Delft University of Technology
Department Watermanagement
Water Resources Section

Exam CIE5450 09.00 – 12.00 hrs November 7, 2012

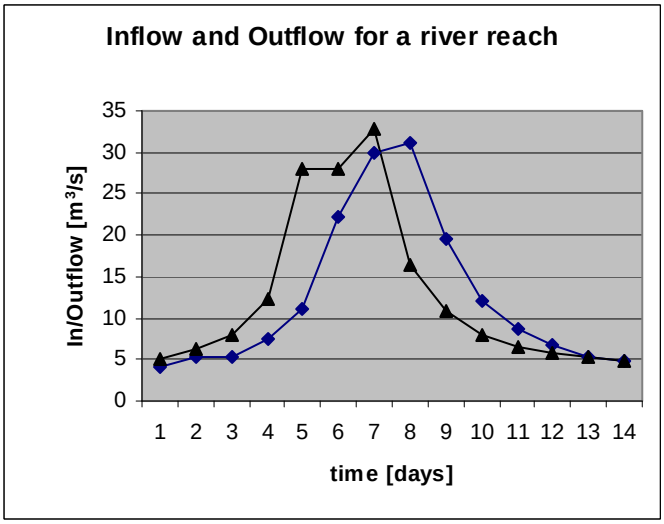
!!The exam exists of question for 5 topics.
!!**Please start every question on a new page with your name and study number**

Exam Hydrology of Catchments River Basins and Deltas

1. Flood and Reservoir routing (100 points)

A widely utilized assumption in flood routing through a river channel is that storage (S) is a function of weighted inflow (I) and outflow (O), written as:
$S=K[xI+(1-x)O]$ (1)

Assume that relation (1) applies to a river reach and the Inflow and Outflow hydrograph show as depicted in the figure below.



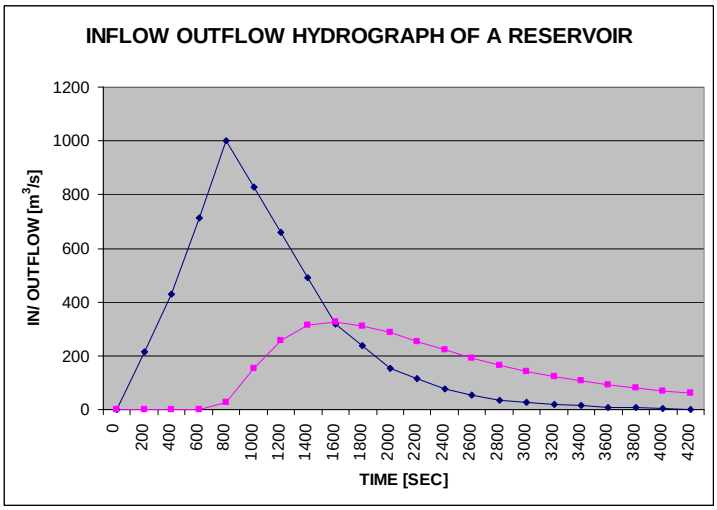
Question:

1a) What are the upper and lower limit for x in formula (1) in a river reach? (10 points)
1b) Estimate in this case the value for K and explain. (15 points)

Assume that the relation (1) applies to a reservoir and that the Inflow hydrograph and Outflow hydrograph of a flood event show as below. The outflow is only over the spillway crest of the dam. Assume the relation between storage and water level of the reservoir as :

$$H_c = \frac{1}{0.158} Ln\left(\frac{S_c + 4274407}{1939917}\right) - 5$$

with H_c in meters above the crest and S_c in m^3 storage above the crest.



time s	In m^3/s	Qout m^3/s
0	0	0
200	215	0
400	430	0
600	715	0
800	1000	27
1000	830	155
1200	660	258
1400	490	314
1600	320	320
1800	237.5	312
2000	155	286
2200	115	255
2400	75	223
2600	55.5	193
2800	36	167
3000	27	144
3200	18	124
3400	13.5	107
3600	9	92
3800	6.5	80
4000	4	69
4200	0	60

Questions:

1c) Rewrite equation (1) for this case and explain your answer. (15 points)

1d) How much water has to be stored in [m^3] before the crest level is reached. Show your calculations. (20 points)

1e) What is the highest water level above the crest for the event. Explain and show your calculations. (40 points)

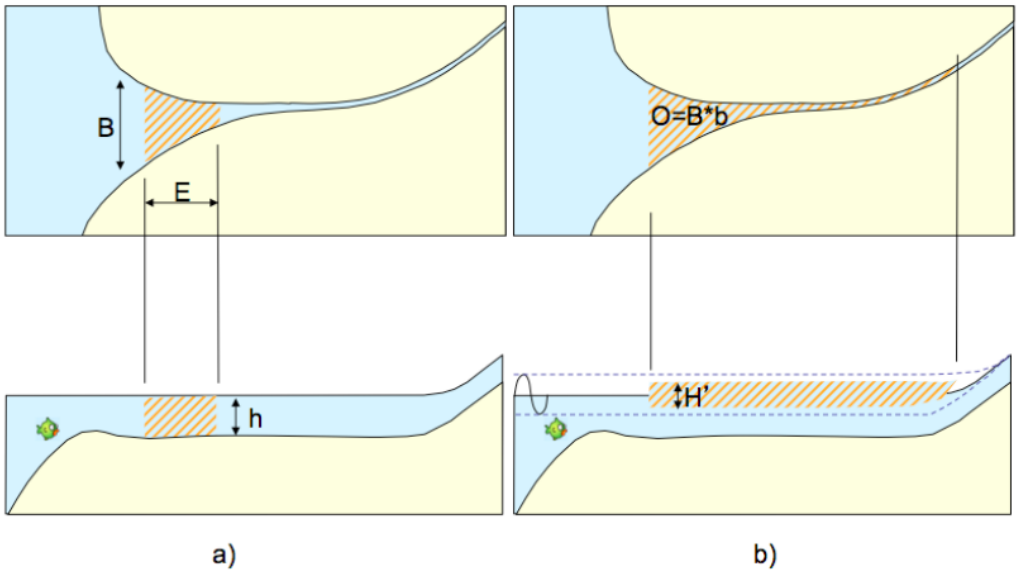
2. The water balance of an estuary (100 points)

In the below figure we see a planar view and a longitudinal cut through an estuary. On the basis of the parameters mentioned:

2a) Write the water balance equation of this estuary (40 points)

2b) How does H' relate to the tidal range H? (30 points)

2c) How can you incorporate the effect of tidal damping if the damping is defined as: $\delta_H = \frac{1}{H}\frac{\partial H}{\partial x}$ (30 points)



3. Explain as brief as you can: (100 points)

3a. What is equifinality (25 points)

3b. Why is interception important for hydrological modelling? (25 points)

3c. Why are water scarcity statistics based on the amount of water available per person per year deceptive? (25 points)

3d. How would you define moisture recycling? (25 points)

4. On hypersalinity. In an exponentially shaped estuary the tidal average salinity *S* can be described by: (100 points)

$$\frac{\partial S}{\partial t} + \frac{Q}{A}\frac{\partial S}{\partial x} + \frac{1}{A}\frac{\partial}{\partial x}\left(DA\frac{\partial S}{\partial x}\right) = -\frac{Sr}{h}$$

4a. Which terms of this equation can cause hypersalinity? (50 points)

4b. Which terms in this equation (can) counteract hypersalinity? (25 points)

4c. What is the most important geometrical parameter that influences hypersalinity? (25 points)

5. The dimensionless equation for tidal damping/amplification is: (100 points)

$$\frac{dy}{dx}\left(1+\frac{y}{\alpha}\right)=\frac{y}{\beta}$$

with:

$$\frac{1}{\beta}=\frac{1}{b}-f\frac{g}{C^2}\frac{\upsilon\sin\varepsilon}{ch}$$

5a. From which of the two St. Venant equations do the two terms of 1/β originate? Explain why you conclude this. (30 points)

5b. What kind of estuary do we have when β goes to infinity? (30 points)

5c. Under which condition do we have linear amplification and when do we have exponential damping? (40 points)