King Saud University
College of Engineering
Department of Civil Engineering

FINAL EXAM

CE 322 Hydraulics – 1 st Semester 1429 - 1430 H

Sunday, 13th, Safar, 1430
Time allowed: 3 hrs

Student name (In Arabic)	
Student number	
Section Time	

Total number of Questions: 5

Attempt all questions

Questions	Maximum Marks	Marks obtained
Q ≠ 1	10	
Q ≠ 2	8	
Q ≠ 3	12	
Q ≠ 4	12	
Q ≠ 5	8	
	Total marks	_____ 50

Total marks obtained (in words):_____

Question (1) (10 Marks)

The pumps which characteristics are shown in following table are arranged in series in a system having a static lift equal to 80 ft. The pipe line comprises 0.5 ft. diameter and 1200 ft. length, with minor losses 20 times the velocity head. Take f = 0.022

Pump A			Pump B		
Q (gpm)	H (ft)	Efficiency (%)	Q (gpm)	H (ft)	Efficiency (%)
0	186	0	0	172	0
500	179	54	400	166	59
1000	158	70	800	140	77
1500	112	67	1200	90	74

Determine the following:
(i) operating condition
(ii) head developed by each pump
(iii) input power

Question (2) (8 Marks)

A steel pipeline 1600 m long discharges 150 L/s of water from a reservoir to the atmosphere through a valve at the downstream end. The pipeline is 250 mm in diameter with a wall thickness (e) of 10 mm (thin-walled conduit without expansion joints, anchored at the upper end). (K=2.10 GPa, E=210 GPa, ρ = 1000 Kg/m^3 and the Poisson's ratio "σ" = 0.3)

(a) Calculate the maximum transient pressure at the valve if the valve is closed in 30 seconds.

(b) Calculate the maximum pressure rise at the valve if the valve is closed in 2 seconds

Question (3) (12 Marks)

a- For a 50 ft wide rectangular channel section, determine the depth of flow and the velocity at a 100 ft downstream section using the energy principle if the flow depth and velocity of flow at the upstream section are 4.55 ft and 8.55 ft/s respectively. Neglect the energy loss and assume that $\alpha_1 = \alpha_2 = 1$ and S=1/1000)

b- A sewer pipe is proposed to be laid on a slope of 1 in 2500 and is required to carry 1.5 m^3/s. What size of a circular pipe should be used if the pipe has to flow half full (n = 0.015)?

c- Design the best hydraulic rectangular section to carry a discharge of 140 cfs on a slope of 0.01 in a concrete channel (n = 0.015)

Question (4) (12 Marks)

(a) Derive a relation between the bed width (b) and the water depth (y) for a best hydraulic rectangular section

(b) A trapezoidal channel with a bottom width of 4 m and side slopes of 4 H : 1 V carries a discharge of 45 m^3/s and Manning's roughness coefficient is 0.025. Determine the following:

1- The critical depth and the critical velocity
2- The minimum specific energy
3- The critical slope
4- Classify the flow and the bed slope if the longitudinal slope is 0.001 and the normal depth is 2.2 m

Question (5) (8 Marks)

1- Water flows at a rate of 400 cfs in a rectangular channel of 20 ft width with a depth of 1 ft. If a hydraulic jump is possible in the channel, what is the depth of flow after the jump?

(i) 4.50 ft
(ii) 2.09 ft
(iii) 1.90 ft
(iv) 3.50 ft

2- For a rectangular section with 9 ft bed width, 4.5 water depth, and average velocity of 3 ft/s, if the kinematic viscosity is 0.92×10^{-5} ft^2/s, the Reynolds number (R_e) is equal to:

(i) 2.20×10^5
(ii) 5.20×10^5
(iii) 0.20×10^5
(iv) 7.34×10^5

3- For a trapezoidal channel with 4 m bed width, 2 m water depth, and 1.5:1 side slope, if the discharge is 14 m^3/s, the Froud number (F_r) is equal to:

(i) 0.292
(ii) 0.270
(iii) 0.118
(iv) 0.691

4- Discharge measurements provided the following velocity and area values for various sections of a channel.

Section	1	2	3	4	5	6
Area m^2	75	401	521	492	387	125
Velocity m/s	0.18	0.31	0.55	0.58	0.40	0.22

The energy and momentum correction coefficients are:

(i) 1.29, 1.01
(ii) 1.05, 1.15
(iii) 1.246, 1.0865
(iv) None of the above