WATER WORKS, WATERSUPPLY

Hydrogeology Msc Program

2021/22 1st semester

COURSE SYLLABUS

University of Miskolc
Faculty of Earth Science and Engineering
Institute of Environmental Management

Content

1. Course description, details

Course Title: Waterworks, water supply **Instructor:** Dr. Tamás Madarász PhD, associate professor Gábor Nyiri, PhD student	**Code:** MFKHT720027 **Responsible department/institute:** Institute of Environmental Management Type of course: Compulsory
Position in curriculum (which semester): 2	**Pre-requisites (if any): -**
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** exam
Credits: 3	**Course:** full time

Course Description:
The students will be familiar with the basic elements of modern waterworks and water supply. Based on a sample network design, the students will be able to design the necessary parts of a working waterworks plant as well as pipe system of the water distribution system.
The short curriculum of the subject:
The estimation and calculation of the water demand. Water demand for the fireflow. The measurement of the water loss in the supply system. Requirements concerning the water quality. Pumps, pipes, water towers and their hydraulics. The principal assignments of this subject are the design and management calculations of a water distribution network. The class shall be guided through the protocol of designing a simple water distribution network. Minor separate assignments may be given to the class. The individual project progress shall be discussed on during the class meetings. The principle assignment submission deadline is the last course meeting. Written submissions (drawings, reports, etc) are to emphasize clarity and legibility.

Competencies to evolve:
Knowledge:
T1 – It includes knowledge of hydrogeology, water resource management, water quality protection, water treatment, production and waterworks operat
T2 – Extensive knowledge of hydrogeological assessment and monitoring techniques related to watershed approach and considers ecological water demands.
T4 – Have a working knowledge of computer-aided design and analysis
T5 – Knows and understands hydrogeological modelling techniques.
T8 – Have general and specialist management skills to manage complex design work.
Ability:
K1 – Ability to understand the laws and relationships related to the location, movement and quality of groundwater, to apply and put into practice the knowledge acquired, and to use problem-solving techniques.
K4 – Ability to effectively apply water production techniques and knowledge of modern well construction technologies.
K5 – Ability to apply design, knowledge and technologies related to water supply and water treatment at a high level.
K6 – Prepared to tackle complex water resource management, water conservation and aquifer protection challenges.
K8 – Able to solve mining and pit dewatering problems at a high level
K10 – Prepared to effectively apply relevant national and European professional, environmental and conservation legislation
K11 – Ability to implement an ecological approach in line with the EU Water Framework Directive
K13 – The ability to independently participate in and manage research, development and expertise in the field of hydrogeology
K14 – Ability to lead and participate in complex design work and project management in water management and water supply
K15 – Ability to solve complex problems in a flexible way through creative problem solving, to work in a team, to think and cooperate effectively with representatives of other disciplines (e.g. environment, quality, consumer protection, human health, construction, etc.)

Attitude:
A1 – Open-minded and receptive, active in learning about professional and technological methodological developments in the fields of geosciences and environmental engineering, and in solving geological problems from an engineering perspective
A2 – Open and sensitive to problems and sustainability issues related to the environment and its elements
A3 – Have the motivation to work in a changing work, geographical and cultural contexts
A4 – Deep commitment and professional solidarity
A5 – It is committed to lifelong learning, diversity and values
A6 – Respect and act in accordance with the ethical principles and written rules of work and professional culture, and be able to adhere to them when managing small teams
A7 – Adhere to and comply with health and safety, environmental protection, quality assurance and control requirements.
A8 – Characterised by intuition, consistency and a willingness to learn.
A9 – In addition to his technical and engineering background, he also has an interest in science.
Autonomy and responsibility:
F1 – Act independently and proactively to solve professional problems.
F2 – Have a responsible attitude towards the environment.
F3 – Takes decisions independently and in consultation with other disciplines (mainly legal, economic, energy and environmental), for which it takes responsibility.
F4 – In decisions, takes into account the principles and application of environmental protection, quality, consumer protection, product liability, equal access, health and safety at work, technical, economic and legal regulation and engineering ethics.
F5 – Committed to sustainable natural resource management practices.
F6 – He/she is responsible claims in expert oppinions, professional judgements and for the work carried out under his/her supervision.

Assessment and grading:

ACTIVITIES	PERCENTAGES
Assignment reports	50%
Written tests/exams	40% (both tests must meet minimum criteria)
Participation — attendance, attitude	10%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- HAESTAD Methods Advanced water distribution modeling and management http://systemssolution.net/cadtechno/0%20SAMPLE/SPECs%20&%20DETAILS/BOOKS%20MECHANICAL/PLUMBING/WATER%20DISTRIBUTION%20MODELING.pdf
- Avi Ostfeld: Water Supply System Analysis, ISBN 978-953-51-0889-4, InTech, 2012.
- Beckwith S., Chase D. V., Garyman W., Koelle E.,Savic D., Walski T. M.: Advanced water distribution modeling and management, Bentley Institute Press, 2007.
- R. M. Clark, S. Hakim, A. Ostfeld: Handbook of Water and Wastewater Systems Protection, e-ISBN 978-1-4614-0189-6, Springer, 2011.
- D. D. Ratnayaka, M. J. Brandt, K. M. Johnson: Twort's Water Supply, ISBN: 978-0-7506-6843-9 Elsevier, 2009
- Swamee P. K., Sharma A. K.: Design of water supply pipe networks, Wiley-Interscience, 2008.

2. Course syllabus

Course syllabus: Waterworks and water supply (MFKHT720027)
Instructor: Tamás Madarász PhD, lecturer
Assistants: Gábor Nyiri, PhD student; Hoang Ding Thien, PhD student
contact: hgmt@uni-miskolc.hu

Course meeting time and room
Wednesdays 10 am; venue: Building C/2, room 205

Educational tools
Lectures, practical experience, individual assignments, student presentations.
Contact classes appr. 65%

Assignments
The principal assignments of this subject are the design and management calculations of a water distribution network. The class shall be guided through some elements of designing a simple water distribution network components. The individual project progress shall be discussed during the class meetings. The assignment submission deadline shall be announced with each assignments. Written submissions (drawings, reports, etc) are to emphasize clarity and legibility. They are to be submitted as hard copy unless otherwise indicated. During the semester one written test is scheduled, which must be completed at a minimum level of grade 2.

Main Course literature:
- HAESTAD Methods Advanced water distribution modeling and management; http://systemssolution.net/cadtechno/0%20SAMPLE/SPECs%20&%20DETAILS/BOOKS%20MECHANICAL/PLUMBING/WATER%20DISTRIBUTION%20MODELING.pdf
- Course notes, presentations, handouts

Grading
Grades will be based on assignments, test and participation performance. Participation comprises attendance and attitude in class. Oral exam - only when requested by instructor or student.
Overall weighting will be as follows:

Course schedule plan:

Date	**planned topic**	**Materials and Assignment**
September 8	Introduction of course material, syllabus	
September 15	Introduction to water distribution network; physical principles	Homework assignment 1 international insight
September 22	Student presentation on homework assignment; Water consumption, water demand	Water demand, source, technology, price, Course material Chapter 2. Homework assignment 2
September 29	Drinking water network components 1. pipes, reservoirs, valves, hydrants	Course material Chapter 4.
October 6	Seminar on reservoir design	Course material Chapter 3 Homework assignment 3
October 13	Drinking water network components 2. meters and pumps - principles, types, pump selection	Homework assignment 4.
October 20	Consultation on Assignment 3 and 4	
October 27	Network operation characteristics	Course material Chapter 3+ Homework assignment 5
November 3	-	
November 10	Seminar on pipe network	Homework assignment 6
November 17	Methods reducing NRW; Leakage detection	Lecture slides + handout material
November 24	Leakage detection – field work	Field work notes by students
December 1	Water quality and treatment technologies	Lecture slides
December 8	Final exam	

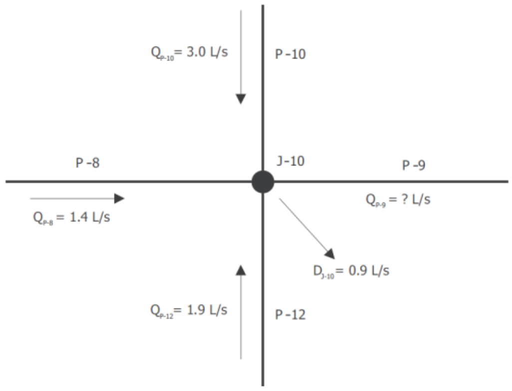
Water works and water supply
Midterm Examination

Name:………………………………………………………….

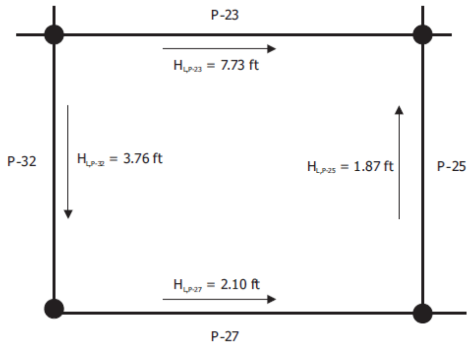
Country:……………………………………………………...

Open book, open notes test!
Duration: 60 minutes

1, Find the magnitude and direction of flow through pipe P-9! (5 points)



2, Does the conservation of energy around the loop apply? Why or why not? (5 points)



3, The water need of the settlement is 2200 m3/day met from a groundwater source of 200m depth using wells. Each wells' nominal capacity is Q=180l/min, they are installed at a distance of 400m, β=0,6.

3,a Calculate the number of minimum Operating well hours (N_{min}) per day, that is needed to meet the water demand of the settlement (8 points)

3,b Calculate the minimum number of wells that need to be installed to meet the water demand of the settlement if the wells can run 24hours a day. (4 points)

4, The table shows the design parameter of an elevated tank (same network as in task 2).

4,a Give the hourly peak consumption of the network in m3/h (6 points)

4,b Calculate the minimum volume of the elevated storage (in m3) using the table below (fill all the grey cells!) (16 points)

4,c What action you can have to further decrease the volume of the storage, list a few options (you can not change the daily water demand!). (6 points)

Time	**Q_{in} (%)**	**Q_{out} (%)**			
0-1	0	0			
1-2	0	0			
2-3	0	0			

3-4	1	0			
4-5	3	1			
5-6	6	5			
6-7	8	8			
7-8	8	14			
8-9	8	6			
9-10	6	4			
110-11	4	5			
11-12	5	6			
12-13	4	3			
13-14	4	4			
14-15	3	5			
15-16	4	4			
16-17	6	4			
17-18	7	5			
18-19	8	12			
19-20	6	8			
20-21	4	3			
21-22	3	2			
22-23	2	1			
23-24	0	0			

Individual Assignment for the semester

Homework assignment
Waterworks, waternetworks
March, 1 2018

1, Create a typical daily water demand distribution table for „your settlement”, based on the parameters provided in the table below.
Q_d=maximum daily water demand
Q_{hmax}= hourly maximum water demand

	Q_{hmax}= 21%	Q_{hmax}= 19%	Q_{hmax}= 17%	Q_{hmax}= 15%
Q_d= 1500m^3/day	A1	B1	C1	D1
Q_d= 1700m^3/day	A2	B2	C2	D2
Q_d= 1800m^3/day	A3	B3	C3	D3

1,a Prepare the hourly water demand distribution table in % of daily water demand
1,b Using excel create the graphics of the above table in a combined diagram showing the hourly water demand with columns, the cumulated daily water demand with line diagram.

2, The water need of the settlement is met from a groundwater source of 200m depth using wells. The wells nominal capacity is Q=300l/min, they are installed at a distance of 200m, β=0,8.
2,a Calculate the number of minimum Operating well hours (N_{min}) per day, that is needed to meet the water demand of the settlement
2,b Calculate the minimum number of wells that need to be installed to meet the water demand of the settlement if the wells can run (a) 24hours a day, if they can (b) run only two shifts 16 hours a day

Reporting deadline: March 8, 2018
Reporting format: Edited and Printed document (table, graphs, calculation) and files archived for further use

Tamás Madarász
course instructor

Homework assignment 2 – Elevated tank design
Waterworks, water networks
March 8, 2018

Design the volume of a system's elevated tank, using the following data and considerations. The goal is to follow the pattern of consumption as close as possible in order to minimize the volume of the elevated tank

Conditions:

- The number of network pumps may vary between 2-4;
- Network pumps can operate for 16 consecutive hours (2 shifts);
- Total volume of tanks (elevated+ underground) should be less than 50% of Q_d daily water demand.
- Tasks 1 and 2 must be repeated to target the best (minimum) storage volume.

1, Establish the network pumps daily operating plan for several cases as described bellow

1,a Create the planning table as bellow for 2, 3 and 4 network pumps
1,b Calculate the rate of 1 pump working hour (%) for each case
1,c Create the graph combined with task 2.

Trial No:			
No of network pumps:			
Time	**No. of operating pumps**	**No. of pump working hours**	**Rate of daily Q_d (%)**
0-1	0	0	
1-2	1	1	
…			
23-24			
		∑=	

2, Establish the design table as bellow

Time	**Q_{in} (%)**	**Q_{out} (%)**	**$\sum Q_{in}$ (%)**	**$\sum Q_{out}$ (%)**	**$\sum(Q_{in}-Q_{out})$**
0-1					
1-2					
…					
23-24					
					min=
	∑=	∑=			max=

2,a Calculate the design volume of the elevated storage (as % of Q_d) for every trial using the table (trials should aim to test the options of 2, 3 and 4 network pumps, and also the iteration efforts to minimize the storage capacity)
2,b Crerate the graphs for graphical solution, based on the classroom instructions ($\sum Q_{in}$ (%); $\sum Q_{out}$ (%); Pump working hours (%)
2,b Archive the design table versions and also the respective graphs

3, Chose and fix the design storage volume and the respective table. Select the type of elevated tanks from the available standard volumes.

Reporting deadline: March 21

Reporting format: Edited and Printed document (table, graphs, calculation) and files archived for further use

Tamás Madarász
course instructor

Homework assignment 4 – Underground tank design
Waterworks, water networks
April 5, 2018

Design the volume of a system's underground tank, using the following data and considerations. The goal is to minimize the volume of the underground tank and thus the volume of total stored water of the system. ($V_{elevated}$ + $V_{underground}$ <0,5*Q_d).

Conditions:

- Please refer to Assignment 1, Task 2 (minimum Number of Wells ($N_{w\ min}$; Well operating hours);
- Well pumps can run 24h/day, but each well pump can be switched on/off only once/day!
- Tasks 1 and 2 must be repeated to target the best (minimum) storage volume.

1, Establish the well pumps daily operating plan for several cases as described bellow

1,a Create the planning table as bellow for the cases of $N_{w\ min}$, $N_{w\ min}$ +1 well

1,b Calculate the rate of 1 pump working hour (%) for each case and try to get the best fit to minimize the storage volume

1,c Create the graph combined with task 2.

Trial No:			
No of well pumps:			
Time	**No. of well pumps**	**No. of well pump working hours**	**Rate of daily Q_d (%)**
0-1	0	0	
1-2	1	1	
…			
23-24			
		∑=	

2, Establish the design table as bellow

Time	**Q_{in} (%)**	**Q_{out} (%)**	**$\sum Q_{in}$ (%)**	**$\sum Q_{out}$ (%)**	**$\sum(Q_{in}-Q_{out})$**
0-1					
1-2					
…					
23-24					
					min=
	∑=	∑=			max=

2,a Calculate the design volume of the underground storage (as % of Q_d) for every trial using the table (trials should aim to test the options of for various number of wells and also the iteration efforts to minimize the storage capacity). Be aware that for the Q_{out} column you should use the respective data of finalized Elevated tank design table!

2,b Crerate the graphs for graphical solution, based on the classroom instructions ($\sum Q_{in}$ (%); $\sum Q_{out}$ (%); Well operating hours (%))

2,b Archive the design table versions and also the respective graphs

3, Chose and fix the design storage volume and the respective table. Select the type of underground tanks from the available standard volumes.

Reporting deadline: April 12, 2018

Reporting format: Edited and Printed document (table, graphs, calculation) and files archived for further use

Tamás Madarász
course instructor

ANNEX 1. Water distribution network layout

Consumption	Node
Q/20	2, 5, 7, 8, 10, 11
Q/10	1, 3, 6, 9
3Q/20	4, 12