

Sample 2 Test #3 for CEE-3500

- #1. For Froude similitude, derive the Force ratio in terms of only geometric properties and gravity (i.e., no velocity).
- #2. To study the drag force on a 650-ft-long submarine requires the use of a model that is 36-inches-long. If the submarine will be operating in salt water (specific gravity = 1.06) at a temperature of 50°F and the tests will be performed in fresh water (specific gravity = 1.00) at a temperature of 70°F what would the drag force be on the prototype submarine if the force measured in the model submarine is 15 lb?
- #3. Consider a gravity-driven flow over a spillway of height  $P$  and width  $W$  when the total approach depth of the flow is  $H$ . Using dimensional analysis determine the  $\Pi(P_i)$  term that involves the approach flow velocity  $V$  and gravity  $g$ , if the repeating variables are  $\rho$  (density),  $V$ , and  $H$ .
- #4. Two reservoirs are connected by a pipe that is 500 ft long and carries a discharge of  $3 \text{ ft}^3/\text{s}$ . The difference in elevation of the reservoirs' free surfaces is 100 ft. The pipe has a roughness  $e$  of 0.002 inches and the kinematic viscosity of the water is  $1.5 \times 10^{-5} \text{ ft}^2/\text{s}$ . With a guess of  $f = 0.013$  find the theoretical pipe diameter needed to carry the flow. Neglect all minor losses. Was the guess of  $f = 0.013$  good? Show how to check your guess using the Swamee-Jain equation for the friction factor.
- #5. A pump is installed in a horizontal pipe with a diameter of 0.25 ft and an absolute roughness  $e$  of 0.001 in. A Bourdon manometer located 25 ft upstream of the pump shows a gage pressure of -3 psi while a similar manometer located 25 ft downstream of the pump reads a pressure of +5 psi. If the discharge is 1.25 cfs, what is the power provided by the pump to the flow?