Cairo University **May 2007**
Faculty of Engineering **Time: 2 Hours**
Biomedical Engineering Department **Closed Book/Notes**

3RD YEAR MEDICAL EQUIPMENT II TERM EXAM – PART II

I. Answer the following questions by marking the best answer among the choices given [1 point each]:

1. Computed tomography was invented to …
    a. Detect small differences in contrast (*)
    b. Move plain x-ray into the digital world
    c. Introduce a new method of projection imaging

2. Fan beam x-ray was used in CT starting from the … generation.
    a. First
    b. Second (*)
    c. Third

3. The translational motion of x-ray source and detectors was no longer used starting from …
    a. Second generation
    b. Third generation (*)
    c. Fourth generation

4. The fourth generation x-ray systems are faster than the third generation because …
    a. Only the source needs to move while the detectors are stationary. (*)
    b. Only the detectors need to move while the source is stationary.
    c. Only the patient table needs to move while the source and detectors are stationary.

5. Simple backprojection algorithm produces … images.
    a. Faster
    b. Slower
    c. Blurred (*)

6. Most current CT systems belong to the following technology …
    a. Fourth generation
    b. Spiral CT (*)
    c. Dynamic spatial reconstructor (DSR)

7. If the linear attenuation coefficients of water and fat tissues for 60 keV x-rays are 0.206 and 0.185 respectively. Then, the CT number for fat is equal to …
    a. – 102 (*)
    b. + 102
    c. +10.2

8. To reconstruct a 128×128 CT slice with a CT scanners using a fan x-ray beam and 32 detectors, it is necessary to have a number of rotations of the head that is equal to …
    a. 128
    b. 256
    c. 512 (*)

9. Spiral CT scanning relies on …
    a. Moving the source and detectors in a spiral path around the patient.
    b. Rotating the source and detectors while moving the patient table (*)
    c. Moving the source and detectors in a spiral path while moving the patient table

10. Given the definition of the transmembrane pressure (TMP) in hemodialysis, it is always …
    a. Negative (*)
    b. Positive
    c. Zero

11. Blood line leading from the hemodialyzer to the patient is called …
    a. Arterial blood line
    b. Venous blood line (*)
    c. Exit blood line

12. Water moving by … gradient is called osmosis.
    a. Energy
    b. Concentration (*)
    c. Pressure

13. The error of a device that monitors and displays transmembrane pressure is … when the set value of the TMP is 200 mmHg.
    a. ±20 mmHg (*)
    b. ±10 mmHg
    c. ±5 mm Hg

14. Dialysate bypass is necessary in the following condition …
    a. Blood leak
    b. Air bubble detection
    c. Conductivity alarm (*)

15. Blood pump is shut off in the following condition …
    a. Ultrafiltration monitor alarm
    b. Disinfection protection alarm
    c. Dialysate temperature alarm (*)

16. Single-fault condition means …
    a. Not more than one defect in any component in the whole system (*)
    b. Not more than one defect in each component in the whole system
    c. Both of the above

17. Ultrafiltration rate is measured using …
    a. One flowmeter in the filter
    b. Two flowmeters before and after the filter in the dialysate circuit (*)
    c. Two pressure sensors on the blood and dialysate sides

18. Removal of waste metabolites from the body in hemodialysis uses the following mechanism:
    a. Osmosis
    b. Ultrafiltration
    c. Diffusion (*)

19. The following imaging modality is used in lithotripsy: …
    a. Plain x-ray system
    b. Biplane x-ray system (*)
    c. Ultrasound imaging

20. The nature of shock waves is …
    a. Mechanical wave (*)
    b. Electromagnetic waves
    c. Transverse waves

21. DC-containing signal isolation can be done using …
    a. Optical isolators (*)
    b. Capacitors
    c. Transformers

22. The electrical power supply isolation can only be done using …
    a. Optical isolators
    b. Capacitors
    c. Transformers (*)

II. Mark the following statement as either True (T) or False (F) [½ point each]:

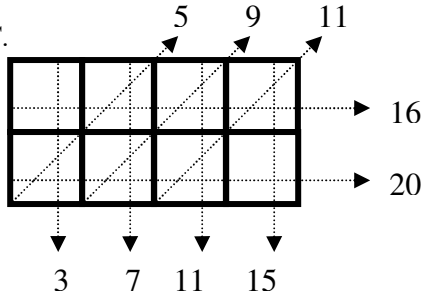
23. Filtered backprojection relies on a simple high-pass filtering. (T)
24. Computed tomography is used to generate higher resolution images than plain x-rays.(F)
25. The use of fan beam x-rays in CT scanners is more efficient than pencil beam x-rays. (T)
26. Water moving by pressure gradient is called ultrafiltration. (T)
27. Dialysate side is usually sterilized before each patient is treated in hemodialysis. (T)
28. In transmembrane pressure alarm, dialysate bypass is necessary. (F)
29. Ultrafiltration rate is controlled by changing the transmembrane pressure. (T)
30. The unit of CT numbers is Hounsfield (T)
31. Venous clamp is activated when a blood leak is detected (F)
32. Isolation aims at making the possibility of signal contamination minimal. (F)

III. Solve the following Problems

33. [1.5 Points] In designing an ultrafiltration rate estimation unit using flowmeters, if the desired accuracy of the ultrafiltration rate calculation is ±100mL/hr and given the nominal dialysate flow rate of 1L/min and a desired ultrafiltration rate of 1L/hr, then compute the minimum accuracy (%) of the flowmeters to be used. (sol= 0.08%)

34. [1.5 Points] Solve the following reconstruction problem using ART.

1 3 5 7
2 4 6 8



Best of Luck