1. ( ) [10%] The traditional cuff method (called sphygmomanometer) measures the systolic and diastolic blood pressures. The cuff around the arm is inflated to a high pressure and depressurized gradually. A stethoscope is used to listen to the so-called Korotkov sound. The first sound that corresponds to the systolic pressure is caused by (A) blood flow through opening blood vessels that have been pinched by the cuff, (B) collapsing of the blood vessels by the cuff pressure, (C) oscillations in the cuff-manometer system, (D) mitral valve sound transmitted via the blood vessels, (E) none of the above.

2. ( ) [10%] Which of the following methods is not suitable for measuring the phasic (time-varying) waveform of blood flow or blood flow velocity? (A) electromagnetic flowmeter, (B) Doppler ultrasound flowmeter, (C) indicator dilution method, (D) laser Doppler flowmeter, (E) none of the above.

3. ( ) [20%] For a pressure catheter/transducer system, we try to estimate its frequency response by use of fluid dynamic formulas and the physical dimensions and properties of the system. The dimensions of the catheter are: radius \( r = 0.1 \text{ cm} \) and length \( l = 100 \text{ cm} \). The catheter is filled with saline which has density \( \rho = 1 \text{ g/cm}^3 \) and viscosity \( \mu = 1 \text{ poise} \) (poise = g•cm\(^{-1}\)s\(^{-1}\)). The Young's modulus of elasticity \( E \) of the pressure transducer is \( 4 \times 10^8 \text{ g•cm}^4\text{s}^{-2} \). The natural frequency, \( \omega_n \), for the system should be (in radians/s) (A) 218, (B) 296, (C) 354, (D) 412, (E) none of the above.

4. ( ) [30%] The following pressure waveform obtained with a "pop test" shows the step response of a pressure catheter/transducer system. Assume that the catheter/transducer system can be accurately described as a 2nd-order system. (a) Determine the damped frequency, \( \omega_d \), in radians/s. (b) Determine the damping factor, \( \alpha \). (c) Determine the natural frequency, \( \omega_n \), in radians/s and also convert it to the unit of Hz.

5. ( ) [30%] We use the thermal dilution technique to measure the cardiac output. A bolus of 20 cm\(^3\) iced saline (i.e. at 0 \(^\circ\)C) is injected into the right atrium at time zero. The specific heat of saline is 1 cal/(cm\(^3\)•\(^\circ\)C). The heat-loss constant \( K \) is estimated to be 0.85. The temperature measured at the pulmonary artery is shown below as a function of time. (a) What is the little bump that appears about 6 sections after the injection? (b) How are you going to treat this little bump in the flow calculation? (c) Determine the cardiac output in Liter/min.