PRGR 666 Water infrastructure Systems

Catalog description:

PRGR 666 Water Infrastructure systems (2 cr.)

Analysis and design using commercially available software: water distribution systems including pipes, reservoir, pumps and losses. Results visualizations and assessment: pressure, velocity, head losses. Analysis and design using commercially available software: wastewater collection systems including pipes, manholes, drop manholes, wet wells, and other appurtenances. Results visualizations and assessment. Maintenance & Safety; Sampling, Sampling Methods and Parameters; Analysis & Data Handling; Management & Supervision.

Pre-requisite: Hydraulics

Course Objectives:

The course aims to enable its participants to design **municipal** water and wastewater systems. The first part of the course covers the water supply systems where emphasis will be placed on the distribution network including the transport pipelines, the pumping stations, the balancing tanks, valves, and hydrants. The level of design will be "design development", and an appropriate analysis software will be introduced and used.

The second part of the course deals with wastewater collection systems and covers the following topics: Wastewaters in urban areas: sources, design discharges. Wastewater collection systems: types, components, layouts. Sewers: hydraulic analysis and design, slopes, materials. Sewer networks: hydraulic analysis under steady and unsteady conditions using commercially available software. Pumping stations and forcemains: hydraulic analysis and design of wet well, pumping system, and forece-main. Manholes: types, spacing, drop.

Course Modules:

WM-1: Municipal water supply systems
WM-2: Estimates of water demands
WM-3: Hydraulic analysis of pipe systems (steady state and unsteady state)
WM-4: Hydraulic design of pipe systems
WM-5: Water quality modeling
WWM-1: Types of WW systems
WWM-2: Estimates of design discharges
WWM-3: Sewer hydraulics (state and unsteady state)
WWM-4: Sewer design
WWM-5: Design of pumping stations
WWM-6: Storm water systems

Week	Lecture	Module	Topic	Assignments/Project
WK#1	L1 L2	---------- WM-1: Municipal water supply systems	• Course introduction • Methods of supply • Elements of the municipal water supply system.	
WK#2	L3 L4	WM-2: Estimates of water demands	• Estimation of water demands. • Time variability of wastewater discharges; peaking factors; water-use patterns • Layout and preliminary sizing of networks	• Assignment #1
WK#3	L5 L6	WM-3: Hydraulic analysis of pipe systems (steady state and unsteady state)	• Hydraulic analysis of pipe networks (theory) • Using simulation models (EPANet)-Steady state	• Assignment#2 • Project #1
WK#4	L7 L8	WM-4: Hydraulic design of pipe systems	• Design of pipe networks (Design criteria) • Unsteady state analysis of water networks	
WK#5	L9 L10	 WM-5: Water quality modeling	• Analysis of results and design revision • Hydraulic design of elevated tanks and pumping stations • Water quality modeling • Sustainability of municipal water supply systems	

Wk#6	L11 L12	WWM-1: Types of WW systems WWM-2: Estimates of design discharges	• Sources of wastewaters in urban areas • Types of collection systems • Elements of collection system • Estimation of wastewater from: -Domestic sources -Educational facilities -Commercial -Industrial sources -Storm water -Seepage water	• Assignment #3
Wk#7	L13 L14	WWM-3: Sewer hydraulics (state and unsteady state) WWM-4: Sewer design	• Hydraulic analysis of sewers: degree of filling; velocity; pressurization • Hydraulic design of sewers: selection of slope; preliminary sizing, sewer material	• Project #2
Wk#8	L15 L16		• Layout of sewer networks • Hydraulic analysis of sewer networks using SewerCAD: Steady State	
Wk9	L17 L18		• Hydraulic analysis of networks: unsteady state Using SewerCAD: Extended Period Analysis	
WK#10	L19 L20	WWM-5: Design of pumping stations	• Wastewater pumping stations: components; types; hydraulic design of sump, pumping system, and force main • EPS analysis	

Wk#11	L21 L22	WWM-6: Storm water systems	• Design of urban storm water systems: Estimates of design discharges	• Assignment #4
Wk#12	L23 L24		• Design of urban storm water systems: Design of sewers	

Learning Outcomes:

At the conclusion of this course, each participant will be able to do the following:

- Being able to layout the main grid and water distribution pipes, and locate treatment plant(s), and storage facilities.
- Being able to estimate the design demands of municipal, industrial, institutional water uses.
- Ability to design hydraulically the pipe network.
- Simulate, and design the pipe network using computer simulation models and check firefighting capability.
- Ability to carry out the hydraulic design of transmission pipelines and pumping stations.
- Ability to perform the hydraulic design of elevated tanks.
- Understand water quality changes and risk of contamination in the water supply system
- Understand the various types of urban drainage sewerage systems, and their selection.
- Being able to layout the sewers and locate pumping stations and treatment plant(s)
- Ability to design hydraulically the sewers, and design their profile.
- Simulate, and design the sewer network using computer simulation/design models.
- Ability to design hydraulically the pumping stations and forcemains

Textbook:

1. Watery supply and wastewater removal by Nazih Shammas and Lawrence Wang , 3rd Edition, 2011, John Wiley& Sons, Inc.
2. User's manual of the EPAnet Software.

Instructor:

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Assessment and grades:

Assignments:	50 %
Design Projects:	50 %
Total :	100 %

Course Management:

- Lecture notes will be timely posted on Moodle **(**Both presentations and printable files).
- Required weekly activities will be posted on Moodle (Assignments and Design Projects).
- Assignments are to be done individually.
- Projects can be done in groups of **two** (if desired). You form your own groups and coordinate the activities yourself. Generally a common grade will be given to the group members.
- Queries on assignments and projects can be posted on respective forums. You may respond to a query raised by your colleague. I'll respond to your query as well.
- You submit your answer to an assignment or a design project through Moodle. Please observe the due dates as late submittals beyond one week will not be accepted. A 15 % penalty shall apply to late submittals.