exposure has been done within 0.43 sec at X-ray setting of 80 kVp and 200 mA using high frequency X-ray unit. If the rectification constant, Cr for high frequency unit is 1.43, calculate the heat unit (HU) produced by this X-ray tube.

(ii) Anode cooling chart for **Q3(c)(i)** is shown in **Figure Q3(c)**. How long it does it take for this X-ray tube to operate for another exposure?

(8 marks)

Q4 (a) Classify the basic components for projection radiography system.

(4 marks)

(b) Explain in detail the image formation mechanism for the radiography projection system.

(6 marks)

(c) Attenuation phenomenon in radiography such as scattering effect can reduced the X-ray imaging quality. Suggest the best method to reduce this X-ray scattering effect, and explain further detail its mechanism.

(4 marks)

(d) Explain in detail how X-ray Computed Tomography work.

(6 marks)

Q5 (a) Latent image formation is different in conventional radiography (CR) and digital radiography (DR). Differentiate the mechanism of image formation between CR and DR.

(4 marks)

(b) In radiography imaging, there are two type of digital radiography (DR) imaging technique, which consists of indirect digital radiography and direct digital radiography. Differentiate the mechanism for both techniques.

(4 marks)

(c) Picture archiving and communication system (PACS) is a networking system to distribute the digital image in radiography. Draw a schematic diagram of this system and explain in detail how this system work.

(6 marks)

(d) Computed tomography and fluoroscopy are a common device for radiography imaging technique. Differentiate between both techniques in term of the image resolution, and suggest which is the best imaging technique between both of these techniques.
(6 marks)

-END OF THE QUESTIONS-

LIST OF FORMULA

$Heat\ Unit, HU = Voltage, V\ x\ Current, I\ \text{x}\ Operation\ times, t\ x\ \text{Rectification constant}, C_r\ x\ Number\ of\ \text{exposure}, N$
$Absorbed\ Dose\ Rate, DR = Activity, A\ x \frac{Radiation\ Energy, E}{mass\ of\ material, m}$
$\text{Blurring}, B = a.\cdot \frac{d_2}{d_1} = a \cdot (m-1)$
$m = \frac{d_2 + d_1}{d_1}$
$\text{Geometric Unsharpness}, U_g = \frac{B}{m} = a \cdot \left(1 - \frac{1}{m}\right)$

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SEMESTER / SESSION : SEM I / 2018/2019 PROGRAMME : BWC
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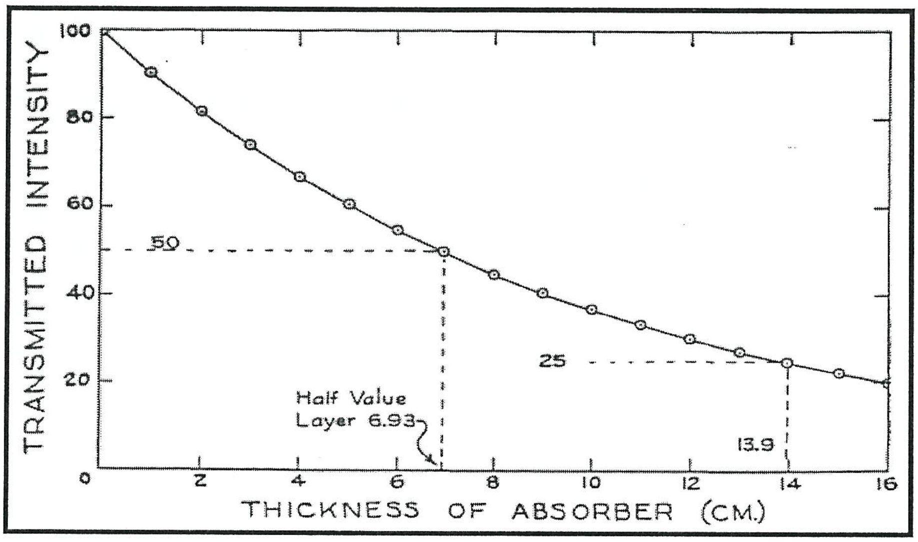

Figure Q2(d)

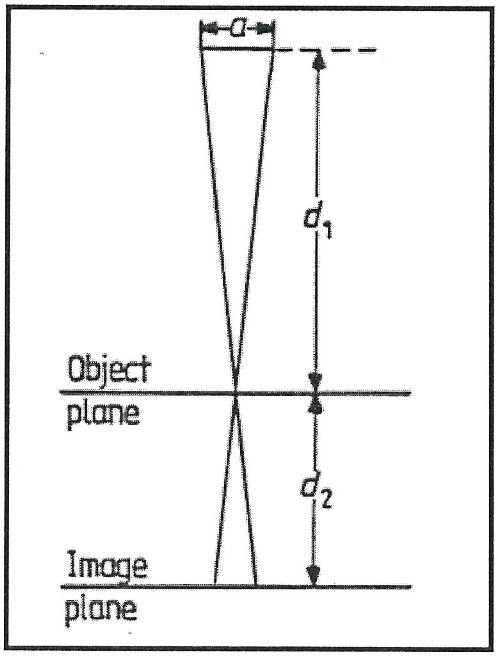

Figure Q3(a)

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SEMESTER / SESSION : SEM I / 2018/2019
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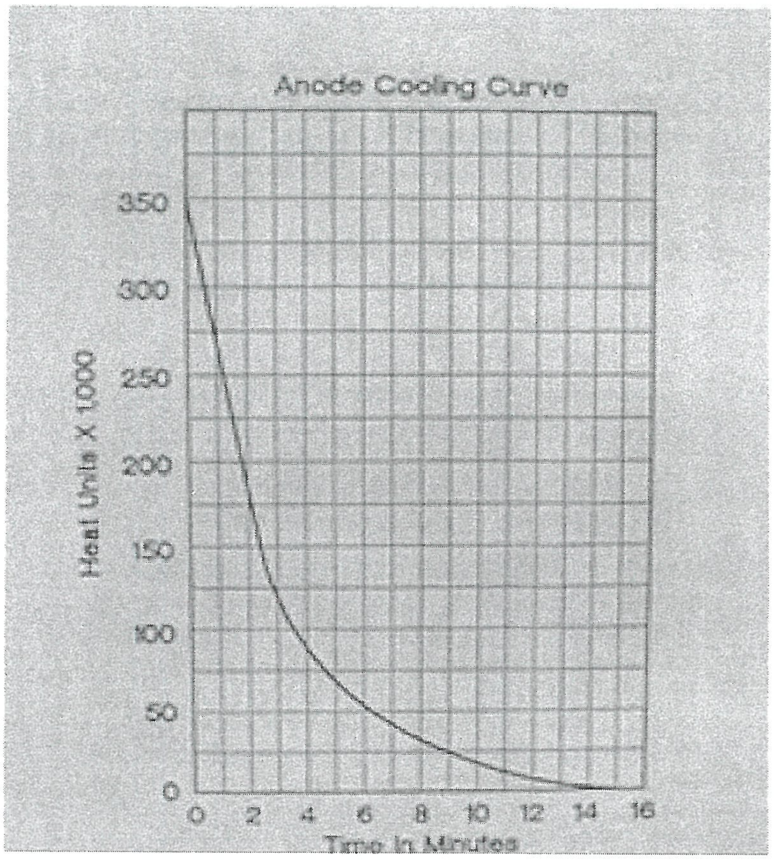

Figure Q3(c)