NBE-E4310 - Biomedical Ultrasonics

EXERCISE 3 (20p)

Independent/group work 14.2.2019 at 12-14; correct solutions 28.2.2019 at 12-14

Submission: Please submit your responses via MyCourses as one zip file containing your responses in pdf and Matlab format.

The deadline for submitting your Exercise 3 responses is at 11:00 AM on Feb 28, 2019.

---

1. Acoustic mercury “fountain” (2p)

An ultrasonic beam is focused on the surface of liquid mercury directly from below. As a result a $100\ \mu m$ tall fountain is formed. What is the I_{spta} ? How about I_{sppa}, when the duty cycle of the ultrasound exposure is 40% ?

2. Geometric attenuation (6p)

Derive the expression of the geometric attenuation when the sound is produced by a:

a) point source,

b) line source.

3. Cavitation (6p)

Calculate the resonance size for a bubble excited by 1 MHz Ultrasound in water,

a) near the water-air interface at 1 atm

b) at 10 cm depth

c) at 1 m depth

4. Ultrasound safety (6p)

The instantaneous intensity at the PNP is:

a) $1\ \frac{W}{\mathrm{cm}^2}$

b) $100\ \frac{W}{\mathrm{cm}^2}$

c) $1000\ \frac{W}{\mathrm{cm}^2}$

Which of these are likely to cause biological damage? Why?

Assume that the ultrasound is delivered in short pulses with no macroscopic thermal effects.