

EXERCISES – ULTRASOUND PHYSICS AND TECHNOLOGY

Exercises from the book, Short-Answer Questions:

(Variants of the underlined exercises will be used as written exam questions, the other exercises are good preparation for the oral exam)

Chapter 2: 1-6, 8, 10, 7,9

Chapter 3: 1-5, 6, 7, 9

Chapter 4: 3, 6, 7, 2, 8

Chapter 5: 3, 4

Chapter 6: 1

Chapter 7: 1-8 (Multiple choice: 1-16)

Chapter 8: 1-4 (Multiple choice: 1-16)

Chapter 9: 1-2, 3-5 (Multiple choice: 2-3, 1, 4-6)

Chapter 10: 1, 5-6, 2-4, 7-8 (Multiple choice: 1-10)

Chapter 11:

Chapter 12: 1, 3

Chapter 13: 1-4, 5, 6

Chapter 14: 1, 3, 5, 6, 8, 2,4,7

Chapter 15:

Chapter 16:

Exercises to the literature in the categories at Canvas:

(Variants of the underlined exercises will be used as written exam questions, the other exercises are good preparation for the oral exam)

1_History

1. What are Inge Edler and Helmuth Hertz known for?

2_Physics

2. A plane continuous wave with frequency 10 MHz and pressure amplitude 53 kPa propagates in water. What is the intensity, particle displacement and particle velocity of this wave?

3. In pulse-echo contexts, a pulse repetition of 5 μ s is very short. How long does the pulse travel at this time (in water)?

4. If the maximum depth was 10 cm, how long is the repetition time needed for all echoes to register before the next pulse is transmitted?

5. What is speckle?

6. The attenuation of ultrasound in tissue is affected by a number of factors. Which?

7. The pressure amplitude of a registered echo has decreased 30 dB compared to the transmitted pulse whose maximum amplitude was 200 kPa. How big is the echo amplitude expressed in Pa? What are the corresponding values for intensity? Assume that $Z = 1500 \times 1003 \text{ kg / m}^2$.

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| 4_Bats | 8. In what way do bats eco-localization signals differ to dolphins?
9. What is meant by CF and FM in bat context?
10. What does the bat wins on targeting the side of the beam, instead of the center of the beam, towards the object that it chases? |
| 7_Dolphins | 11. Name a theory of how echo localization sounds can be generated by toothed whales!
12. How does the sound from the water connect to the interior of the inner ear of a toothed whale?
13. Describe how porpoises do to locate fish in turbid waters. |
| 6_Therapy | 14. <u>Explain why an excited sinusoidal ultrasound signal can have a sawtooth shape 10 cm from the sensor?</u>
15. <u>Describe one of the principles for how shock waves in a lithotripter are generated.</u> |
| 8_Echocardiography | 16. <u>Name at least 5 important examples of what information can be obtained in an ultrasound examination of the heart ?</u> |
| 12_Special techniques | 17. <u>Describe the basic principle of photoacoustic emission.</u> |
| 5_Industrial applications | 18. <u>What different wave types/modes can a sound wave be transmitted in a solid material?</u>
19. <u>Give one example of an industrial application and describe the measurement principle.</u> |
| 10_Sonar | 20. <u>Both the methods SSS and SAS provide a very useful image of the seabed surface, which can be used for e.g. marine geological and marine biological purposes, or to search for objects on the bottom (eg mines).</u>

a) <u>What is shown in the images that the instruments give?</u>
b) <u>What determines how small objects can be seen in instruments of these types?</u>
c) <u>Why does a SAS generally have higher detail resolution than an SSS?</u> |