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Test 2 - S3 - CH2003 FLUID MECHANICS

Date: 09/10/13

Maximum Marks: 20

Time: 1 hr

Answer all questions

1. Give the expression for determining the velocity of sound. What is Mach number? (1+1)
2. Define Reynolds number in terms of forces. How is it defined for a). Flow in a circular pipe of diameter D and b.) Flow in a rectangular duct of cross section a x b. (2)
3. a) Define hydraulic grade line and energy line (1+1)
   b) What is its use?
4. Air under standard conditions flows through 4mm dia tubing with an average velocity 50 m/s. For such conditions, flow would normally be turbulent. However if precautions are taken to eliminate disturbances to flow, it may be possible to maintain laminar flow. A. Determine the pressure drop in a 0.1 m section of the tube if flow is laminar. B. Repeat the calculations if the flow is turbulent. (roughness factor = 0.04 mm) (4)
5. Cooling water for a chemical plant must be pimped from a river 2500 ft from the plant site. Preliminary design calls for a flow of 600 gal/min and 6-in steel pipe. Calculate the pressure drop and the annual pumping cost if power cost 3 cents per kilowatt per hour. Would the use of an 8-in pipe reduce the power cost enough to offset the increased pipe cost? Use \$15/ft of length for the installed of 6-in pipe and \$20/ft for 8-in pipe. Annual charges are 20% of the installed cost. Assume the efficiency of the pump to be 90%. (5)
6. The pump shown in figure (i) is used to lift a process liquid of density 1.93 slug/ft^3 from a storage tank, and discharge it at a rate of 0.75 cubic feet per second into the top of an absorber. The inlet to the absorber is located 25 feet above the free surface of the liquid in the storage tank, and the pump inlet is located at an elevation of 15 feet above that of the free surface. You can assume that the absorber operates at atmospheric pressure. A 2" ID pipe leads from the storage tank to the pump, while the pipe from the pump to the top of the absorber is of ID 3". You can assume the losses in the 2" ID pipe to be 4 velocity heads, and the losses in the 3" ID pipe to be 5 velocity heads. Assuming the pump is 85% efficient; calculate the BHP (Brake Horse Power) of the pump. (5)

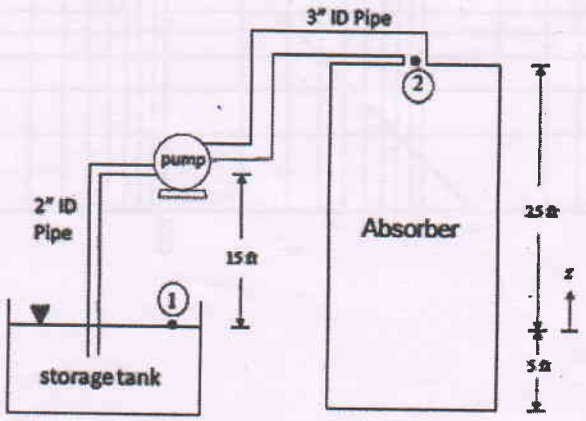

Figure (i)

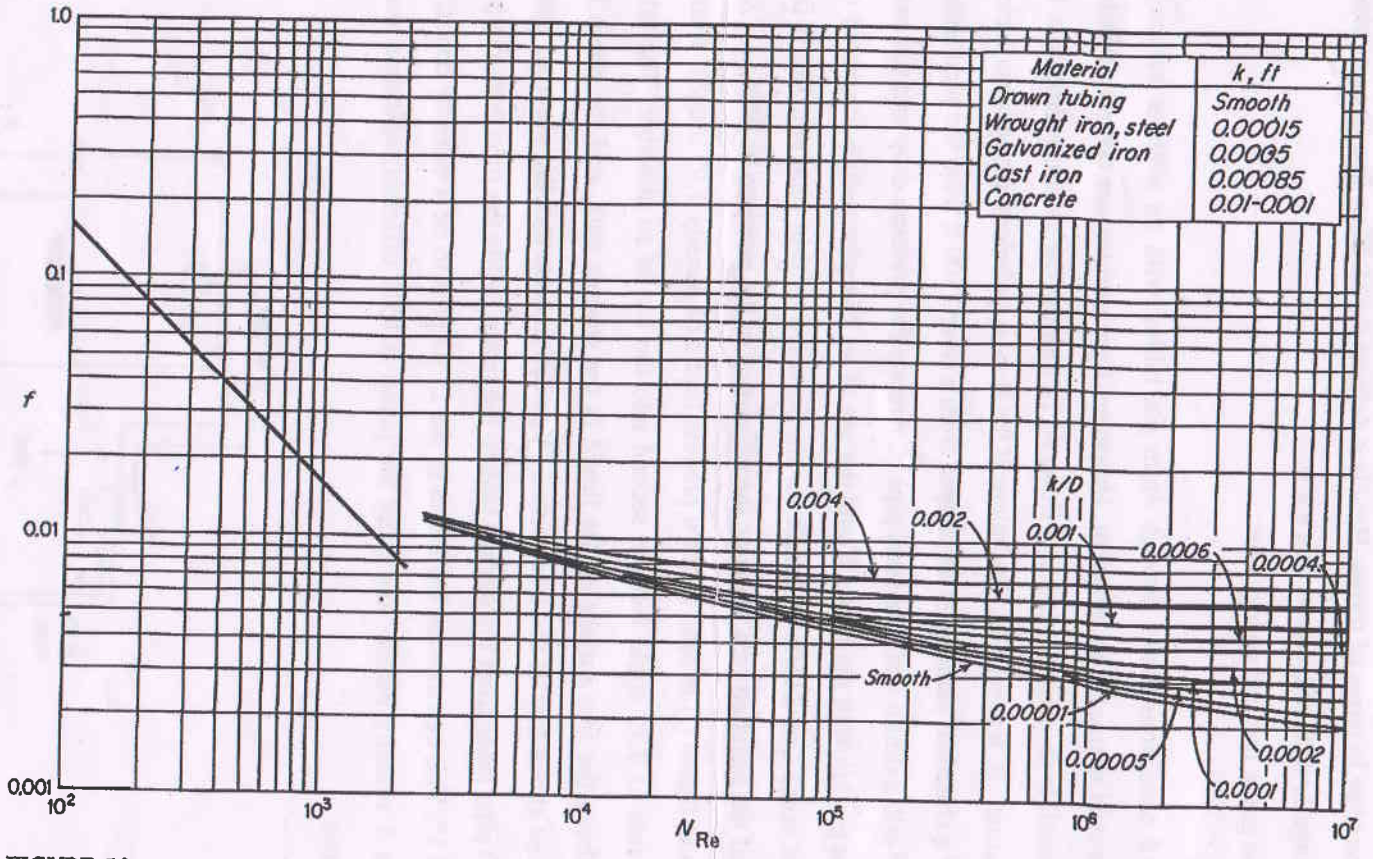

FIGURE 5.9
Friction-factor chart.