ADDIS ABABA INSTITUTE OF TECHNOLOGY

SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING

Curriculum

For Master of Science Degree Program

In Civil and Environmental Engineering

(Water Supply and Environmental Engineering)

August, 2024

Contents

Table of Abbreviations

ECTS	European Credit Transfer and Accumulation System
EIA	Environmental Impact Assessment
GIS	Geographic Information Systems
GPA	Grade Point Average
IWA	International Water Association
MSW	Municipal solid waste
PGD	Post graduate diploma
RS	Remote Sensing
SAC	SCEE academic council
SCEE	School of Civil and Environmental Engineering
SGC	SCEE graduate committee
WASH	Water supply, sanitation, and hygiene

1. Background

The MSc in Water Supply and Environmental Engineering is a postgraduate program designed to equip professionals with advanced knowledge and skills to address critical water and environment related challenges. This field is crucial due to the increasing national and global demand for clean water, coupled with environmental concerns like pollution and climate change. Besides, most developing countries like Ethiopia envisions a future characterized by prosperity, achieved through the implementation of integrated water resource management and the assurance of access to clean drinking water, sanitation, and energy for all its citizens by the year 2030. The nation also aspires to cultivate a clean, healthy, safe, and protected environment that aligns with its goal of becoming a leading example of prosperity in Africa by 2030. These aspirations are grounded in the recognition that access to drinking water, sanitation, and environmental protection is vital for sustainable development and the overall well-being of its populace.

Countries acknowledge the crucial importance of water in fostering sustainable development and enhancing the quality of life for its citizens. By emphasizing effective water resource management and broadening access to essential services, most countries like Ethiopia seeks to address challenges related to poverty, health, and economic advancement. Ethiopia for example is committed to establishing a Climate Resilient Green Economy, which aims to harmonize economic growth with environmental sustainability. This commitment includes initiatives to mitigate the effects of climate change, safeguard biodiversity, and responsibly manage natural resources. Developing countries such as Ethiopia aim to ensure that access to clean drinking water, sanitation, and environmental conservation is intricately connected to their broader development goals, acknowledging the environment as a vital resource that should be safeguarded for the welfare of both present and future generations. This post-graduate program has been designed to transform these visions into reality.

Typically, the program covers a broad spectrum of topics, including water supply, environmental engineering, and specialized areas. Water supply courses encompass water resources assessment and management, hydrogeology, hydrology, water treatment processes, distribution systems, and quality management. Environmental engineering focuses on wastewater collection and treatment, solid waste management, environmental impact assessment, pollution control, remediation, and microbiology. Specialized areas may include urban drainage, water and sanitation, or environmental management systems.

The program aims to cultivate a deep understanding of hydrological and environmental processes among students. It equips them with the necessary skills to design, operate, and manage water supply and wastewater systems effectively. Furthermore, the program fosters critical thinking and problem-solving abilities to address complex challenges at the intersection of water and the environment. Ultimately, it prepares graduates for successful careers in research, consultancy, or leadership positions within the water and environment sector.

Graduates of an MSc in Water Supply and Environmental Engineering find diverse career opportunities. They can work for government agencies such as water boards and environmental protection authorities, contribute their expertise to consulting firms, and play a crucial role in operating water and wastewater treatment plants. Additionally, research institutions benefit from their knowledge, and they can engage in environmental conservation through non-profit organizations. Furthermore, industries with high water consumption often employ these professionals to manage their water resources efficiently.

The MSc in Water Supply and Environmental Engineering program typically has disciplinary roots in either engineering, specifically Civil Engineering with a strong focus on environmental and water-related aspects, or science with a specialization in water resources and engineering principles. In terms of institutional context, the program has been offered within school of Civil and Environmental Engineering (SCEE).

The program typically offers three degree options: Master of Science (MSc), Master of Engineering (MEng) and postgraduate diploma (PGD). The MSc program focuses on deepening knowledge of the subject matter through rigorous coursework and research. Conversely, the MEng program emphasizes the practical application of engineering principles, with a stronger focus on design and implementation. Unlike the MSc and MEng programs, the PGD option is available for applicants who wish to advance their studies without engaging in research thesis or study and design projects. This pathway is designed for students who have successfully completed their coursework but are unable to undertake research thesis or study and design projects.

2. Rationale

The MSc in Water Supply and Environmental Engineering is imperative due to the escalating national water supply problems, environmental degradation, and the pressing need for sustainable development. This program is crucial for individuals, society, businesses, and nations.

- **Individual Needs:** The program equips professionals with advanced knowledge and skills to address complex water-related challenges, offering career advancement opportunities and personal fulfillment through contributing to a sustainable future.
- **Societal Needs:** A skilled workforce in this field is essential to ensure access to clean water, sanitation, and a healthy environment, improving public health, reducing poverty, and enhancing overall quality of life.
- **Business Needs:** Industries reliant on water resources require skilled professionals to optimize water supply, minimize environmental impact, and comply with regulations, ensuring business sustainability and competitiveness.
- **National Contributions:** Graduates contribute to national development by designing and implementing effective water supply and management strategies, protecting water resources, and mitigating environmental risks, supporting economic growth and social progress.
- **Knowledge Expansion:** Research conducted within the program advances the understanding of hydrological processes, water quality management, and environmental engineering, contributing to the global knowledge base and informing policy decisions.

In essence, an MSc in Water Supply and Environmental Engineering is pivotal in cultivating the expertise necessary to tackle critical water supply and environmental challenges, fostering sustainable development, and building a resilient future for generations to come.

3. Mission

To cultivate highly skilled engineers through rigorous teaching, cutting-edge research, and dedicated community engagement. The program is committed to equipping graduates with advanced knowledge and practical skills to address critical water supply and environmental challenges. By fostering innovation and leadership, the program aim to ensure sustainable water supply system development, protect environment, and improve public health and well-being for present and future generations.

4. Objectives

The MSc program in Water Supply and Environmental Engineering aims to:

- Develop competent professionals: Equip students with advanced knowledge and practical skills in water supply, sanitation and environmental engineering, and related fields.
- Foster critical thinking: Cultivate students' ability to analyze complex water supply and environmental challenges and develop innovative solutions.
- Promote research: Encourage students to conduct research to advance the understanding of hydrological processes, water quality, and environmental impact assessment.
- Build leadership skills: Develop students into leaders capable of addressing water and environmental issues at local, national, and international levels.
- Instill ethical values: Foster a strong sense of environmental ethics and social responsibility among students.
- Prepare for professional practice: Equip graduates with the necessary skills to excel in various water environment related sectors, including government, consulting, industry, and academia.
- Contribute to sustainable development: Foster a generation of professionals committed to sustainable water resource management and environmental protection.

5. Outcome

Graduates of the MSc program in Water Supply and Environmental Engineering should be able to:

Knowledge and Understanding

- Demonstrate a comprehensive understanding of hydrological, hydrogeologic, hydraulic, and environmental engineering principles.
- Apply advanced knowledge in water resources assessment, management, and development.
- Possess in-depth knowledge of water supply and wastewater treatment processes, including design, operation, and maintenance.
- Understand environmental impact assessment methodologies and be able to conduct comprehensive assessments.

Skills

- Conduct research and analyze complex water supply and environmental problems.
- Design and implement water supply and sanitation systems.
- Develop and evaluate water supply management strategies.
- Utilize advanced modeling and simulation tools for water supply planning and management.
- Communicate technical information effectively to both technical and non-technical audiences.
- Collaborate effectively with multidisciplinary teams.
- Manage water supply projects and resources efficiently.

Attitudes and Values

- Demonstrate a commitment to sustainable development and environmental protection.
- Exhibit ethical and professional conduct.
- Display leadership and innovation in addressing water supply and environmental challenges.
- Possess a lifelong learning attitude and a desire to stay updated on advancements in the field.

Graduates with these competencies will be well-prepared to contribute to the sustainable management of water resources and the protection of the environment.

6. Degree Nomenclature

For the MSc with Thesis in Water Supply and Environmental Engineering Graduate Program the degree nomenclature should read:

THE DEGREE OF

Master of Science in Civil and Environmental Engineering

(Water Supply and Environmental Engineering)

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For the MEng in Water Supply and Environmental Engineering Graduate Program the degree nomenclature should read:

THE DEGREE OF

Master of Engineering in Civil and Environmental Engineering

(Water Supply and Environmental Engineering)

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For the post graduate diploma in Water Supply and Environmental Engineering Graduate Program the degree nomenclature should read:

Post Graduate Diploma in Civil and Environmental Engineering

(Water Supply and Environmental Engineering)

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7. Graduate profile

The MSc program in Water Supply and Environmental Engineering aims to produce graduates who can assume various roles within the water sector. The graduate profiles are as follows:

Degree Option	**MSc**	**MEng**	**PGD**
Water Supply Engineer/Manager:			
• Possesses strong analytical and problem-solving skills.	√	√	√

• Can conduct comprehensive water supply assessments and develop management strategies.	√	√	√
• Can design, operate, and maintain water supply system.	√	√	√
• Understands water supply, hydrological and hydraulic modeling tools.	√	√	√
Water and Wastewater Treatment Engineer:			
• Has expertise in water and wastewater treatment processes.	√	√	√
• Can design, operate, and maintain treatment facilities.	√	√	√
• Understands water quality standards and regulations.	√	√	√
• Possesses knowledge of environmental impact assessment related to wastewater treatment.	√	√	√
Environmental Engineer:			
• Has a broad understanding of environmental engineering principles.	√	√	√
• Can conduct environmental impact assessments and develop mitigation measures.	√	√	√
• Understands waste management and pollution control strategies.	√	√	√
• Possesses knowledge of environmental regulations and compliance.	√	√	√
Water and Sanitation Specialist:			
• Has a focus on water and sanitation issues in developing countries.	√	√	√
• Understands community-based approaches to water and sanitation.	√	√	√
• Can design and implement both urban and rural water supply and sanitation projects.	√	√	√
• Has knowledge of water and sanitation policies and programs.	√	√	√
Researcher and Academic:			
• Possesses strong research skills and a passion for knowledge advancement.	√	√	
• Can conduct independent research and publish findings in scientific journals.	√		
• Has teaching and mentoring abilities.	√		

These profiles represent potential career paths for graduates of the MSc program. The specific skills and knowledge acquired by students will depend on their chosen research areas and degree option.

8. Teaching and Learning Methodology

The effective delivery of an MSc in Water Supply and Environmental Engineering requires a diverse range of teaching and learning methodologies to cater to different learning styles and ensure optimal knowledge acquisition. Here are the adopted approaches:

- Lectures: Traditional method for delivering theoretical knowledge and providing a structured overview of the subject matter.
- Tutorials: Smaller group sessions for in-depth discussions, problem-solving, and clarification of concepts.
- Laboratory work: Practical sessions to apply theoretical knowledge and develop experimental skills.
- Fieldwork: Hands-on experience in real-world settings to understand water supply, sanitation, hydrological and environmental processes.
- Case studies: Analysis of real-world water and environmental challenges to develop problem-solving and decision-making abilities.

- Group projects: Collaborative learning to enhance teamwork and communication skills.
- Seminars and workshops: Inviting experts to share their knowledge and experiences.
- Online learning: Utilizing technology for flexible learning, including online resources, video lectures, and virtual discussions.
- Research-based learning: Integrating research into the curriculum to foster critical thinking and problem-solving skills.

By combining these methods, the program create a dynamic and engaging learning environment that equips students with the necessary knowledge and skills to excel in their chosen careers.

9. Thesis and Project Advising Approach

A robust thesis advising approach is crucial for the success of MSc students. Here are some key components of an effective system:

Advisor Selection and Assignment

- Faculty expertise: Match students with advisors whose research interests align with the student's proposed thesis topic.
- Advisor workload: Ensure that advisors have the capacity to adequately supervise students.
- Student preferences: Consider student preferences and research interests when assigning advisors.

Thesis Proposal Development

- Comprehensive guidance: Provide structured support for students in developing their thesis proposals.
- Research methodology training: Equip students with the necessary skills to design and conduct research.
- Ethical considerations: Emphasize the importance of ethical research practices.

Thesis Supervision

- Regular meetings: Establish a clear schedule for regular meetings between advisor and student.
- Feedback and support: Provide constructive feedback and support throughout the thesis process.
- Research methodology guidance: Offer ongoing guidance on research methodology and data analysis.
- Writing support: Assist students in developing their writing and presentation skills.

Thesis Defense Preparation

- Mock defense: Conduct practice defenses to prepare students for the final examination.
- Thesis refinement: Provide feedback on the final thesis draft.
- Defense support: Offer guidance and support during the thesis defense.

Evaluation and Improvement

- Student feedback: Regularly gather feedback from students on the advising process.

- Advisor evaluation: Assess advisor performance and provide feedback.
- Continuous improvement: Implement changes based on feedback to enhance the thesis advising process.

By following these guidelines, the program foster a supportive and productive thesis advising environment that contributes to the overall success of MSc students.

10. Teaching-learning Facilities

To effectively deliver an MSc in Water Supply and Environmental Engineering, a combination of physical infrastructure, equipment, and instructional materials is essential.

Physical Infrastructure

- Classrooms: Well-ventilated and equipped with audio-visual aids for lectures and seminars.
- Laboratories: Dedicated spaces for hydraulics, water quality, wastewater, sanitary and environmental engineering experiments.
- Computer labs: With high-speed internet access for students to access online resources, software, and conduct simulations.
- Library: Well-stocked with relevant textbooks, journals, and digital resources.
- Fieldwork sites: Accessible locations for practical training and data collection.

Equipment

- Hydrological and hydraulic equipment: Rain gauges, flow meters, current meters, water level recorders, piezometers, etc.
- Water quality equipment: pH meters, conductivity meters, turbidity meters, spectrophotometers, microscopes, etc.
- Environmental monitoring equipment: water and waste water quality monitors, soil sampling equipment, etc.
- Computer hardware and software: High-performance computers, hydrological and environmental modeling software, Geographic Information Systems (GIS) software, statistical software, etc.
- Laboratory equipment: Glassware, chemicals, safety equipment, and other standard laboratory apparatus.

Instructional Materials

- Textbooks and reference books: Covering various aspects of Water Supply and Environmental Engineering.
- Academic journals: For up-to-date research and articles.
- Online resources: Databases, theses, e-books, and digital learning platforms.
- Course materials: Lecture notes, slides, handouts, and assignments.
- Audio-visual aids: Videos, documentaries, and presentations.

Additional Considerations

- Maintenance and calibration of equipment: Regular checks to ensure accuracy and reliability.

- Software licenses and updates: Keeping software current for optimal performance.
- Library resources: Continual expansion and updating of the collection.
- Safety measures: Adherence to laboratory safety protocols and provision of necessary safety equipment.

By providing these resources and facilities, the program create a conducive learning environment that supports students in achieving their academic goals.

11. Assessment Policies and Techniques

A comprehensive assessment strategy is crucial for evaluating students' understanding and application of knowledge in this program. A combination of the following assessment methods will be employed:

Continuous Assessment

- Quizzes: To assess students' grasp of core concepts and their ability to apply them to problem-solving.
- Assignments: To evaluate students' ability to research, analyze, and present information on specific topics.
- Laboratory reports: To assess practical skills, data analysis, and report writing abilities.
- Fieldwork reports: To evaluate students' ability to collect data, analyze findings, and draw conclusions from real-world experiences.
- Presentations: To assess communication skills, critical thinking, and the ability to convey complex information effectively.

End-of-Semester Assessment

- Exams: To evaluate overall understanding of the course material and problem-solving abilities.
- Research projects: To assess students' ability to conduct independent research, analyze data, and draw meaningful conclusions.
- Thesis: To evaluate the student's ability to conduct in-depth research, contribute to the field of knowledge, and effectively communicate findings.

Other Assessment Methods

- Group projects: To assess teamwork, collaboration, and problem-solving skills.
- Case studies: To evaluate students' ability to apply theoretical knowledge to real-world scenarios.
- Portfolio assessment: To showcase students' overall development and achievements throughout the program.

It's important to note that the appropriate mix of assessment methods will depend on the specific course objectives and learning outcomes. For instance, laboratory-based courses might emphasize practical assessments like lab reports and field work, while theoretical courses might rely more on exams and assignments.

12. Grading

Student evaluation will adhere to articles 114.1 and 114.2 of the Senate legislation concerning examinations and theses, respectively. The grading for examinations will utilize the following letter grading system, which is associated with specific point values.

Raw Mark	Letter Grade	Grade Points
[95, 100)	A+	4.00
[85, 95)	A	4.00
[80, 85)	A-	3.75
[75, 80)	B+	3.50
[70, 75)	B	3.00
[65, 70)	B-	2.75
[60, 65)	C+	2.50
[50, 60)	C	2.00
[40, 50)	D	1.00
< 40	F	0.00

The evaluation of theses for both MSc and MEng tracks will be conducted using the following ranking system, which includes specific grading scales and corresponding letter grades.

Rank	Grading scale in percent	Letter Grade
Excellent	≥ 85	A
Very Good	$75 \leq X < 85$	B+
Good	$60 \leq X < 75$	B
Satisfactory	$50 \leq X < 60$	C+
Fail	< 50	F

13. Admission Requirements

The admission requirements for applicants encompass both general and specific requirements, which are outlined as follows.

General:

- The Graduate Admission Test: The candidate is required to successfully complete the graduate aptitude test administered by the university or another pertinent governmental body, such as the ministry of education, in order to evaluate their verbal, quantitative, and analytical reasoning skills as indicators of potential success in graduate studies.
- Letters of recommendation: Letters from academic or professional references can be requested.
- Statement of purpose: A written statement outlining the applicant's academic and career goals can be requested.
- Curriculum Vitae: A detailed resume highlighting academic and professional experience can be requested.

Specific Requirements

- Bachelor's degree: In a relevant field such as Civil Engineering, Environmental Engineering, Water Resources Engineering, or a closely related discipline.

- Entrance Examination: Candidates are required to successfully complete an entrance examination designed by the SCEE to evaluate their particular qualifications for the program.
- Minimum GPA: minimum Grade Point Average (GPA) of 2.4.
- Relevant coursework: Specific undergraduate courses in subjects like water supply, sanitation, hydrology, hydraulics, environmental science, mechanics, and mathematics are prerequisites.

14. Duration of the Program

The duration for the completion of a Master's program shall range from a minimum of 12 months (for those who seek to get the PGD) to a maximum of 24 months for Master of Science and Master of Engineering degrees. Any extension of the duration beyond this limit is expected to be administered according to the rules and regulations of the AAU Senate.

15. Graduation Requirements

For Master of Science Degree (MSc) the requirements are:

- Successful completion of 3 basic module (19 European Credit Transfer and Accumulation System (ECTS))
- Successful completion of 5 core module courses (31 ECTS).
- Successful completion of 3 elective module courses worth at least 16 ECTS
- Successful completion research method course and defense of MSc Thesis work (36 ECTS)

For Master of Engineering Degree (MEng) the requirements are:

- Successful completion of 3 basic module (19 ECTS)
- Successful completion of 5 core module courses (31 ECTS).
- Successful completion of 5 elective module courses worth at least 26 ECTS excluding Pedagogy course
- Successful completion research method course and defense of Independent Project work (26 ECTS)

For post graduate diploma (PGD) the requirements are:

- Successful completion of 3 basic module (19 ECTS)
- Successful completion of 5 core module courses (31 ECTS).
- Successful completion of 2 elective module courses worth at least 10 ECTS excluding Pedagogy course

16. Quality Assurance

To maintain and enhance the quality of the MSc in Water Supply and Environmental Engineering program, a robust monitoring and evaluation system is shown below. This system is designed to collect data on various aspects of the program and use it to inform decision-making and continuous improvement.

The program quality assurance strategy involves three approaches viz. input, process and output monitoring. Input monitoring focuses on tracking the resources allocated to the program, such as faculty, staff, facilities, equipment, and financial support, to ensure adequate provisions. Process monitoring delves into the program's implementation, assessing curriculum delivery methods, teaching strategies, and student

support services to evaluate their effectiveness in achieving program goals. Output monitoring measures the immediate outcomes of program activities, including student enrollment, graduation rates, and thesis completion, to assess the program's efficiency and productivity. By combining these monitoring strategies, program administrators can gain valuable insights into the program's performance and identify areas for improvement.

Evaluation methods for the program quality assurance encompass Student Satisfaction Surveys, Graduate Tracer Studies, Employer Surveys, Curriculum Review, Faculty Evaluation, Program Outcome Assessment and Benchmarking to assess program effectiveness and identify areas for improvement. Student satisfaction surveys provide invaluable insights into the educational experience, capturing perceptions of teaching quality, curriculum relevance, facilities, and overall program satisfaction. Graduate tracer studies offer a longitudinal perspective, tracking alumni career trajectories to measure program outcomes and impact on professional success. Employer surveys supplement this by gathering feedback on graduate preparedness and skill alignment with industry demands. Curriculum review ensures ongoing relevance by aligning program content with evolving academic standards and industry needs. Faculty evaluation, through student feedback, peer assessment, and research productivity, supports continuous improvement in teaching and scholarship. Program outcome assessment measures the extent to which students achieve stated learning objectives, while benchmarking against peer institutions provides external validation and identifies opportunities for enhancement.

Data collection methods employed a mixed-methods approach to comprehensively assess the program. The collection method involve surveys and questionnaires, interviews, focus groups, document analysis and performance indicators**.** Surveys and questionnaires quantified student, faculty, staff, and employer perspectives, providing numerical data on program strengths and weaknesses. In-depth interviews with key stakeholders offered rich qualitative insights into program experiences and challenges. Focus groups facilitated collective exploration of specific program aspects, capturing shared opinions and diverse viewpoints. Document analysis of course syllabi, student records, and reports provided contextual understanding of program design and implementation. Finally, performance indicators were utilized to track program outcomes over time, offering quantitative benchmarks for evaluation and improvement.

Data analysis and reporting are crucial components of program quality assurance. Descriptive, and comparative analysis together with impact analysis and regular reporting will be conducted based on the data collected. Descriptive analysis involves summarizing data to uncover trends and patterns, providing a foundational understanding of program performance. Comparative analysis places program outcomes in context by benchmarking against industry standards or historical data, enabling identification of strengths, weaknesses, and areas for improvement. Impact analysis delves deeper, assessing the program's contribution to student learning outcomes and career success, ultimately demonstrating its value and effectiveness. Regular reporting ensures that stakeholders are informed about program progress, challenges, and successes, fostering transparency, accountability, and informed decision-making.

17. Teaching Staff

The subsequent list of personnel is available to facilitate the delivery of the MSc program.

No.	Name	Qualification	Specialization
1	Agizew Niguse	Assoc. Prof.	Hydrology and Environmental Engineering

2	Asnake Teshome	Chief Lab Technician	Water quality and sanitary engineering
3	Ethiopia Bisrat	Lecturer	Civil and Environmental Engineering
4	Fiseha Behulu	Assist. Prof.	Water distribution modelling
5	Geremew Sahilu	Assoc. Prof.	Civil and Environmental Engineering
6	Jhony Girma	Assist. Prof.	Civil and Environmental Engineering (Water Supply and Environmental Engineering)
7	Kehali	Senior Lab Technician	Water quality and sanitary engineering
8	Mahlet Melaku	Lecturer	Civil and Environmental Engineering
9	Mebruk Mohammed	Assoc. Prof.	Civil and Environmental Engineering
10	Zerihun Getaneh	Assist. Prof.	Civil and Environmental Engineering (Water Supply and Environmental Engineering)

18. Module and Course Coding

Modules are designated with the prefix "CENG" which represents the name of the school, appended by –M and followed by a four-digit numerical code:

- The initial digit signifies the module level corresponding to the academic year, with 6 and 7 representing the respective first and second year of the program.
- The second digit denotes the specific streams or programs within the Civil and Environmental school, where 6 is assigned to water-related programs.
- The final two digits serve as a serial number for the modules within the MSc program.

Courses are designated with the prefix "CENG," which represents the name of the school, followed by a four-digit numerical code:

- The initial digit signifies the course level corresponding to the academic year, with 6 and 7 representing the respective first and second year of the program.
- The second digit denotes the specific streams or programs within the Civil and Environmental school, where 6 is assigned to water-related programs.
- The final two digits serve as a serial number for the courses within the MSc program.

19. Module List

This program has four modules basic, core, elective, and research/project modules as shown below. Basic modules are foundational courses providing essential knowledge and skills. Core modules delve deeper into the program's specific subject area, building upon basic knowledge. Electives allow students to specialize their studies by choosing courses aligned with their interests or career goals. The research/project module is typically a culminating course in the Master's program that equips students with the advanced skills and knowledge necessary to conduct independent research or project. It focuses on developing research methodologies, critical thinking, and problem-solving abilities.

Code	**Title**
CENG-M 6601	**Basic module**
CENG 6601	Numerical Methods and Applications in WRE
CENG 6651	Surface and Subsurface Hydrology

CENG 6653	Pollutant Fate and Transport
CENG-M 6602	**Core module**
CENG 6652	Environmental Systems Analysis
CENG 6654	Modeling Water Distribution
CENG 6656	Water and Wastewater Treatment and Process Design
CENG 6655	Water Supply and Sanitary Systems: Principles and Technologies
CENG 6658	Urban Drainage
CENG-M 6603	**Elective module**
CENG 6657	Environmental Sampling and Analysis
CENG 6659	Water Quality Modeling and Management
CENG 6661	Solid Waste Engineering and Management
CENG 6662	Water Utilities Management
CENG 6663	Environmental Health and Water Pollution
CENG 6664	Advanced Wastewater Treatment
CENG 6665	GIS and Remote Sensing Application in Environmental Management
CENG 6666	Environmental Remediation & Reclamation
CENG 6668	Emergency Water Supply and Sanitation
CENG 6669	Water Infrastructure and Environment
CTP6001	Pedagogy
CENG ####	Open Elective course[++]
CENG-M 7600	**Research and project module**
CENG 7901	Research Methods
CENG 7903	MEng Independent Project
CENG 7900	MSc Thesis
[++]A MSc student is permitted to enroll in any pertinent MSc course offered by the graduate programs at SCEE, contingent upon the approval of the SCEE graduate committee (SGC) and SCEE academic council (SAC).	

20. Modular Structure

Below is a summary table that categorizes modules into basic, core, elective, and research categories, detailing the competencies and their associated objectives.

Module Name	Competencies	Objectives
CENG-M 6601 Basic Modules	• Fundamental understanding of surface & subsurface hydrology, hydraulics, pollutant fate & transport. • Proficiency in numerical/mathematical modeling and statistical analysis. • Ability to apply basic engineering principles to water-related problems. • Knowledge of environmental regulations and policies.	• Define fundamental hydrological, hydraulic, pollutant fate and transport processes relevant to water resources. • Apply mathematical and statistical methods to analyze water-related data. • Solve basic engineering problems related to water supply, environmental pollution and wastewater treatment. • Demonstrate understanding of environmental regulations and their implications for water management.

CENG-M 6602 Core Modules	• In-depth knowledge of water distribution systems, wastewater treatment, and environmental engineering & urban drainage system design. • Competency in water quality assessment and management. • Ability to apply advanced water distribution, hydraulic and hydrological modeling techniques. • Understanding of environmental system assessment and risk assessment.	• Design water supply and wastewater treatment systems based on engineering principles. • Assess and manage water quality parameters and their impact on human health and ecosystems. • Develop and apply water distribution, hydrological and hydraulic models for water supply planning and management. • Evaluate environmental impacts of water-related projects using appropriate assessment tools.
CENG-M 6603 Elective Modules	• Specialized knowledge in a specific area of water supply or environmental engineering (*e.g.*, water sampling and analysis, water quality modeling, solid waste disposal & management, water pollution). • Skill in developing and implementing innovative solutions to water-related challenges, application of GIS and remote sensing, emergency water supply & sanitation provision, teaching. • Capacity for independent learning and critical thinking.	• Acquire specialized knowledge in a selected area of water supply and/or environmental engineering. • Develop innovative solutions to address Water Supply and Environmental Engineering related challenges. • Demonstrate critical thinking and problem-solving abilities in a water and environmental engineering context.
CENG-M 7600 Research Module	• Advanced research skills, including literature review, research design, data collection, analysis, and interpretation. • Ability to conduct independent research and contribute to the field of Water Supply and Environmental Engineering. • Effective communication skills to disseminate research findings through written and oral presentations. • Critical thinking and problem-solving abilities to address complex water-related issues.	• Formulate a research question and develop a research plan. • Conduct literature review to identify knowledge gaps and research opportunities. • Collect, analyze, and interpret data to address the research question. • Effectively communicate research findings through written and oral presentations. • Contribute to the advancement of knowledge in the field of Water Supply and Environmental Engineering.

21. Courses within Modules

The table below presents clusters of courses organized into modules, including course codes, titles, and ECTS. For each course, the allocated hours for lectures, tutorials, laboratory work, and independent study are specified, along with the total ECTS for the module. It is important to note that no courses are scheduled in a sequential manner; rather, all courses can be taken concurrently.

Code	Course Title	ECTS	Lec	Lab/Field	Indep. Study
CENG-M 6601	**Basic module**	**19**	**7**	**3**	**9**
CENG 6601	Numerical Methods and Applications in WRE	6	2	1	3
CENG 6651	Surface and Subsurface Hydrology	7	3	1	3
CENG 6653	Pollutant Fate and Transport	6	2	1	3
CENG-M 6602	**Core module**	**31**	**7**	**3**	**9**
CENG 6652	Environmental Systems Analysis	6	2	1	3
CENG 6654	Modeling Water Distribution	6	2	1	3
CENG 6656	Water and Wastewater Treatment and Process Design	7	3	1	3
CENG 6655	Water Supply and Sanitary Systems: Principles and Technologies	6	2	1	3
CENG 6658	Urban Drainage	6	2	1	3
CENG-M 6603	**Elective module**	**26/16***			
CENG 6657	Environmental Sampling and Analysis	5	2	1	2
CENG 6659	Water Quality Modeling and Management	5	2	1	2
CENG 6661	Solid Waste Engineering and Management	6	2	1	3
CENG 6662	Water Utilities Management	6	2	1	3
CENG 6663	Environmental Health and Water Pollution	5	2	1	2
CENG 6664	Advanced Wastewater Treatment	6	2	1	3
CENG 6665	GIS and Remote Sensing Application in Environmental Management	6	2	1	3
CENG 6666	Environmental Remediation & Reclamation	5	2	1	2
CENG 6668	Emergency Water Supply and Sanitation	5	2	1	2
CENG 6669	Water Infrastructure and Environment	5	2	1	2
CTP6001	Pedagogy	6	2	1	3
CENG ####	Open Elective course++	-			
CENG-M 7600	**Research and project module**	**26/36****	**2**	**1**	**23/33**
CENG 7901	Research Methods	6	2	1	3
CENG 7903	MEng Independent Project	20			20
CENG 7900	MSc Thesis	30			30

***at least 26 for MEng and at least 16 for MSc options**
***26 for MEng and 36 for MSc options**
++A MSc student is permitted to enroll in any pertinent MSc course offered by the graduate programs at SCEE, contingent upon the approval of the SGC and SAC.

22. Semester Course Breakdown

The following tables outlines the sequencing and scheduling of courses by semester and year, incorporating the ECTS. Additionally, it details the time allocated for lectures, tutorials, laboratories, and independent study. Furthermore, a categorization of the three graduation options is included below.

Year I, Semester I (for MSc, MEng or PGD options)					
Code	**Course Title**	**ECTS**	**Lec**	**Lab/Field**	**Indep. Study**
CENG 6601	Numerical Methods and Applications in WRE	6	2	1	3
CENG 6651	Surface and Subsurface Hydrology	7	3	1	3
CENG 6653	Pollutant Fate and Transport	6	2	1	3
CENG 6655	Water Supply and Sanitary Systems: Principles and Technologies	6	2	1	3
CENG ####	Elective 1	5 or 6	2	1	2/3
	Total	**30 or 31**			

Year I, Semester II (for MSc, MEng or PGD options)					
Code	**Course Title**	**ECTS**	**Lec**	**Lab/Field**	**Indep. Study**
CENG 6652	Environmental Systems Analysis	6	2	1	3
CENG 6654	Modeling Water Distribution	6	2	1	3
CENG 6656	Water and Wastewater Treatment and Process Design	7	3	1	3
CENG 6658	Urban Drainage	6	2	1	3
CENG ####	Elective 2	5 or 6	2	1	2/3
	Total	**30 or 31**			

Year II, Semester I (for MSc or MEng options)					
Code	**Course Title**	**ECTS**	**Lec**	**Lab/Field**	**Indep. Study**
CENG 7901	Research Methods	6	2	1	3
CENG ####	Elective 3	5 or 6	2	1	2/3
CENG ####	Elective 4*	5 or 6	2	1	2/3
CENG 7900/ CENG 7903	MSc Thesis/MEng Independent Project**	30/20			
	Total	**36, (36 to 38)*** **			
***only for MEng students ****MSc Thesis (CENG 7900) for MSc and MEng Independent project (CENG 7903) for MEng option *****36 for MSc and (36 to 38) for MEng option					

Year II, Semester II (for MSc or MEng options)					
Code	**Course Title**	**ECTS**	**Lec**	**Lab/Field**	**Indep. Study**

CENG 7900/ CENG 7903	MSc Thesis/MEng Independent Project*	30/20			30
CENG ####	Elective 5**	5 or 6	2	1	2/3
	Total	**30/(25 or 26)**			
*****MSc Thesis (CENG 7900) for MSc and MEng Independent project (CENG 7903) for MEng option ****** only for MEng students					

23. Module Handbook

CENG-M 6601: Basic module

Code	Course Title	ECTS	Lec	Lab/Field	Indep. Study
CENG-M 6601	**Basic module**	**19**	**7**	**3**	**9**
CENG 6601	Numerical Methods and Applications in WRE	6	2	1	3
CENG 6651	Surface and Subsurface Hydrology	7	3	1	3
CENG 6653	Pollutant Fate and Transport	6	2	1	3

Competencies:

Upon completion of this module the students will have:

- Fundamental understanding of surface & subsurface hydrology, hydraulics, pollutant fate & transport.
- Proficiency in numerical/mathematical modeling and statistical analysis.
- Ability to apply basic engineering principles to water-related problems.

Objectives:

- Define fundamental hydrological, hydraulic, pollutant fate and transport processes relevant to water resources.
- Apply mathematical and statistical methods to analyze water-related data.
- Solve basic engineering problems related to water supply, environmental pollution and wastewater treatment.

Module Delivery

Elective courses can be delivered through a variety of methods, including:

- **Lectures:** Formal presentations by faculty experts on specific topics.
- **Workshops:** Hands-on training and skill development sessions.
- **Online learning:** Flexible access to course materials and interactive online platforms.
- **Fieldwork/Lab work:** Practical experience through laboratory tests, site visits and data collection.

Module Duration

Elective courses can vary in duration, typically ranging from five to seven ECTS or equivalent. The minimum total number of elective credits required for this MSc program is as shown in the graduate requirement section.

Teaching-Learning Methods

A combination of teaching and learning methods can be employed to enhance student engagement and learning:

- Lectures: To impart theoretical knowledge and stimulate critical thinking.
- Group discussions and debates: To foster collaboration and problem-solving skills.
- Case studies and problem-based learning: To apply theoretical knowledge to real-world scenarios.
- Independent study and design projects: To develop research skills and encourage self-directed learning.
- Guest lectures and industry visits: To expose students to current trends and industry practices.

Assessment Approach

Assessment methods for elective courses should align with the course objectives and competencies. Possible assessment approaches include:

- Written assignments: Essays, reports, or research papers to evaluate knowledge and critical thinking.
- Presentations: Oral presentations to assess communication and presentation skills.
- Projects: Individual or group projects to evaluate problem-solving and practical application of knowledge.
- Exams: To assess theoretical understanding and knowledge retention.
- Portfolios: To demonstrate overall learning and development.

CENG-M 6602: Core Module

Code	Course Title	ECTS	Lec	Lab/Field	Indep. Study
CENG-M 6602	**Core module**	**31**	**7**	**3**	**9**
CENG 6652	Environmental Systems Analysis	6	2	1	3
CENG 6654	Modeling Water Distribution	6	2	1	3
CENG 6656	Water and Wastewater Treatment and Process Design	7	3	1	3
CENG 6655	Water Supply and Sanitary Systems: Principles and Technologies	6	2	1	3
CENG 6658	Urban Drainage	6	2	1	3

Competencies:

Upon completion of this module the students will have:

- In-depth knowledge of water distribution systems, wastewater treatment, and environmental engineering & urban drainage system design.
- Competency in water quality assessment and management.
- Ability to apply advanced water distribution, hydraulic and hydrological modeling techniques.
- Understanding of environmental system assessment and risk assessment.

Objectives:

- Design water supply and wastewater treatment systems based on engineering principles.
- Assess and manage water quality parameters and their impact on human health and ecosystems.

- Develop and apply water distribution, hydrological and hydraulic models for water supply planning and management.
- Evaluate environmental impacts of water-related projects using appropriate assessment tools.

Module Delivery

Elective courses can be delivered through a variety of methods, including:

- Lectures: Formal presentations by faculty experts on specific topics.
- Workshops: Hands-on training and skill development sessions.
- Online learning: Flexible access to course materials and interactive online platforms.
- Fieldwork/Lab work: Practical experience through laboratory tests, site visits and data collection.

Module Duration

Elective courses can vary in duration, typically ranging from five to seven ECTS or equivalent. The minimum total number of elective credits required for this MSc program is as shown in the graduate requirement section.

Teaching-Learning Methods

A combination of teaching and learning methods can be employed to enhance student engagement and learning:

- Lectures: To impart theoretical knowledge and stimulate critical thinking.
- Group discussions and debates: To foster collaboration and problem-solving skills.
- Case studies and problem-based learning: To apply theoretical knowledge to real-world scenarios.
- Independent study and design projects: To develop research skills and encourage self-directed learning.
- Guest lectures and industry visits: To expose students to current trends and industry practices.

Assessment Approach

Assessment methods for elective courses should align with the course objectives and competencies. Possible assessment approaches include:

- Written assignments: Essays, reports, or research papers to evaluate knowledge and critical thinking.
- Presentations: Oral presentations to assess communication and presentation skills.
- Projects: Individual or group projects to evaluate problem-solving and practical application of knowledge.
- Exams: To assess theoretical understanding and knowledge retention.
- Portfolios: To demonstrate overall learning and development.

CENG-M 6603: Elective module

Number	Course Title	ECTS	Lec	Lab/Field	Indep. Study
CENG-M 6603	**Elective module**				
CENG 6657	Environmental Sampling and Analysis	5	2	1	2
CENG 6659	Water Quality Modeling and Management	5	2	1	2
CENG 6661	Solid Waste Engineering and Management	6	2	1	3
CENG 6662	Water Utilities Management	6	2	1	3

CENG 6663	Environmental Health and Water Pollution	5	2	1	2
CENG 6664	Advanced Wastewater Treatment	6	2	1	3
CENG 6665	GIS and Remote Sensing Application in Environmental Management	6	2	1	3
CENG 6666	Environmental Remediation & Reclamation	5	2	1	2
CENG 6668	Emergency Water Supply and Sanitation	5	2	1	2
CENG 6669	Water Infrastructure and Environment	5	2	1	2
CTP6001	Pedagogy	6	2	1	3
CENG ####	Open Elective course[+]	-			
[+]A student is permitted to enroll in any pertinent MSc course offered by the graduate programs at SCEE, contingent upon the approval of the SGC and SAC.					

Module Description

The elective courses module offers MSc students the opportunity to deepen their knowledge and expertise in specific areas of Water Supply and Environmental Engineering. Courses are designed to supplement the core curriculum and provide students with the flexibility to tailor their studies to their research interests and career goals.

Competencies

- Specialized knowledge in a specific area of water supply or environmental engineering (*e.g.*, water sampling and analysis, water quality modeling, solid waste disposal & management, water pollution).
- Skill in developing and implementing innovative solutions to water-related challenges, application of GIS and remote sensing, emergency water supply & sanitation provision, teaching.
- Capacity for independent learning and critical thinking.
- Problem-solving: Ability to identify, analyze, and develop innovative solutions to complex water and environmental challenges.
- Collaboration: Ability to work effectively in interdisciplinary teams

Objectives

- Problem-solving: Applying advanced knowledge to address real-world water and environmental issues.
- Innovation: Fostering the development of new ideas and technologies.
- Acquire specialized knowledge in a selected area of water supply and/or environmental engineering.
- Develop innovative solutions to address Water Supply and Environmental Engineering related challenges.
- Demonstrate critical thinking and problem-solving abilities in a water and environmental engineering context.
- Interdisciplinary integration: Connecting water and environmental engineering with other fields (*e.g.*, hydrology, ecology, economics etc.).

Module Delivery

Elective courses can be delivered through a variety of methods, including:

- Lectures: Formal presentations by faculty experts on specific topics.

- Workshops: Hands-on training and skill development sessions.
- Online learning: Flexible access to course materials and interactive online platforms.
- Fieldwork, Lab work: Practical experience through laboratory tests, site visits and data collection.

Module Duration

Elective courses can vary in duration, typically ranging from five to seven ECTS or equivalent. The minimum total number of elective credits required for this MSc program is as shown in the graduate requirement section.

Teaching-Learning Methods

A combination of teaching and learning methods can be employed to enhance student engagement and learning:

- Lectures: To impart theoretical knowledge and stimulate critical thinking.
- Group discussions and debates: To foster collaboration and problem-solving skills.
- Case studies and problem-based learning: To apply theoretical knowledge to real-world scenarios.
- Independent study and design projects: To develop research skills and encourage self-directed learning.
- Guest lectures and industry visits: To expose students to current trends and industry practices.

Assessment Approach

Assessment methods for elective courses should align with the course objectives and competencies. Possible assessment approaches include:

- Written assignments: Essays, reports, or research papers to evaluate knowledge and critical thinking.
- Presentations: Oral presentations to assess communication and presentation skills.
- Projects: Individual or group projects to evaluate problem-solving and practical application of knowledge.
- Exams: To assess theoretical understanding and knowledge retention.
- Portfolios: To demonstrate overall learning and development.

CENG-M 7900: Research and project Module

Number	Course Title	ECTS	Lec	Lab/Field	Indep. Study
CENG-M 7900	**Research and project module**	**26/36***	**2**	**1**	**19/33**
CENG 7901	Research Methods	6	2	1	3
CENG 7903	MEng Independent Project	20			16
CENG 7900	MSc Thesis	30			30
***26 for MEng and 36 for MSc graduation options**					

Module Description

The research module constitutes the core of the MSc program in Water Supply and Environmental Engineering. It is designed to cultivate independent research capabilities, critical thinking, and problem-solving skills. Students will conceptualize, execute, and disseminate research contributing to the advancement of knowledge in the field.

Competencies

- Advanced knowledge of water supply engineering principles: Hydrology, hydraulics, water quality, and water treatment processes.
- Strong foundation in environmental engineering: Solid & Sanitary Waste management, and environmental impact assessment.
- Proficiency in research methodologies and study & design approaches: study and design, data analysis, statistical modeling, and scientific writing.
- Ability to conduct research, study and design: Formulating research questions, and developing research methodologies, study & design approaches.
- Critical thinking and problem-solving skills: Analyzing complex water and environmental challenges.

Objectives

- Formulate a research question, study & and design problems, and develop their plan.
- Conduct literature review to identify research and study opportunities.
- Collect, and analyze to address the research question or study & design problems.
- Effectively communicate findings through written and oral presentations.
- Contribute to the advancement of knowledge in the field of Water Supply and Environmental Engineering.

Module Delivery

The research and project module is primarily delivered through a one-on-one supervisory relationship between the student and a faculty advisor. Regular meetings, and progress reviews provide opportunities for feedback, guidance, and collaboration.

Module Duration

The duration of the research and project module typically spans one to two years, depending on the complexity of the research project and the AAU's regulations. It is a full-time commitment requiring dedicated effort from the student.

Teaching-Learning Methods

- One-on-one supervision: Regular meetings with the advisor to discuss research progress, challenges, and strategies.
- Research/study/design presentations: Opportunities to present research findings to peers, faculty, and external experts.
- Literature review and critical analysis: Extensive engagement with relevant research literature to develop a strong theoretical foundation.
- Data collection and analysis: Application of appropriate research methodologies and statistical techniques.
- Research/project proposal development: Formulation of a clear and comprehensive research proposal outlining research objectives, methodology, and expected outcomes.
- Thesis/project report writing: Development of a well-structured and coherent dissertation that effectively communicates research findings.

Assessment Approach

The research and project module is primarily assessed through the completion of published articles and a doctoral dissertation. The dissertation is evaluated based on its originality, contribution to knowledge,

research methodology, data analysis, clarity of presentation, and adherence to academic standards. Additional assessments may include progress reports, research proposals, and oral defenses.

24. Course Guide Books

CENG 6601 – Numerical Methods and Application in WRE

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Numerical Methods and Application in Water Resources Engineering

N	Section	Contents
1	Module:	
	1.1. Module Title	Basic
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Develop mathematical models for water and environmental engineering problems. • Utilize programing language like MATLAB to implement numerical methods for solving engineering problems. • Apply numerical differentiation techniques (finite difference, finite element, finite volume) to solve ordinary and partial differential equations. • Analyze and interpret numerical results in the context of water and environmental engineering applications.
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6601
	4.2. Credit Hrs/ECTS	6 ECTS
5	Semester and Year	Year I Semester I
6	Prerequisite	None
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course is designed to equip students with the necessary skills to develop and apply numerical methods to solve complex problems in Water Supply and Environmental Engineering. It focuses on the formulation and solution of mathematical models using a powerful programing language like MATLAB. Students will gain hands-on experience in developing computer programs to simulate various hydrological and environmental processes, described using ordinary and partial differential equations.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Understand the fundamental concepts of numerical methods and their application to water and environmental engineering. • Master a programing language like MATLAB programming environment and its application to numerical computations.

		• Develop and implement numerical models for various PDE and ODE in hydrological and environmental processes. • Critically evaluate numerical results and draw meaningful conclusions.

12	Course Contents	• Introduction to a programing language (e.g. MATLAB):
		  ○ Language environment and programming basics
		  ○ Program execution and flow control
		  ○ Data types, arrays, and indexing
		  ○ Numerical error and precision
		• Numerical Differentiation:
		  ○ Finite difference approximation
		  ○ Finite element method
		  ○ Finite volume method
		  ○ Application to ordinary and partial differential equations
		• Mathematical Modeling and Simulation:
		  ○ Formulation of mathematical models for water and environmental systems
		  ○ Model discretization and solution techniques
		  ○ Development of a programming language (e.g. MATLAB) codes for model implementation

13	Teaching and learning techniques	• Lectures: Theoretical concepts and problem-solving techniques will be presented. • Computer-based exercises: Students will gain hands-on experience with a programming language and numerical modeling. • Group projects: Students will work collaboratively on real-world engineering problems. • Assignments: Homework assignments will reinforce learning and assess student understanding.
14	Assessments	• Assignments: Regular assignments to evaluate problem-solving and programming skills. • Midterm exam: Assessment of theoretical knowledge and problem-solving abilities. • Final project/Exam: Comprehensive evaluation of students' ability to apply numerical methods to a real-world engineering problem.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	-
	16.2. References	-
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Tech.	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6651 – Surface and Subsurface Hydrology
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Surface and Subsurface Hydrology

N	Section	Contents
1	Module:	
	1.1. Module Title	Basic
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Understand and apply hydrologic principles in the planning and design of Water Supply and Environmental Engineering projects • Apply rainfall-runoff models to simulate hydrological processes and assess impacts of climate and land use changes • Estimate safe yields from surface water resources • Determine design rainfall and runoff • Conduct groundwater surveys using geophysical, remote sensing, and field techniques. • Evaluate groundwater hydraulic properties and aquifer characteristics. • Estimate groundwater resources and determine safe yield. • Develop groundwater management strategies.
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6651
	4.2. Credit Hrs/ECTS	7 ECTS
5	Semester and Year	Year I Semester I
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 Agizew Nigussie (PhD) agizew.nigussie@aait.edu.et Office No. 240
8	Course Description	This course provides a comprehensive understanding of hydrological processes, both on the surface and subsurface. It focuses on the application of conceptual deterministic rainfall-runoff models for analyzing hydrological phenomena, including climate change impacts, extreme events, and discharge forecasting. Additionally, the course delves into groundwater occurrence, properties, and hydraulics, equipping students with the skills to evaluate groundwater resources for sustainable management.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities

11	Learning Outcomes Students will be able to:	• Understand and explain hydrological processes. • Acquire skills of hydrological data collection, analysis and interpretation using different sources and tools • Perform hydrograph analysis and flood routing • Use hydrological model to simulate runoff • Conduct frequency analysis and determine design rainfall and runoff • Develop the ability to assess groundwater potential. • Gain proficiency in groundwater exploration and development techniques. • Understand the importance of sustainable groundwater management.
12	Course Contents	• Introduction o Hydrological cycle o Hydrological processes • Surface Hydrology o Watershed characteristics o Rainfall analysis o Infiltration and evapotranspiration o Runoff generation processes o Hydrograph analysis o Flow duration curve o Flood routing o Hydrologic modeling o Hydrologic statistics (Statistical tests, time series analysis, hydrologic design) • Subsurface Hydrology o Groundwater occurrence and distribution o Hydrogeological properties of aquifers o Groundwater exploration methods (geophysical, remote sensing, field) o Groundwater hydraulics (well hydraulics, aquifer parameters) o Groundwater management and sustainability
13	Teaching and learning techniques	• Lectures: Theoretical concepts and case studies • Practical exercises: Hands-on experience with hydrological modeling software • Group projects: Application of hydrological concepts to real-world problems • Guest lectures: Industry experts and research presentations
14	Assessments	• Assignments and homework: Evaluation of theoretical understanding and problem-solving skills • Midterm exam: Assessment of knowledge of core concepts • Final exam: Comprehensive evaluation of overall course learning • Practical reports: Demonstration of data analysis and interpretation skills • Group project: Assessment of teamwork, problem-solving, and presentation abilities

15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	• Textbooks: Recommended hydrology and hydrogeology textbooks • Journal articles: Current research on hydrological and groundwater topics • Software: Hydrological and groundwater modeling software • Data: Hydrological and hydrogeological datasets • Online resources: Websites and databases with hydrological information
	16.1.Textbooks	• Hydrologic Analysis and Design by R. H. McCuen. Prentice Hall, 1989; 2nd Edition • Applied Hydrology by Vente Chow, David Maidment and Larry W. Ways, McGraw-Hill, 1988 7.
	16.2. References	• Hydrology: Principles, Analysis and Design, H. M. Raghunath, New Age International Publishers, 2006; 2nd Edition • Flood Frequency Analysis, A.Ramachandrarao Kahled H. Hamed, CRC Press, 2000 • Groundwater Hydrology: Engineering, Planning, and Management; M. Karamouz • A. Ahmadi • M. Akhbari, CRC Press, 2011 • Groundwater and Wells, edited by Robert J. Sterrett, 3rd ed, Johnson Screens, 2007
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6652 – Environmental Systems Analysis
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Environmental systems analysis

No	Section	Contents
1	Module:	
	1.1. Module Title	Core
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Apply systems thinking to analyze complex environmental problems. • Develop and use quantitative models to simulate environmental systems. • Evaluate the effectiveness of different management strategies. • Communicate complex technical information to a diverse audience.
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6652
	4.2. Credit Hrs/ECTS/	6 ECTS
5	Semester and Year	Year I Semester II
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 Mebruk Mohammed (PhD) mebruk.mohammed@aait.edu.et Office No. 224 A
8	Course Description	Introduction to concepts and applications of systems analysis and modeling techniques to environmental problems will first be raised in the course. Then, integrated management strategies addressing multi-objective planning through application of optimization methods and soft computing techniques in water environment related fields is discussed. Finally; concepts of system uncertainty and sensitivity applied to environmental decision-making will be introduced.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Understand the principles of systems thinking and its application to environmental problems. • Master quantitative modeling techniques, including system dynamics, optimization, and simulation. • Develop skills in data collection, analysis, and interpretation. • Gain experience in using computer code for systems analysis.
12	Course Contents	• Environmental systems analysis an over view

		• Optimization models and methods
		  ○ Overview of optimization models
		  ○ Dynamic programming
		  ○ Linear programming with excel solver
		• Soft computing techniques
		  ○ Soft computing an introduction
		  ○ Data driven modelling
		  ○ Artificial neural networks
		  ○ Evolutionary algorithms: Genetic Algorithm
		  ○ Qualitative modelling
		  ○ Fuzzy Optimization
		• System sensitivity and uncertainty analysis
		  ○ Issues, concerns and terminology
		  ○ System uncertainty analysis
		  ○ System sensitivity analysis

13	Teaching and learning techniques	• Lectures on theoretical concepts and modeling principles • Hands-on computer exercises using system analysis modeling software • Group projects involving model development and analysis
14	Assessments	• Assignments: Homework problems and case studies • Model development and presentation • Tests: To assess understanding of core concepts • Final exam: To assess understanding of core concepts and Comprehensive evaluation of knowledge and problem-solving skills • Class participation: To encourage active engagement and critical thinking
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	
	16.1.Textbooks	-
	16.2. References	• Techniques of Environmental systems analysis, By Pantell Richard, NY, Wiley 1976 • Environmental systems analysis with MATLAB, Stefano Libelli, 2016 • Systems analysis and water quality management, Thomas Robert, 1972 • Civil and Environmental systems engineering, Re Valle, Charles
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6653 – Pollutant Fate and Transport

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Pollutant Fate and Transport

No	Section	Contents
1	Module:	
	1.1. Module Title	Core
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Describe the fundamental principles of contaminant transport in surface water and groundwater systems. • Apply mathematical models to simulate the fate and transport of pollutants in aquatic environments. • Evaluate the impact of various physical, chemical, and biological processes on pollutant behavior.
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6653
	4.2. Credit Hrs/ECTS	6 ECTS
5	Semester and Year	Year I Semester I
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 Mebruk Mohammed (PhD) mebruk.mohammed@aait.edu.et Office No. 224 A
8	Course Description	This course introduces the concept of transport processes in the environment with emphasis on Movement and transformation of pollutants/contaminants released in the water environment. Fundamentals of diffusion, advection, dispersion, reaction and sorption. Aggregation and parameterization of various mixing processes, leading to dispersion at spatial and temporal scales. Importance of heterogeneity, anisotropy and stratification in natural media. Basic principles are illustrated by application to river, lakes, and groundwater pollution problems.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Describe the fundamental principles of contaminant transport in surface water and groundwater systems. • Apply mathematical models to simulate the fate and transport of pollutants in aquatic environments. • Evaluate the impact of various physical, chemical, and biological processes on pollutant behavior.

12	Course Contents	• Introduction to Pollutant Fate and Transport
		  ○ Sources and types of pollutant
		  ○ An overview of pollutant fate and transport modeling
		• Fate and Transport in surface water
		  ○ Fate and Transport in river system
		  ○ Fate and Transport in lakes and reservoirs
		• Fate and Transport in Subsurface Water
		  ○ Basics of groundwater flow
		  ○ Physical transport mechanisms in groundwater
		  ○ Dispersion and retardation in groundwater
		  ○ Movement of DNAPL's and LNAPL's

13	Teaching and learning techniques	• Lectures: Formal presentations on specific topics. • Online learning: Flexible access to course materials and interactive online platforms.
14	Assessments	• Assignments: Homework problems and case studies • Final exam: To assess understanding of core concepts and Comprehensive evaluation of knowledge and problem-solving skills • Research paper or project: To apply course concepts to a real-world problem and demonstrate independent research abilities • Class participation: To encourage active engagement and critical thinking
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	
	16.1.Textbooks	*Chemical Fate and Transport in the Environment* by Hemond and Fechner.
	16.2. References	• Elsevier, Principles of contaminant Transport in soil • J. Wiley, 2005, Integrated Environmental Modelling, Hoboken, NJ, • Wilbert Lick, 2009, Sediment and contaminant transport in surface waters • Zheng Chunmiao, Applied Contaminant Transport modelling, New York
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Tech.	-
17	Assessment rubrics	• Assignments, project evaluation, tests, class participation: 50% • Final Exam: 50%

CENG 6654 – Modeling Water Distribution Networks
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Modeling water distribution networks

No	Section	Contents
1	Module:	
	1.1. Module Title	Core
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Model development: Construct accurate and reliable hydraulic models of water distribution systems. • Model calibration: Calibrate and validate hydraulic models using field data. • Hydraulic analysis: Perform steady-state and transient analyses of water distribution networks. • Optimization techniques: Apply optimization methods to improve system performance. • Problem-solving: Identify and solve complex problems related to water distribution systems.
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6654
	4.2. Credit Hrs/ECTS	6 ECTS
5	Semester and Year	Year I Semester II
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	Modelling Water Distribution Networks is a core course designed to equip students with the necessary knowledge and skills to analyze, design, and optimize water supply distribution systems. The course focuses on the application of hydraulic analysis models to evaluate existing networks and develop new ones. Students will gain expertise in various modeling techniques, calibration procedures, and advanced analyses, including water quality and transient flow.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes	• Understand the principles of hydraulic modeling for water distribution systems.

	Students will be able to:	• Apply different modeling approaches to real-world scenarios. • Analyze the hydraulic performance of existing water distribution networks. • Design new water distribution systems based on hydraulic criteria. • Assess the impact of transient pressures on the system. • Optimize water distribution systems for efficiency and reliability.
12	Course Contents	• Introduction to water distribution systems and hydraulic principles • Overview of water distribution modeling software (*e.g.*, EPANET, WaterCAD) • Model development and data requirements • Model calibration and validation techniques • Steady-state hydraulic analysis (pressure, flow, and energy) • Transient analysis (water hammer) • Optimization of water distribution systems (*e.g.*, pump scheduling, pipe sizing) • Case studies and real-world applications
13	Teaching and learning techniques	• Lectures: Theoretical concepts and principles will be explained through lectures. • Practical exercises: Students will engage in hands-on exercises using water distribution modeling software. • Case studies: Real-world examples will be analyzed to enhance problem-solving skills. • Group projects: Students will work collaboratively on modeling projects. • Guest lectures: Industry experts may be invited to share their experiences.
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	• Textbook(s) on water distribution modeling • Course notes and handouts • Water distribution modeling software • Online resources and databases • Relevant journal articles and research papers
	16.1.Textbooks	• Walski Thomas M, Donald V Chase, Dragan A Savic and Walter Grayman, et al. (2003). Advanced water distribution modeling and management, Civil and Environmental Engineering and Engineering Mechanics Faculty Publications

	16.2. References	• AWWA (2012). Computer Modeling of Water Distribution Systems, Manual of Water Supply Practices — M32, American Water Works Association.
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6655 – Water Supply and Sanitary Systems: Principles and Technologies
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Water Supply and Sanitary Systems: Principles and Technologies

No	Section	Contents
1	Module:	
	1.1. Module Title	Core
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Analyze the water supply and sanitation needs of different communities (rural, urban) • Design and evaluate the development of various water supply and sanitation systems considering technical, economic, and environmental factors • Select appropriate technologies for different water sources and system configurations • Assess the sustainability of water supply and sanitary systems and implement measures for environmental protection • Identify and manage risks associated with water supply and sanitation systems • Analyze and synthesize sustainable service delivery of water supply and sanitary services
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6655
	4.2. Credit Hrs/ECTS	6 ECTS
5	Semester and Year	Year I
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 Geremew Sahilu (PhD) Geremew.sahilu@aait.edu.et Office no.
8	Course Description	Water Supply and Sanitary Systems: Principles and Technologies is a core course designed to provide a comprehensive understanding and synthesis of the planning, design, implementation, and management of water supply and sanitation systems. The course will delve into the fundamental principles, technologies, and systems involved in delivering safe and adequate water to end-users while ensuring proper management of wastewater through sustainable sanitation and environmental protection.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.

10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Describe the components and processes involved in water supply and sanitation systems. • Evaluate different water sources and their suitability for various applications. • Evaluate different sanitation systems and their suitability for various application • Design and analyze water distribution networks and sewerage systems. • Apply principles of hydraulics and hydrology to water supply and sanitation systems. • Assess the environmental impacts of water supply and sanitation systems and propose mitigation measures. • Develop water supply and sanitation plans for different communities. • Understand the economic and social aspects of water supply and sanitation.
12	Course Contents	• Introduction to Water Supply and Sanitation: Definition, importance, and challenges. • Water Supply System o Type of water supply systems categorized by (Source/Sector/Settlement Pattern/ Location/ Environment and Management) ▪ Components (Physical and Institutional) ▪ Development of Water Supply System (Pre/during/post-construction) ▪ Alternative Water Supply Sources ▪ Water Source Protection • Sanitation System o Introduction to Sanitary Systems ▪ Components of Sanitary System ▪ Conveyance System ▪ Treatment System by (Level/ Location and Nature) • Modeling of Water Supply and Sanitation System (Practiced considering particular town or city as a case study or a project)
13	Teaching and learning techniques	• Lectures • Case studies • Group projects • Field visits • Guest lectures • Online resources and simulations
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge.

		• Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	• Water and Wastewater Engineering, Design Principle and Practices, Mackenzie L. Davis • TWORT's Water Supply, 6th Edition, Michael Johnson, Don D. Ratanayaka and Malcom J. Brandt
	16.2. References	• Natural Wastewater Treatment Systems; Ronald W.Crites, Joe Middlebrooks and Sherwood C. Reed; Taylor & Francis Group, 2006 • Asset Management: A Guide for Water and Wastewater Systems, Environmental Finance Centre of New Mexico Tech, 2006 • Compendium of Sanitation Systems and Technologies; Elizabeth Tilley, Lukas Ulrich, Chirstoph Luti, Phillipe Reymond and Christian Zurbrugg, The International Water Association (IWA), eawag, aquatic research
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6656 – Water and Wastewater Treatment and Process Design
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Water and Wastewater Treatment and Process Design

No	Section	Contents
1	Module:	
	1.1. Module Title	Core
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Apply fundamental principles of biology, chemistry, and physics to water and wastewater treatment processes. • Analyze and interpret water quality data to inform treatment process selection and design. • Design and optimize water and wastewater treatment systems based on engineering principles and economic considerations. • Evaluate the performance of water and wastewater treatment facilities and recommend improvements. • Understand the environmental impact of water and wastewater treatment processes and develop sustainable solutions.
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6656
	4.2. Credit Hrs/ECTS	6 ECTS
5	Semester and Year	Year I
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 Agizew Nigusie (PhD) agizew.nigussie@aait.edu.et Office No. 240
8	Course Description	Water and Wastewater Treatment and Process Design is a core course designed to equip students with the fundamental knowledge and skills required for the planning, design, operation, and management of water and wastewater treatment systems. The course will delve into the underlying principles of biological, physical, and chemical sciences, as well as the governing equations that underpin water quality and wastewater treatment processes. Students will gain a comprehensive understanding of water and wastewater treatment unit operations, process design methodologies, and the operational management of water treatment facilities. A strong emphasis will be placed on conventional treatment processes. Students will also be introduced to resource oriented wastewater management approaches.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.

10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Describe the physical, chemical, and biological characteristics of water and wastewater. • Explain the principles of unit operations used in water and wastewater treatment. • Design water and wastewater treatment systems based on specific water quality requirements and discharge standards. • Analyze the performance of water and wastewater treatment processes and identify areas for improvement. • Describe sludge management and end use options • Evaluate the economic, social and environmental impacts of water and wastewater treatment alternatives.
12	Course Contents	• Introduction to Water and Wastewater: Water quality parameters, wastewater characteristics, treatment goals, selection of treatment processes, overall design process • Unit process principles • Water Treatment Unit Operations and processes: Water intake, pretreatment, clarification, filtration, disinfection, and specialized treatment processes (Theory and practice, Design, Operation and maintenance) • Wastewater Treatment Unit Operations and processes: Preliminary, primary, secondary, and tertiary treatments (Theory and practice, Design, Operation and maintenance) • Plant design and layout • Water and wastewater plants residuals management • Resource oriented wastewater treatment
13	Teaching and learning techniques	• Lectures • Laboratory experiments • Case studies • Problem-solving exercises • Group projects • Field visits • Guest lectures
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.

16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	• Davis (2020) Water and Wastewater Engineering–Design Principles and Practice, 2nd Ed., McGraw-Hill, USA.
	16.2. References	• Crittenden, Trussell, Hand, Howe and Tchobanoglous (2012) MHWs Water Treatment–Principles and Design, 3rd Ed., John Wiley & Sons Inc., Hoboken, NJ. • David Hendricks, Water Treatment Unit Processes, Physical and Chemical, Talor & Francis, Bocca Raton, 2006 • Tchobanoglous, Stensel, Tsuchihashi and Burton (2014) Wastewater Engineering–Treatment and Resource Recovery, 5th Ed., McGraw-Hill, NY. • Von Sperling M. (2015). "Wastewater Characteristics, Treatment and Disposal". IWA Publishing
	16.3. Lab Materials and Equipment	• Jar test apparatus • Equipment and reagents for testing key water and wastewater parameters
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, project evaluation, class participation: 50% • Final Exam: 50%

CENG 6658 – Urban Drainage

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Urban Drainage

N	Section	Contents
1	Module:	
	1.1. Module Title	Core
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Understanding of urban hydrology and its impact on drainage systems • Ability to design and analyze various sewage disposal systems • Proficiency in the design and implementation of stormwater management systems • Knowledge of urban runoff quality and its management • Capacity to utilize modeling tools for assessing urban drainage systems • Skill in developing sustainable urban drainage strategies
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 6658
	4.2. Credit Hrs/ECTS	6 ECTS
5	Semester and Year	Year I
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 Geremew Sahilu (PhD) Geremew.sahilu@aait.edu.et Office no.
8	Course Description	The Urban Drainage course is designed to equip students with the knowledge and skills necessary for the planning, design, and management of sustainable sewage and stormwater management systems in urban environments. The course will cover a comprehensive range of topics, including sewage disposal systems, sewage collection and disposal, stormwater management, urban hydrology, and runoff quality and modeling. Upon completion, students will be able to develop effective solutions to urban drainage challenges and contribute to sustainable urban development.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Analyze urban drainage problems and identify appropriate solutions • Design and evaluate different types of sewage disposal systems • Develop strategies for managing stormwater runoff in urban areas • Assess the impact of urban development on water quality • Utilize hydrological and hydraulic models for urban drainage analysis

		• Incorporate sustainable principles into urban drainage planning and design
12	Course Contents	• Urban Hydrology: Rainfall characteristics, infiltration, runoff generation, and hydrological modeling. • Sewage Disposal Systems: Types of sewage systems, estimation of sewage quantity and quality, design of sewers, pumping stations, and treatment plants. • Stormwater Management: Conventional and sustainable stormwater management practices, stormwater detention and retention systems, infiltration basins, and green infrastructure. • Integrated Flood Risk Management – Flood risk assessment, structural and Non-Structural Measures • Urban Runoff Quality: Sources of pollutants, water quality monitoring, and treatment options. • Urban Runoff Modeling: Hydrological and hydraulic modeling software, model calibration and validation, and application of models to urban drainage design.
13	Teaching and learning techniques	• Lectures: Providing theoretical foundations and case studies • Problem-solving exercises: Applying knowledge to practical scenarios • Field visits: Observing real-world urban drainage systems • Group projects: Developing collaborative problem-solving skills • Guest lectures: Providing industry insights and perspectives
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	• Urban Drainage, 2nd Edition, David Butler and John W. Davies
	16.2. References	• Compendium of Sanitation Systems and Technologies; Elizabeth Tilley, Lukas Ulrich, Chirstoph Luti, Phillipe Reymond and Christian Zurbrugg, The IWA, eawag, aquatic research
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, project evaluation, class participation: 50% • Final Exam: 50%

CENG 6657 – Environmental Sampling and Analysis
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Environmental Sampling and Analysis

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Mastery of sampling techniques for different environmental media. • Proficiency in various analytical methods for physical, chemical, and biological parameters. • Ability to design sampling plans based on statistical principles. • Skill in data management, analysis, and interpretation. • Understanding of quality assurance and quality control measures in environmental analysis.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6657
	4.2. Credit Hrs/ECTS	5 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course provides a comprehensive understanding of the principles and practices involved in environmental sampling and analysis. It covers the collection, preservation, and analysis of various environmental matrices, including surface water, groundwater, soil, air, and solid waste. Students will develop proficiency in both field and laboratory techniques, as well as data management and interpretation.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Explain the importance of proper sampling techniques in environmental monitoring. • Select appropriate sampling methods and equipment for different environmental matrices. • Collect, preserve, and transport environmental samples according to standard procedures.

		• Perform various laboratory analyses for physical, chemical, and biological parameters. • Apply statistical methods for data analysis and interpretation. • Evaluate and report environmental data effectively. • Demonstrate an understanding of environmental regulations and quality assurance/quality control.

12	Course Contents	• Introduction to environmental sampling and analysis
		  ○ Importance of environmental monitoring
		  ○ Types of environmental samples (water, soil, air, solid waste)
		  ○ Sampling design and planning
		• Sampling techniques
		  ○ Equipment and methodology for different environmental matrices
		  ○ Quality assurance and quality control measures
		  ○ Sample preservation and transportation
		• Laboratory methods
		  ○ Physical, chemical, and biological analysis techniques
		  ○ Instrumentation and equipment
		  ○ Sample preparation and analysis procedures
		• Data management and analysis
		  ○ Statistical methods for data analysis
		  ○ Data presentation and interpretation
		  ○ Quality assurance and quality control data
		• Field and laboratory demonstrations
		  ○ Hands-on experience in sampling and analysis
		  ○ Practical application of learned concepts

13	Teaching and learning techniques	• Lectures: Theoretical concepts and principles will be delivered through lectures. • Laboratory sessions: Practical skills will be developed through hands-on laboratory exercises. • Group projects: Students will work collaboratively on sampling and analysis projects. • Case studies: Real-world environmental issues will be analyzed to apply learned concepts.
14	Assessments	• Assignments: To assess theoretical understanding and problem-solving skills. • Laboratory reports: To evaluate practical skills and data analysis capabilities. • Field reports: To assess field sampling and data collection skills. • Group projects: To evaluate teamwork, communication, and project management skills. • Final exam: To assess overall course understanding and application of knowledge.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	• Textbook: A suitable textbook on environmental sampling and analysis will be recommended.

		• Laboratory manuals: Detailed procedures for laboratory experiments will be provided. • Reference materials: Additional readings and articles will be recommended for further exploration. • Online resources: Relevant websites and databases will be suggested for information access. • Software: Statistical software and data analysis tools will be introduced.
	16.1.Textbooks	-
	16.2. References	-
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6659 – Water Quality Modeling and Management
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Water Quality Modeling and Management

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Quantify water quality parameters and processes in surface water bodies. • Develop and apply water quality models to assess the impact of pollution sources. • Evaluate the suitability of water bodies for various designated uses based on modeling results. • Integrate water quality modeling with management and policy considerations. • Communicate technical information effectively to both technical and non-technical audiences.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6659
	4.2. Credit Hrs/ECTS	5 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	Water Quality Modeling and Management is a core course designed to equip students with the necessary knowledge and skills to assess, model, and manage surface water quality issues. The course will delve into the quantitative aspects of water quality modeling, applying mechanistic and empirical models to evaluate the status of water bodies and predict pollutant fate. Additionally, it will explore the broader context of water quality management and policy, emphasizing the integration of modeling with practical decision-making.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities

11	Learning Outcomes Students will be able to:	• Understand the fundamental principles of water quality and its impact on aquatic ecosystems. • Master the application of various water quality models to different water bodies. • Develop critical thinking and problem-solving skills in addressing water quality challenges. • Gain proficiency in data collection, analysis, and interpretation for water quality assessment. • Appreciate the role of water quality management in achieving sustainable water resources development.
12	Course Contents	• Introduction to water quality: Basic concepts, parameters, and standards. • Hydrological processes: Watershed hydrology, streamflow characteristics, and their impact on water quality. • Water quality modeling: o Conceptualization of water quality models o Mechanistic and empirical modeling approaches o Model calibration and validation o Case studies of model application • Water quality management: o Water quality standards and regulations o Pollution control strategies o Integrated water resources management o Water quality monitoring and assessment
13	Teaching and learning techniques	• Lectures: Conveying theoretical concepts and providing foundational knowledge. • Problem-solving sessions: Applying theoretical concepts to practical problems. • Case studies: Analyzing real-world water quality issues. • Computer laboratories: Hands-on experience with water quality modeling software. • Field visits: Observing and collecting data from water bodies. • Group projects: Developing collaborative problem-solving and communication skills.
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	• Textbooks: Recommended textbooks on water quality modeling, hydrology, and environmental engineering.

		• Reference materials: Technical papers, reports, and online resources. • Software: Water quality modeling software (*e.g.*, QUAL2K, SWAT). • Data: Hydrological and water quality data for case studies.
	16.1.Textbooks	• Chapra SC (1997), Surface Water Quality Modleing, The McGraw-Hill Companies, Inc.
	16.2. References	• Zhen-Gang Ji (2008), Hydrodynamics and Water Quality Modeling Rivers, Lakes, And Estuaries, John Wiley & Sons • Nirmalakhandan, N. (2002), Modeling Tools for Environmental Engineers and Scientists, CRC Press
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6661 – Solid Waste Engineering and Management
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Solid Waste Engineering and Management

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Apply advanced engineering and scientific principles to address solid waste management challenges. • Design and implement integrated solid waste management systems. • Characterize and assess the physical, chemical, and biological properties of municipal solid waste (MSW). • Evaluate and select appropriate solid waste collection, transportation, and transfer methods. • Analyze and optimize solid waste processing technologies, including recycling, composting, and combustion. • Design, operate, and monitor landfills in accordance with environmental regulations. • Assess the environmental and economic impacts of solid waste management practices. • Develop strategies for waste minimization, reuse, and recycling.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6661
	4.2. Credit Hrs/ECTS/	6 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course provides an in-depth exploration of the engineering and scientific principles underlying the management of MSW. It emphasizes the critical role of effective waste management in safeguarding public health, preserving the environment, and conserving resources through recycling and recovery. Students will gain a comprehensive understanding of integrated solid waste management strategies, waste characterization, collection, transportation, processing, and disposal methods, including landfill design and management.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.

10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Understand the global and local context of solid waste management. • Evaluate the environmental and public health impacts of improper waste management. • Develop sustainable solid waste management plans. • Design and implement waste reduction and recycling programs. • Assess the feasibility of different waste treatment and disposal technologies. • Conduct environmental impact assessments for solid waste management projects. • Communicate effectively on complex solid waste management issues.
12	Course Contents	• Introduction to Solid Waste Management: Overview of solid waste management challenges, global and local perspectives, policy and regulatory frameworks. • Characterization and Properties of MSW: Composition, physical, chemical, and biological properties of MSW. • Solid Waste Generation and Management: Waste generation rates, factors influencing waste generation, waste minimization strategies. • Solid Waste Collection and Transportation: Collection systems, transfer stations, transportation methods, and equipment. • Solid Waste Processing: Separation, recycling, composting, incineration, and other processing technologies. • Landfill Engineering and Management: Site selection, design, construction, operation, monitoring, closure, and post-closure care. • Hazardous Waste Management: Identification, characterization, and management of hazardous waste components in MSW. • Economic and Environmental Impacts: Life cycle assessment, cost-benefit analysis, environmental impact assessment. • Case Studies: Analysis of successful and unsuccessful solid waste management projects.
13	Teaching and learning techniques	• Lectures: Conveying theoretical concepts and providing foundational knowledge. • Problem-solving sessions: Applying theoretical concepts to practical problems. • Case studies: Analyzing real-world solid waste issues. • Computer laboratories: Hands-on experience with solid waste analysis modelling software. • Field visits: Observing and collecting data from solid waste disposal sites. • Group projects: Developing collaborative problem-solving and communication skills.
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills.

		• Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	• George Tchobanoglous, and Frank Kreith, "Integrated Solid Wastes Engineering principles and Management" Second Edition 1992
	16.2. References	• Tchobanoglous, George and Kreith, Frank (2002). Handbook of Solid Waste Management, Second Edition • Worrell A. William and Vesilind P Arine "Solid Wastes Engineering" 2nd ed. Cengage Learning 2012. • John Pichtel (2014). Waste Management Practices: Municipal, Hazardous, and Industrial, CRC Press
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6662 – Water Utilities Management
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Water Utilities Management

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Understand the intricate operations of water supply and wastewater management systems. • Develop and implement effective management strategies for water utilities of different sizes. • Master asset management principles and practices within the water utility context. • Analyze and optimize operational systems for both centralized and decentralized utilities. • Apply fundamental principles of building management to water utility operations. • Make informed decisions regarding water resource management and wastewater treatment.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6662
	4.2. Credit Hrs/ECTS/	6 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course is designed to equip students with the comprehensive knowledge and skills necessary to effectively manage water supply and wastewater management utilities of varying scales. The course delves into the entire spectrum of utility operations, from source to end-user for water supply and from source to disposal for wastewater. Emphasis is placed on the operational systems and asset management strategies employed in both centralized and decentralized utilities. Additionally, the course provides an introduction to the critical components of building management within the broader context of water utilities.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.

10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Describe the key components of water supply and wastewater systems. • Analyze the challenges and opportunities associated with water utility management. • Develop and implement water and wastewater management plans. • Conduct comprehensive asset management for water utility infrastructure. • Optimize operational efficiency and effectiveness in water utilities. • Integrate building management principles into water utility operations. • Evaluate the environmental and social impacts of water utility practices.
12	Course Contents	• Introduction to water supply and wastewater systems • Water resources management and demand assessment • Water treatment and distribution systems • Wastewater collection and treatment processes • Asset management principles and practices • Operational management of water and wastewater utilities • Financial management and cost recovery in water utilities • Regulatory framework and environmental compliance • Building management systems and water efficiency • Case studies of successful water utility management
13	Teaching and learning techniques	• Lectures • Case studies • Group discussions • Simulations • Field visits • Guest lectures • Online learning platforms
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	-
	16.2. References	•

	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6663 – Environmental Health and Water Pollution

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Environmental Health and Water Pollution

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Understand the relationship between water quality and human health. • Identify and assess various waterborne pathogens and their impact on public health. • Evaluate the sources, types, and impacts of water pollution on ecosystems and human health. • Apply water quality monitoring and assessment techniques to inform decision-making. • Develop effective strategies for preventing and controlling water pollution.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6663
	4.2. Credit Hrs/ECTS/	5 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	Environmental Health and Water Pollution is a core course designed to equip Master of Science students in Water Supply and Environmental Engineering with the theoretical and practical knowledge necessary to manage and prevent health risks associated with water supply and sanitation. The course will delve into the diverse sources and impacts of water pollution, along with effective monitoring, assessment, and control strategies.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Describe the major waterborne diseases, their causative agents, and transmission pathways.

		• Explain the principles of water quality control and sanitary bacteriology. • Assess the chemical and biological parameters of water quality. • Evaluate the impacts of different types of water pollution on human health and the environment. • Propose and implement effective water pollution prevention and control measures.
12	Course Contents	• Water-related diseases: Epidemiology, prevention, and control. • Pathogens: Bacteria, viruses, and parasites; their characteristics and role in waterborne diseases. • Water quality control: Physical, chemical, and biological parameters; standards and regulations. • Sanitary bacteriology: Sampling, analysis, and interpretation of results. • Biological monitoring: Use of bioindicators to assess water quality. • Water chemistry: Relevant chemical properties and their impact on water quality. • Sources of water pollution: Point and non-point sources, agricultural, industrial, and domestic pollution. • Surface water pollution: Impacts on aquatic ecosystems and human health. • Groundwater contamination: Sources, transport, and remediation. • Water quality assessment: Physical, chemical, and biological indicators; water quality indices. • Effects of water pollution: On human health, ecosystems, and socio-economic development. • Water pollution prevention and control: Legal frameworks, policy instruments, and technological solutions.
13	Teaching and learning techniques	• Lectures: To provide theoretical foundations and overview of key concepts. • Practical exercises: To enhance problem-solving skills and application of knowledge. • Laboratory work: To develop practical skills in water quality analysis and monitoring. • Field visits: To expose students to real-world water pollution issues and management practices. • Group projects: To foster teamwork and critical thinking. • Case studies: To illustrate complex water pollution problems and their solutions.
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.

15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	• Textbook(s): Comprehensive coverage of course content. • Reference books: For in-depth exploration of specific topics. • Journal articles: To provide access to the latest research findings. • Online resources: For additional information and supplementary materials. • Laboratory manuals • Field guides: For identification of aquatic organisms and environmental assessment.
	16.1.Textbooks	-
	16.2. References	•
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6664 – Advanced Wastewater Treatment
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Advanced Wastewater Treatment

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Apply microbiological concepts to wastewater treatment processes. • Model and analyze suspended growth systems for optimal performance. • Design and evaluate various biological wastewater treatment processes. • Select appropriate treatment technologies based on specific wastewater characteristics and environmental conditions. • Assess the reliability and cost-effectiveness of wastewater treatment systems.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6664
	4.2. Credit Hrs/ECTS/	6 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course delves into the advanced principles and practices of wastewater treatment, emphasizing biological processes. It equips students with a comprehensive understanding of microbial ecology, kinetics, and reactor design for efficient and sustainable wastewater management. The course covers a wide range of topics, including conventional and advanced treatment processes, nutrient removal, anaerobic treatment, and decentralized wastewater systems.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Develop a strong foundation in microbiology and its relevance to wastewater treatment. • Understand the kinetics and stoichiometry of biochemical reactions in wastewater.

		• Gain proficiency in modeling and simulating biological wastewater treatment processes. • Acquire knowledge of different treatment technologies, including conventional and advanced systems. • Develop the ability to design and optimize wastewater treatment systems. • Understand the principles of decentralized wastewater treatment and its applications.
12	Course Contents	• Microbiology: Fundamentals of microbiology, microbial classification, growth kinetics, and metabolism. • Biochemical Reaction Kinetics: Modeling of suspended growth systems, parameter estimation, and process optimization. • Conventional Wastewater Treatment: Overview of primary, secondary, and tertiary treatment processes. • Biological Nutrient Removal: Nitrogen and phosphorus removal mechanisms, process design, and operation. • Anaerobic Treatment: Principles, process configurations, and applications of anaerobic digestion. • Attached Growth Reactors: Trickling filters, biological aerated filters, and membrane bioreactors. • Decentralized Wastewater Treatment: Low-cost treatment options, constructed wetlands, and system design. • Bisolids treatment and management • System Evaluation: Reliability, cost-benefit analysis, and life cycle assessment of wastewater treatment systems.
13	Teaching and learning techniques	• Lectures: Theoretical concepts and principles will be delivered through lectures. • Laboratory Exercises: Practical experience in microbiological techniques, wastewater analysis, and reactor operation. • Case Studies: Real-world examples of wastewater treatment challenges and solutions. • Group Projects: Students will work in groups to design and analyze wastewater treatment systems. • Guest Lectures: Industry experts will share their experiences and insights.
14	Assessments	• Assignments: Regular assignments to assess students' understanding of course material. • Laboratory Reports: Evaluation of practical skills and data analysis. • Midterm Exam: Assessment of theoretical knowledge and problem-solving abilities. • Group Project: Evaluation of teamwork, problem-solving, and presentation skills. • Final Exam: Comprehensive assessment of course learning outcomes.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.

16	Learning Resources	• Relevant journal articles and research papers • Laboratory manuals and handouts • Online resources and databases • Industry reports and case studies
	16.1.Textbooks	• Metcalf & Eddy Wastewater Engineering: Treatment, Disposal, and Reuse
	16.2. References	• Mogens Henze Mark C. M. van Loosdrecht George A. Ekama Damir Brdjanovic (2008). Biological Wastewater Treatment: Principles, Modelling and Design, IWA Publishing
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6665 – GIS and Remote Sensing Application for Environmental Management
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: GIS and Remote Sensing Application for Environmental Management

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Understand the fundamentals of GIS and Remote Sensing (RS) and their application in environmental management. • Effectively utilize GIS software for data management, analysis, and visualization. • Apply GIS and RS techniques to conduct environmental impact assessments. • Integrate spatial data with other environmental information for comprehensive analysis. • Communicate environmental information effectively through maps and spatial data products.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6665
	4.2. Credit Hrs/ECTS/	6 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course provides a comprehensive understanding of GIS and RS as essential tools for effective environmental management. It explores the integration of these technologies in the environmental impact assessment (EIA) process, emphasizing their role in identifying, analyzing, and visualizing potential environmental impacts. Through practical exercises and case studies, students will develop proficiency in using GIS software to support decision-making and planning for sustainable environmental management.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes	• Develop a strong foundation in GIS and RS concepts and principles.

	Students will be able to:	• Acquire practical skills in using GIS software for environmental data handling. • Demonstrate the ability to conduct spatial analysis for environmental assessments. • Understand the role of GIS in the EIA process and its application in impact identification and evaluation. • Be able to communicate environmental findings effectively using GIS-based products.

12	Course Contents	• Introduction to GIS and RS
		  ○ Basic concepts and principles
		  ○ Data types and sources
		  ○ Spatial data models
		• GIS data acquisition and management
		  ○ Data collection methods
		  ○ Data preprocessing and cleaning
		  ○ Database creation and management
		• GIS analysis techniques
		  ○ Spatial analysis tools and functions
		  ○ Overlay analysis and modeling
		  ○ Geostatistical analysis
		• RS principles and applications
		  ○ RS data acquisition and processing
		  ○ Image interpretation and analysis
		  ○ Change detection and monitoring
		• GIS and RS in EIA
		  ○ Integration of GIS and RS in EIA
		  ○ Impact identification and assessment
		  ○ Mapping and visualization of impacts
		  ○ Case studies of EIA using GIS

13	Teaching and learning techniques	• Lectures: Theoretical concepts and principles will be introduced through lectures. • Practical exercises: Hands-on experience with GIS software will be provided through practical assignments and projects. • Case studies: Real-world examples will be analyzed to illustrate the application of GIS and RS in environmental management. • Fieldwork (optional): Site visits and data collection activities can be incorporated to enhance practical learning. • Group work: Collaborative projects can foster teamwork and problem-solving skills.
14	Assessments	• Assignments: Regular assignments will assess students' understanding of course concepts and their ability to apply GIS and RS techniques. • Practical exams: Hands-on exams will evaluate students' proficiency in using GIS software and conducting spatial analysis. • Project: A comprehensive project will assess students' ability to integrate GIS and RS for environmental problem-solving. • Presentations: Oral presentations will evaluate students' communication skills and ability to convey findings effectively.

15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	• Textbooks: Relevant GIS and RS textbooks will be recommended. • GIS software: Access to GIS software (*e.g.*, ArcGIS, QGIS) is essential. • RS data: Various RS datasets will be provided for analysis. • Online resources: Additional learning materials and resources can be accessed through online platforms.
	16.1.Textbooks	-
	16.2. References	•
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6666 – Environmental Remediation and Reclamation

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Environmental remediation and reclamation

N	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Assess the nature and extent of soil and water contamination. • Develop and implement effective remediation strategies. • Evaluate the suitability of different treatment and remediation technologies. • Understand the regulatory framework for environmental remediation. • Apply principles of remediation hydraulics to contaminated site management. • Evaluate the environmental impact of chemical and agricultural activities.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6666
	4.2. Credit Hrs/ECTS/	5 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course provides a comprehensive overview of the principles and practices involved in the remediation of contaminated land and water. It explores the challenges associated with the treatment, reuse, and land application of liquid and solid wastes. Students will gain a deep understanding of pollution control methodologies, various treatment and remediation technologies, and the application of biological, chemical, and microbiological techniques for remediation. A particular emphasis is placed on remediation hydraulics, as well as the impact of chemical industries and agriculture on soil and water contamination. The course concludes with a focus on rehabilitating and remediating former chemical and agricultural sites.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes	• Describe the sources, types, and impacts of soil and water contamination.

	Students will be able to:	• Explain the principles of various remediation technologies (physical, chemical, biological). • Design remediation systems for different types of contaminants. • Conduct site assessments and develop remediation plans. • Evaluate the effectiveness of remediation projects. • Communicate technical information related to environmental remediation clearly and effectively.
12	Course Contents	• Introduction to environmental remediation and reclamation • Types of contaminants and their impacts • Site assessment and characterization • Remediation hydraulics • Physical, chemical, and biological remediation technologies • Treatment and reuse of liquid and solid wastes • Remediation of chemical and agricultural sites • Case studies of successful remediation projects • Environmental regulations and permitting
13	Teaching and learning techniques	• Lectures • Case studies • Laboratory experiments • Group projects • Guest lectures • Online resources and simulations
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Laboratory reports • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	-
	16.2. References	•
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6668 – Emergency Water Supply and Sanitation
College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Emergency Water Supply and Sanitation

N	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Assess the water and sanitation needs of communities, particularly in emergency contexts. • Design, implement, and manage sustainable community-based water supply, sanitation, and hygiene (WASH) systems. • Apply appropriate technologies and approaches for different settings. • Understand the importance of hygiene promotion and behavior change. • Develop and implement emergency WASH plans. • Collaborate with communities and stakeholders in WASH programs.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6668
	4.2. Credit Hrs/ECTS	5 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course is designed to equip students with the essential skills and knowledge required for the effective provision, operation, management, and sustainability of community and emergency WASH systems. It focuses on addressing the critical issue of inadequate access to safe water and sanitation, which contributes significantly to disease burden. The course will cover both theoretical and practical aspects of WASH, with a strong emphasis on community-based approaches, low-cost technologies, and emergency response planning and management.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Explain the linkages between water, sanitation, and hygiene and human health. • Analyze the causes and consequences of inadequate WASH access in communities and emergency situations. • Apply relevant policies, strategies, and guidelines for WASH programs. • Design and implement low-cost water supply and sanitation systems.

		• Develop and implement hygiene promotion programs. • Assess the sustainability of WASH interventions. • Plan and manage emergency WASH responses.
12	Course Contents	• Community Water Supply, Hygiene, and Sanitation: o Overview of WASH challenges and their impact on health o Global and national WASH policies and strategies o Low-cost water supply technologies o Sanitation and hygiene promotion • Rural Water Supply and Sanitation: o Planning, design, and construction of rural water supply systems o Operation and management of rural water supply systems o Sanitation and hygiene in rural areas o Gender, social, and cultural aspects of rural WASH • Emergency Water Supply and Sanitation: o Emergency WASH assessment and planning o Water sources and treatment in emergencies o Sanitation and hygiene in emergencies o Coordination and management of emergency WASH responses
13	Teaching and learning techniques	• Lectures • Case studies • Group work and discussions • Field visits • Practical exercises and simulations • Guest lectures from experts
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	-
	16.2. References	•
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Tech.	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 6669 – Water Infrastructure and Environment

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Water Infrastructure and Environment

No	Section	Contents
1	Module:	
	1.1. Module Title	Elective
	1.2. Type of Module	Elective
2	Core competencies Students will be able to:	• Analyze the impacts of water infrastructure on natural ecosystems and vice versa. • Evaluate the environmental performance of existing and proposed water infrastructure projects. • Develop strategies for mitigating negative environmental impacts and enhancing positive ones. • Apply principles of sustainable water management in the context of infrastructure development. • Communicate effectively about complex environmental issues related to water infrastructure.
3	Course Type	Elective
4	Course Identifiers	
	4.1. Course Code	CENG 6669
	4.2. Credit Hrs/ECTS	5 ECTS
5	Semester and Year	-
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course delves into the intricate relationship between water infrastructure and the environment. It provides a comprehensive understanding of how human-made water systems (such as dams, pipelines, and wastewater treatment plants) interact with natural ecosystems (rivers, lakes, wetlands, and groundwater). Students will explore the impacts of these interactions, both positive and negative, and develop strategies for sustainable water management. The course emphasizes the importance of integrating environmental considerations into water infrastructure planning, design, operation, and maintenance.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities

11	Learning Outcomes Students will be able to:	• Understand the fundamental concepts of hydrology, ecology, and environmental engineering. • Acquire knowledge of different types of water infrastructure and their functions. • Develop skills in assessing environmental impacts and risks associated with water infrastructure projects. • Gain experience in applying environmental management tools and techniques. • Evaluate the sustainability of water infrastructure systems.
12	Course Contents	• Introduction to water infrastructure and the environment • Hydrological processes and water resources • Ecological principles and ecosystem services • Environmental impacts of water infrastructure • Water infrastructure and climate change adaptation • Integrated water resources management • EIA and mitigation • Sustainable water infrastructure design and operation • Case studies of successful and unsuccessful water projects
13	Teaching and learning techniques	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning
14	Assessments	• Assignments and homework: To assess understanding of theoretical concepts and problem-solving abilities. • Midterm exam: To evaluate knowledge of core concepts and problem-solving skills. • Final exam: To assess overall course understanding and application of knowledge. • Group project: To evaluate teamwork, problem-solving, and presentation skills.
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	-
	16.2. References	•
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Tech.	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Final Exam: 50%

CENG 7900 – MSc Thesis

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: MSc Thesis

No	Section	Contents
1	Module:	
	1.1. Module Title	Research and project
	1.2. Type of Module	Research
2	Core competencies Students will be able to:	• Advanced knowledge of Water Supply and Environmental Engineering principles: Hydrology, hydraulics, water quality, and water treatment processes. • Strong foundation in environmental engineering: Solid & Sanitary Waste management, air pollution, and EIA. • Proficiency in research methodologies: Experimental design, data analysis, statistical modeling, and scientific writing. • Ability to conduct research: Identifying research gaps, formulating research questions, and developing research methodologies.
3	Course Type	Research
4	Course Identifiers	
	4.1. Course Code	CENG 7900
	4.2. Credit Hrs/ECTS	30 ECTS
5	Semester and Year	Year II, Semester I and II
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Description	MSc Thesis constitutes the core of the MSc program in Water Supply and Environmental Engineering. It is designed to cultivate research capabilities, and problem-solving skills. Students will conceptualize, design, execute, and disseminate research contributing to the advancement of practice in the field.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all thesis contents submitted by students to fulfill thesis requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The advisor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities

11	Learning Outcomes Students will be able to:	• Formulate a research question. • Conduct literature review to identify knowledge gaps. • Collect, analyze, and interpret data to address the research question. • Effectively communicate research findings through written and oral presentations. • Contribute to the advancement of practice in the field of Water Supply and Environmental Engineering.
12	Thesis Activities	• Thesis proposal development (writing and oral defense) • Literature review and research methodology • Data collection and analysis • Thesis writing and presentation • Thesis defense
13	Teaching and learning techniques	• One-on-one supervision: Regular meetings with the advisor to discuss research progress, and challenges. • Literature review: Extensive engagement with relevant research literature. • Data collection and analysis: Application of appropriate research methodologies and statistical techniques. • Research proposal development: Formulation of research proposal outlining research objectives, methodology, and expected outcomes. • Thesis writing: Development of a well-structured and coherent thesis that communicates research findings.
14	Assessments	• The research module is primarily assessed through the completion of research proposal and a Master's thesis.
15	Course Policy	Students are required to: adhere to the established advising code of conduct; meet all submission deadlines; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	
	16.1.Textbooks	-
	16.2. References	-
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Tech.	-

17	Assessment rubrics	• Initial assessments
		  ○ Research proposals, and Oral defenses.
		• Thesis
		  ○ Originality,
		  ○ Contribution to knowledge,
		  ○ Research methodology,
		  ○ Data analysis,
		  ○ Clarity of presentation, and
		  ○ Adherence to academic standards.

CENG 7901 – Research Methods

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: Research Methods

No	Section	Contents
1	Module:	
	1.1. Module Title	Research and Project
	1.2. Type of Module	Major
2	Core competencies Students will be able to:	• Research Design: Formulate research questions, develop hypotheses, and design appropriate research methodologies. • Data Collection: Employ various data collection techniques and instruments. • Data Analysis: Analyze quantitative and qualitative data using statistical and other relevant methods. • Research Ethics: Adhere to ethical principles in research conduct. • Scientific Writing: Prepare and communicate research findings effectively through written reports and presentations. • Presentation Skills: Develop and deliver effective presentations, and demonstrate basic teaching competencies.
3	Course Type	Major
4	Course Identifiers	
	4.1. Course Code	CENG 7901
	4.2. Credit Hrs/ECTS	6 ECTS
5	Semester and Year	Year I
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Course Description	This course is designed to equip students with the essential research methodologies and skills required for conducting research in the field of Water Supply and Environmental Engineering. It provides a comprehensive foundation in research design, data collection, analysis, interpretation, and communication. Students will develop critical thinking, problem-solving, and ethical considerations necessary for successful research endeavors. The course also emphasizes the development of teaching skills through seminar preparation and presentation, fostering a holistic approach to academic and professional development.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all assignments and projects submitted by students to fulfill course requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.

1	Students with Disability	The instructor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities
11	Learning Outcomes Students will be able to:	• Critically evaluate research problems and formulate research objectives. • Design research studies using appropriate methodologies. • Collect, organize, and analyze data using statistical and other relevant techniques. • Interpret research findings and draw sound conclusions. • Communicate research results effectively both orally and in writing. • Prepare and deliver academic presentations. • Demonstrate understanding of research ethics.
12	Course Contents	• Research Fundamentals: o Introduction to research, its purpose, and types. o Research ethics and integrity. o Literature review and critical appraisal. • Research Design: o Research questions, hypotheses, and objectives. o Research designs (experimental, correlational, survey, case study). o Sampling techniques. • Data Collection Methods: o Qualitative and quantitative data collection methods. o Questionnaire development and administration. o Interviewing techniques. o Observation methods. o Data management and organization. • Data Analysis: o Descriptive statistics. o Inferential statistics. o Data analysis software (*e.g.*, SPSS, R). o Qualitative data analysis techniques. • Research Writing and Presentation: o Scientific writing style and structure. o Grant proposal writing. o Academic writing and publishing. o Oral presentation skills. • Presentation Skills: o Seminar preparation and delivery. o Assessment techniques.
13	Teaching and learning techniques	• Lectures • Group discussions • Case studies • Practical exercises • Role-playing • Guest lectures • Fieldwork (if applicable)
14	Assessments	• Assignments • Quizzes

		• Research proposal • Research paper • Seminar presentation • Presentation practice evaluation
15	Course Policy	Students are required to: attend at least 85% of lectures; adhere to the established classroom code of conduct; meet all assignment submission deadlines; refrain from using cellphones during lectures; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	Recommended textbooks, journal articles, online resources, and other relevant materials will be provided to support student learning.
	16.1.Textbooks	-
	16.2. References	•
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Technology	-
17	Assessment rubrics	• Assignments, research project evaluation, class participation: 50% • Research proposal, Research paper, Seminar presentation: 50%

CENG 7903 – MEng Independent Project

College: Addis Ababa Institute of Technology
Department: Civil and Environmental Engineering
Program: MSc Water Supply and Environmental Engineering
Course Title: MEng Independent Project

No	Section	Contents
1	Module:	
	1.1. Module Title	Research and project
	1.2. Type of Module	Independent Project
2	Core competencies Students will be able to:	• Identify and define a study or design problem. • Conduct literature reviews and develop study or design approaches. • Collect, analyze, and interpret data. • Apply engineering principles to design and develop solutions. • Communicate study findings effectively, both orally and in writing. • Work independently and collaboratively on a complex project.
3	Course Type	Project
4	Course Identifiers	
	4.1. Course Code	CENG 7903
	4.2. Credit Hrs/ECTS	20 ECTS
5	Semester and Year	Year II, Semester I and II
6	Prerequisite	none
7	Instructor Name Contact information Office and Office Hrs	 - - -
8	Description	This independent project provides students with the opportunity to undertake an in-depth investigation into a specific topic within the field of Water Supply and Environmental Engineering. Students will develop study, design, and problem-solving skills through the independent execution of a project, culminating in a comprehensive report and presentation.
9	Integrity Statement	As per the legislation established by the AAU Senate, it is mandated that all project study or design report contents submitted by students to fulfill MEng requirements must be original and represent the individual's own efforts. Engaging in unethical practices such as cheating or misrepresenting the work of others as one's own will lead to a failing grade and may incur additional disciplinary actions.
10	Students with Disability	The advisor and the university's designated offices ensure that all available resources and assistance are offered to students with disabilities

11	Learning Outcomes Students will be able to:	• Demonstrate the ability to identify and address a significant problem in the field. • Develop and implement a study plan or design process. • Analyze and interpret study findings or design results. • Communicate study findings or design outcomes effectively to a technical and non-technical audience. • Demonstrate study and design project management skills, including time management.
12	Independent Project activities	• Project proposal development • Literature review and study and/or design approach • Data collection and analysis • Design and implementation • Report writing and presentation • Project defense
13	Teaching and learning techniques	• One-on-one supervision: Regular meetings with the advisor to discuss research progress, and challenges. • Literature review: Extensive engagement with relevant research literature. • Data collection and analysis: Application of appropriate research methodologies and statistical techniques. • Research proposal development: Formulation of research proposal outlining research objectives, methodology, and expected outcomes. • Thesis writing: Development of a well-structured and coherent project study and/or design report that communicates findings.
14	Assessments	• The research module is primarily assessed through the completion of research proposal and a Master's thesis.
15	Course Policy	Students are required to: adhere to the established advising code of conduct; meet all submission deadlines; and avoid any forms of unacceptable behavior, including plagiarism and cheating.
16	Learning Resources	
	16.1.Textbooks	-
	16.2. References	-
	16.3. Lab Materials and Equipment	-
	16.4. Website, ICT and Digital Tech.	-

17	Assessment rubrics	• Initial assessments
		  ○ Research proposals, and Oral defenses.
		• Thesis
		  ○ Originality,
		  ○ Contribution to knowledge,
		  ○ Research methodology,
		  ○ Data analysis,
		  ○ Clarity of presentation, and
		  ○ Adherence to academic standards.