



## Medical Equipment IV (Part 1) Term Exam – 2013

Solve as Much as You Can – Maximum Grade for Both Parts 1 and 2: 75 Points

### Part I. Complete the following sentences [1 point each]:

1. For an ultrasound imaging system working in B-mode scanning with 64 lines/frame and a frame rate of 100 frames/s, the maximum scanning depth is ...  $1/(100 \times 64 \times 13\mu s) = 12\text{cm}$
2. Changing direction of the ultrasound beam results in ... **Same** received signal from scattering.
3. At an interface with  $Z_1 = 4 Z_2$ , the transmitted signal intensity will be  $(1 - (3/5)^2) = 64\%$  % of the incident.
4. Acoustic impedance is ... **Higher** for materials with higher density.
5. A reflection that is received 65  $\mu s$  after transmission is ... **5** cm away from the transducers.
6. To remove clutter signal, a ... **High-Pass** filter is used.
7. A higher Doppler PRF at the same transmission frequency results in ... **shorter** allowed gate depths.
8. CPAP increases lung compliance by increasing ... **volume** at the same ... **Pressure**.
9. To provide an air/oxygen mixture with a specific Oxygen concentration, we use **Venturi** mechanism.
10. **Pressure** is most practical baseline variable and used in all modern ventilators.
11. Water is removed from a hemodialysis patient using a process called **Ultrafiltration**
12. To prevent cross-infection, blood line in hemodialysis is **Disposable**
13. Detection of wrong input dialysate concentrates in hemodialysis can be done using **pH monitors or pump speed monitor**
14. Blood leak detection is usually implemented based on **optical** sensors.

### Part II. Mark the following statements as True (T) or False (F):

15. TGC automatically detects variations in attenuations and compensates for them. **(F)**
16. 4D ultrasound acquires and displays 3D information in real-time. **(T)**
17. Echo ranging in ultrasound imaging assumes constant known speed of ultrasound in different tissues. **(T)**
18. Aliasing in pulsed wave Doppler can be reduced by using higher transmission frequency. **(F)**
19. NIV uses a single limb for taking fresh gas to the patient. **(T)**
20. Some Ventilators can work using a compressed air as energy source. **(T)**
21. The hysteresis in the pressure-volume curve of respiration represents the work done by the alveoli. **(F)**
22. Expiratory cycling can be done using time or spontaneous breathing. **(F)**
23. Spontaneous breathing is always allowed with CPAP treatment. **(T)**
24. Air in the dialysate is completely harmless to the patient and the accuracy of the dialysis treatment. **(F)**

### Part III. Answer the following problems:

25. [5 points] Consider a **continuous-wave Doppler** velocity estimation of the blood flow in a vessel at depth 10 cm. What is the highest velocity that can be estimated with no aliasing if the transmitted signal frequency was 10 MHz?

Since this is continuous wave Doppler, there is no upper limit to highest velocity as in pulsed wave Doppler. So, in theory, it is  $\infty$ .