


Name:	
Enrolment No:	

UPES
End Semester Examination, May 2024
Course: GE Module on Medical Devices and Ultrasound
Semester : 4th
Program: B.Tech Biomedical Engineering
Duration : 3 Hours
Course Code: HSBE 2004 **Max. Marks: 100**

Instructions: Attempt all the questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q1	What do you mean by leakage current?	1.5	CO4
Q2	There is no loss of consciousness in a patient during a mild-shock event. Is this statement true or false?	1.5	CO4
Q3	The resting membrane potential of a cell is -20 mV. Is this statement true or false?	1.5	CO2
Q4	Wearable artificial kidneys work on the principle of: (a) reverse osmosis (b) Doppler effect (c) nano-dialysis (d) none of the above	1.5	CO3
Q5	The cellulose triacetate membranes are less efficient than cuprophanes for hemodialysis. Is this statement true or false?	1.5	CO3
Q6	Which is the governing principle behind signal acquisition in an ultrasound instrument? a. Pulse-echo principle b. piezoelectric effect c. both (a) and (b) d. Diffuse reflectance	1.5	CO1

Q7	Which of the following is true for sound waves? a. they are electromagnetic longitudinal waves b. they are electromagnetic transverse waves c. they are mechanical transverse waves d. they are mechanical longitudinal waves	1.5	CO1
Q8	What is the composition of dialysate solution?	1.5	CO3
Q9	The wearable artificial kidney units use 120 L of dialysate solution. Is this statement true or false?	1.5	CO3
Q10	Shocks due to AC current is more fatal than DC current. Is this statement true or false?	1.5	CO4
Q11	The phased array ultrasound probe can image deeper structures. Is this statement true or false?	1.5	CO1
Q12	What is the standard reduction potential of $Zn^{2+}_{(aq)}/Zn_{(s)}$ if its standard oxidation potential is 0.76 V? a. 0 V b. - 0.76 V c. 0.76 V d. None of the above	1.5	CO2
Q13	An electrode is a metallic conductor which aids in biophysical and biochemical signal acquisition. Is this statement true or false?	1.5	CO2
Q14	The electrode potentials are conventionally given in terms of oxidation potentials only. Is this statement true or false?	1.5	CO2
Q15	Which of the following electrolyte is used in micropipette based microelectrodes? a. 3M NaCl b. 3M KCl c. 1 M AgCl d. 1 M KCl	1.5	CO2
Q16	Galvanic currents involve pulse duration of: a. 10 ms b. >10 ms c. <10 ms d. none of the above	1.5	CO4

Q17	Draw the electrical equivalent circuit of the electrode-skin interface under dry skin conditions.	1.5	CO2
Q18	Which is the most widely used piezoelectric crystal in ultrasound probes?	1.5	CO1
Q19	Needle electrodes have less contact impedance as compared to surface electrodes. Is this statement true or false?	1.5	CO2
Q20	What is the purpose of using damping block in ultrasonography instrument?	1.5	CO1
Section B (4Qx5M=20 Marks)			
Q 1	(a) Calculate the acoustic impedance to the propagation of ultrasound through the liver. Assume the density of liver cells to be $1.05 \times 10^3 \text{ kg/m}^3$ and speed of ultrasound waves through the cells to be 1570 m/s. (b) What is role of matching layer in an ultrasound transducer probe?	5	CO1
Q2	Describe the various blood access techniques for performing hemodialysis, and assess which technique is most suitable.	5	CO3
Q3	Write a short note on the constant current mode of Faradic current-based stimulation.	5	CO4
Q4	Describe the different types of needle electrodes.	5	CO2
Section C (2Qx15M=30 Marks)			
Q 1	Describe the phenomena of depolarisation and repolarisation of cells for generating an action potential.	15	CO2
Q2	(a) Explain the principle behind generation of ultrasound. What are the various types of ultrasound probes? (b) Estimate the attenuation of ultrasound wave passing through soft tissues, of thickness 1.4 cm, for a 2 MHz and 6 MHz wave. Which wave frequency would you adopt to achieve higher imaging resolution? Justify your answer. Assume attenuation coefficient to be 0.5 dB/cm/MHz.	15	CO1
Section D (2Qx10M=20 Marks)			

Q 1	Discuss the role of Faradic and Galvanic currents in electrical stimulation.	10	CO4
Q2	Explain the process of hemodialysis with the help of a suitable diagram.	10	CO3