

**RAD 312 Physics and instrumentation of Ultrasound**

**First midterm exam 18-3-2013**

|  |  |  |  |
| --- | --- | --- | --- |
| Section | A | B | C |
| Marks | 10 | 10 | 10 |

**Student Name:**

**Student #:**

**Section (A): Choose the most correct answer from the following:**

1. **Ultrasound waves are high-frequency sound waves which are:**
2. > 20 Hz
3. <20 KHz
4. >20 KHz
5. >20 MHz
6. <20 Hz
7. **The frequency of a sound wave that has a wavelength of 0.0005 mm is:**
8. 3MHz
9. 3 KHz
10. 7 MHz
11. 7KHz
12. None of the above
13. **Regarding transverse waves :**
14. Particles vibrate perpendicular to the direction of propagation
15. Do not need a medium, can travel in a vacuum
16. Example are x-rays
17. All of the above
18. a and b

**4) Snell`s law states that:**

1. sin Ɵt / sin Ɵ i = C1/ C2
2. sin Ɵt / sin Ɵ i = C2/ C1
3. sin Ɵi / sin Ɵ t = C1/ C2
4. sin Ɵi / sin Ɵ t = C2/ C1
5. none of the above

**5) The two conditions that are required for refraction to occur:**

1. Incident sound beam must fall at an angle and not perpendicular
2. Speed of sound must be different in the two materials
3. Speed of sound must be the same in the two materials
4. a and b
5. a and c

**6) The amount of sound beam attenuation that occurs in 20cm of Liver, given that the attenuation coefficient for liver = 0.5 will be;**

1. 0.1 dB
2. 10 dB
3. 40 dB
4. 0.4 dB
5. None of the above

**7) Quartz has been replaced by PZT due to several reasons:**

1. More efficient
2. Can produce higher frequencies
3. Better sensitivity
4. All of the above
5. a, c and d only

**8) The frequency of the transducer is determined by:**

1. wave length of sound wave
2. number of crystals in transducer
3. thickness of crystal
4. resonance frequency
5. all of the above

**9) Phased array transducer are characterised by:**

1. Flat or straight transducer face and produce a sector field of view
2. Curved transducer face and produce a linear field of view
3. Flat transducer face and produce linear field of view
4. Curved transducer surface and produce a sector field of view
5. None of the above**.**

**10) Regarding transmit and receive focus:**

1. Both done by the operator
2. Both done automatically
3. Transmit focusing done automatically and receiver done by operator
4. Transmit focus done by the operator and receiver focus done automatically
5. None of the above

**Section (B): State if the following statements are “True” or “False” and correct the false ones:**

|  |  |
| --- | --- |
| **1)** The frequency of sound waves is inversely related to the attenuation. |  |
| **2**) The speed of sound waves in a material is determined by its density and thickness. |  |
| **3)** When an ultrasound beam falls on an interface at an angle, the angle of reflection is equal to the angle of incidence and in the same direction. |  |
| **4)** The more distance the waves have to cross in body tissues the more attenuation occurs. |  |
| **5)** The acoustic impedance of a medium is a product of its density and speed of sound through it. |  |
| **6)** To act as transmitters and receivers, PZT crystal must first be polarized, this is done by heating the material above the Curie temperature (365° C). |  |
| **7)** when two sound waves that are out of phase interact with each other, the  net result will be sum of these waves. |  |
| **8)** The purpose of the damping layer is to damp the vibrations from the back of the crystal resulting in longer sound waves which results in better axial resolution. |  |
| **9)** For a given frequency: NFL increase with increase in transducer diameter  and divergence decrease with Increasing diameter. |  |
| **10)** Annular array is focused by applying an electrical pulse to each element in turn, starting with the innermost element and working toward the outer array. |  |

**Section (C): Answer the following questions:**

1. **Calculate the intensity reflection coefficient of a muscle-bone interface if :**

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**Z (muscle) = 1.71x 10 kg/m². s, Z (bone) = 7.8x10 kg/m². s.**

1. **Fill in the 4 blanks in the following statement:**
2. Axial resolution is determined by………………which is affected

by: **1-…………………………**

**2-………………………….**

**3-……………………………**

1. Lateral resolution is determined by…………….. which is affected

by: **1-………………………….**

**2-……………………….**

**3-………………………………**