The Red Hombre

(Instrumentation Systems)

Captain First Rank Marko Ramirez of the Paraguayan Navy was dressed for the special occasion to occur later that day. Five layers of louse-infested castaway uniform parts enclosed his slightly-bloated body. A filthy harbor tug sputtered its engines as it pushed ever so gently against the *Red Hombre*. It was the first mission for the first submarine in Paraguayan history. On its decks was a diverse collection of ragtag paramilitary adventurers who would soon discover that the decks of submarines do not stay dry for long.

"Engines ahead slow, Karlos," he ordered. Karlos fumbled. Ramirez frowned. Karlos was not quite sure he knew where the engine control was located. Ramirez frowned on, afraid that Karlos would ask the question of him. With a frown on his face, Ramirez looked formidable. Karlos never asked.

The submarine slid from her contact with the filthy harbor tug and began slowly plying the waters of filthy harbor. The *Red Hombre* was a sight to behold. Made from scraps bought at yard sales around the world and smuggled into Paraguay, the submarine was at once majestic and cobbled.

The sub was the same inside. Where instrument panels would have been found in other ships, large areas of emptiness presented themselves. Karlos did not know what to make of it. Ramirez knew that nothing had been made of it.

"Get me some assistants," said Ramirez. "This sub needs instruments. Without them we're lost." Karlos obeyed quickly. He contacted the ENBE 601 class, knowing that help could be gotten there cheaply.

"Never mind that you have a final examination coming up," he intoned. "We need your help with some instrumentation issues. What we need are the answers to some problems that I know you can answer. Without them, we can't hope to escape from filthy harbor. With them, we can move to new places and you can escape from ENBE 601. Neither you nor we can lose. Here is the list:"

1. Propose a means to measure the volume flow rate of a liquid flowing through a pipe using transit time ultrasonic flow measurements. Diagram the system completely, using only components that you studied in this course. Fully describe the operation of each element and interfacing considerations between components. The system should terminate in a digital display of flow rate.

2. Describe the three means to transmit separate data values: separating values in time, space, and frequency. What types of hardware are required for each? Compare their merits. Show where each is more advantageous than the others to use.

3. Discuss impedance issues. What care needs to be taken that impedances of two connected components are not mismatched? Give examples of nonelectrical impedances that are important in your work.

4. If you were to purchase a digital data acquisition system, what are some of the important details that you should consider before buying?