



Master of Science in Sanitary Engineering (M. Sc. SE)

Curriculum

**Faculty of Science and Technology
Pokhara University**

2020
POKHARA UNIVERSITY
Master of Science in Sanitary Engineering

1. Program Objectives

The main objective of Master of Science in Sanitary Engineering is to produce professional experts through knowledge, experience and research that can contribute to enhance the quality in sanitation sector based on country's need. The master degree has the following objectives:

- Enhance the expertise of working professionals and young graduates in Sanitation sector.
- Critically evaluate the need of sanitary engineering and implement in effective way.
- Analyze the existing national / international acts, policies and guidelines for the development of sanitation strategy.
- Design the environmental friendly structures in response of pollution control / treatment.
- Bridge the gap of sanitation experts in the post Open Defecation Free (ODF) campaign of Nepal Government towards achievement of Safely Managed Sanitation and Faecal Sludge Management in line with Sustainable Development Goals (SDG): 6.

2. Curricular Structure

The curriculum is designed to equip students with the technical competencies, knowledge, skills, and attitudes needed for success in professional engineering practices in Sanitation sector. The curriculum comprises the following components:

Core Courses (51 Credits): These courses enable the students to understand the basic of Sanitary Engineering, carry out detailed technical study and design of major components of sanitation and sanitary engineering. It also covers the advance knowledge for planning, design and implementation aspects of the project where Students are required to undertake independent thesis work relating to Sanitary Engineering that involves research, development as well as empirical analysis, processing and presentation of the data collected during the course and prepare a Thesis on a prescribed format. For motivating students towards the research and development work, the curriculum focuses on prescribed courses followed by project work which enhance the capability of students to formulate the quality thesis in scientific way.

Elective Courses (6 Credits): The program offers two elective courses each in the first semester and the semester. The elective courses help students develop specialized and focused skills in the areas of their choice related to sanitation. Students may take up to two courses according to their area of specialization from the list of elective subjects provided.

*Elective Courses

- Students are allowed to take electives in semesters I and II
- One Course will be offered for each Elective subject in first two semesters and the prescribed courses will be offered and taken under the project supervisor.

Prescribed Course (3 Credits): The prescribed courses help students to get idea about the key problem, current national/international demand that they will be facing in their working areas and various strategies to tackle them. This course covers student oriented seminars and training programs that enhance student's knowledge by themselves about present scenario and new technologies used in the field. It also help to gain idea to formulate the quality thesis / project proposals and present in professional way.

Thesis (15 Credits): Students are required to undertake independent thesis work that involves research, development as well as empirical analysis, processing and presentation of the data collected during the course. Students are also required to prepare a Thesis on a prescribed format suggested by respective institution.

3. Program Features

The features of the M. Sc. SE program are competitive learning environment, market driven elective courses, and program flexibility. This professional degree program focuses on the technical, managerial and policy issues related with sanitation.

The M. Sc. SE program consist of a total of 60 credit hours comprising core courses, elective course, prescribed courses, project, and thesis.

The regular M. Sc. SE program is to be completed within two years (four semesters). The program will use a range of pedagogical inputs that include on-campus learning through classroom, discussions, presentations, case study and guest lecture series, and off-campus learning through project work and online instructions.

4. Entry Requirements and Admission Procedure

Eligibility

The candidate, pursuing the admission must have four years Bachelors of Engineering (Civil Engineering, Civil and Rural Engineering, Hydropower Engineering, Environmental Engineering) or equivalent from recognized institutions with minimum 45% aggregate or CGPA of 2 from any recognized university. Furthermore, the candidates must adhere to the admission test requirements. The final decision on admission is taken on the basis of scores on the admission test and interview.

Documents Required

The applicant is required to submit the following documents with the application form which is made available by the concerned college/school by paying a predetermined fee:

- Completed and signed application form
- Official transcripts from all the academic institutions attended.

Certificates of all degrees should be photocopied and submitted with proper attestation.

Admission Procedures

A notice inviting applications for admission is publicly announced by the concerned college. Application forms and information brochures are provided, on request, after the payment of the prescribed application fees. The concerned college scrutinizes the application. The eligible candidates are informed to take the entrance test. The date and time for the entrance test are informed to the applicants by the concerned college.

Final selection of students is made on the basis of their aggregate scores in the entrance test, and personal interview.

The candidates, who are given provisional admission under special condition, are required to submit all necessary documents within a month of the beginning of regular classes. Otherwise, the admission will be terminated.

5. Academic Schedule and Course Registration

The academic year will be of two semesters. Admission to the program will be given twice a year according to the schedule published by the Office of the Dean.

Students are required to register courses at the beginning of each semester. Since registration is a very important procedural part of the credit system, all students must present themselves at the college. Registration in absence may be allowed only in rare cases at the discretion of the director/principal. A student's nominee cannot register for courses, but will only be allowed to complete other formalities.

6. Attendance Requirements

The students must attend every lecture, tutorial and practical class. However, to accommodate for late registration, sickness and other such contingencies, the attendance requirements will be a minimum of 80% of the classes actually held.

7. Normal and Maximum Duration of Study

The normal duration and the maximum duration for the completion of the course for the Master of Science in Sanitary Engineering are as follow:

Normal duration: Two years (Four Semesters)

Maximum duration: 4+1 years from the date of registration.

(All the courses have to be completed within four years, and additional one year can be given to thesis work on special request upon the approval of concerned authority)

8. Evaluation System

A student's academic performance in a course is evaluated in two phases as:

- Internally by the concerned faculty member and
- Externally by the Office of the Controller of Examinations through semester-end Examinations.

A sixty percent weightage is given to internal evaluation and forty for external evaluation. The pass mark for both the internal evaluation and external evaluation is sixty percent. A student must qualify in both evaluations separately to get a pass grade in a particular course. The final grade awarded to a student in a course is based on their consolidated performance in both internal and external evaluations.

The internal evaluation may consist of various components like project works, quizzes, presentations, written examinations, and reflection notes preparation. A student will get NOT QUALIFIED (NQ) status in the internal evaluation if his/her performance falls below the minimum requirement. Such students will not be allowed to sit in the semester-end examinations of that particular course.

The pass mark in each course will be a minimum Grade of C. However, students must secure a minimum CGPA of 3.0 at the end of the program for graduation.

9. Grading System

Pokhara University follows a four-point letter grade system. The letter grades awarded to students will be as follows:

| Letter Grade | Grade Point | Description |
|--------------|-------------|---------------------------|
| A | 4.0 | Excellent |
| A- | 3.7 | |
| B+ | 3.3 | Good |
| B | 3.0 | Fair |
| B- | 2.7 | |
| C+ | 2.3 | |
| C | 2.0 | Pass in Individual Course |
| F | 0.0 | Fail |

If a student cannot finish all the assigned works for the course, he/she will be given an incomplete grade 'I'. If all the required assignments are not completed within the following semester, the grade of 'I' will automatically be converted into 'F'.

The performance of a student is evaluated in terms of two indices: (a) Semester Grade Point Average (SGPA) which is the grade point average of the particular semester, and (b) Cumulative Grade Point Average (CGPA) which is the grade point average of all the semesters.

$$\text{CGPA} = [\text{Total honor points earned}] / [\text{Total number of credits completed}]$$

where,

$$\text{Honor Point} = \text{Grade point earned in a subject} \times \text{Number of credits assigned to that subject}$$

10. Degree Requirements

To graduate from the M.Sc. in Sanitary Engineering, a student

- should have a 'C' or better grade in each of the courses as specified in the curricular structure section;
- complete all the courses and Thesis as specified in the curricular structure section within the maximum time period specified in the normal and maximum duration of the study section;
- Have a final CGPA of 3.0 or better on the University's 4.0 grade scale.

11. Distinction and Dean's List

A Student who obtains CGPA of 3.75 or better will receive distinction in M.Sc. in Sanitary Engineering. To qualify for Dean's list, a student must have a CGPA of 3.80 or better.

12. Repeating a Course

A course may be taken only once for grade. Since passing of all courses individually is a degree requirement, the student must reappear the failed courses when offered and must complete. A student will be allowed to reappear maximum of two courses to achieve a minimum CGPA of 3.0. The grade earned on the reappeared examinations will substitute the earlier grade earned by the student in that course. A student can retake a course only when it is offered by the college/university.

13. Credit Transfer and Withdrawal

A maximum of 25% of the total credit hours of course work completed by a student in an equivalent program of a recognized university/institution may be transferred/ waived for credit by the Dean on the recommendation of the Principal/ Head of the college. However, for such transfer of credit, a student must have received a grade 'B' or better in that particular course. Courses taken more than two years earlier than the date of application will not be accepted for transfer of credit.

Credit transfers will also be allowed from different programs of Pokhara University. In such cases, all credits earned by students in compatible courses with a minimum grade 'B' may be transferred to the new program.

The student may apply for withdrawal from the entire semester only on medical grounds. However, partial withdrawal from courses registered in a semester will not be considered.

14. Unfair Means

Students are strictly forbidden from adopting unfair means in class assignments, tests, report-writing, final examinations and thesis work. The following would be considered as adoption of unfair means during examination:

- Communicating with fellow students for obtaining help.
- Copying from another student's script/report/paper.
- Copying from disk, mobile, palm of hand or other incriminating documents and equipment.
- Possession of any incriminating documents, whether used or not.
- Any approach in direct or indirect form to influence teacher concerning grade.
- Unruly behavior which disrupts academic program.

If the instructor/invigator detects a student using unfair means, the student may be given an 'F' grade at the discretion of the Examination Board. Adoption of unfair means may result in the dismissal of the student from the program and expulsion of the student from the college and as such from Pokhara University.

15. Dismissal from the Program

A student is normally expected to obtain a GPA of 3.0 in the semester-end examinations of the Master of Science in Sanitary Engineering. If a student's performance falls short of maintaining this CGPA continuously over the semester, he/she may be advised to leave the program or dismissed from the program.

16. Detailed Curricular Structure

The Master of Science in Sanitary Engineering students are required to complete all courses including project work and dissertation work. The courses consists Core courses including independent thesis, elective courses and prescribed courses. Students are required to attend classes in the school/college and take written examinations conducted by the Controller of Examination, PU to be held at the end of every semester. Students are encouraging to develop the final year dissertation proposal in the (Third Semester) second year as a part of the project work.

Curricular Structure and Course Cycle

| Semester I | | |
|---------------------|---|---------------------|
| Course Code | Course Description | Credit Hours |
| MSE 511 | Introduction to Environmental and Sanitary Engineering. | 3 |
| MSE 512 | Water Pollution Control Engineering | 3 |
| MSE 513 | Public Health and Sanitation | 3 |
| MSE 514 | Non-Sewer Sanitation System | 3 |
| | Elective I | 3 |
| | | 15 |
| Semester II | | |
| Course Code | Course Description | Credit Hours |
| MSE 551 | Emergency Sanitation | 3 |
| MSE 552 | Research Methodology in Sanitary Engineering | 3 |
| MSE 553 | Engineering Design for Sanitary Structures | 3 |
| | Prescribed Course | 3 |
| | Elective II | 3 |
| | | 15 |
| Semester III | | |
| Course Code | Course Description | Credit Hours |
| MSE 611 | Urban Drainage and Sewerage System | 3 |
| MSE 612 | Engineering Project Management | 3 |
| MSE 613 | Sanitation Financing | 3 |
| MSE 614 | Environmental Impact Analysis | 2 |
| MSE 615 | Project Work | 4 |
| | | 15 |
| Semester IV | | |
| Course Code | Course Description | Credit Hours |
| MSE 691 | Research Thesis | 15 |

Note: Students will write a thesis in the fourth semester. However, the thesis work must start from the beginning of third semester, which is in the form of Project.

Elective courses

Initially, the following courses have been identified as electives, offering students the opportunity to specialize in their preferred field of study. These courses allow students to delve into in-depth topics such as sanitation, wastewater treatment, water supply systems, and environmental health, enabling them to align their studies with their career goals. By acquiring specialized knowledge and skills in high-demand areas like water and sanitation management, public health, and environmental engineering, students are better prepared for their desired careers. The university may offer additional elective options, subject to approval by the Subject Committee and the Dean.

| Elective I | |
|--------------------|--|
| Course Code | Course Title |
| MSE 541 | Behaviour Change and Advocacy |
| MSE 542 | Sanitation Services and Technology |
| MSE 543 | Advanced Air Pollution Control Technology |
| MSE 544 | Urban and Rural Systems and Sustainability |

| Elective II | |
|--------------------|--|
| Course Code | Course Title |
| MSE 581 | Advanced Sanitary Engineering |
| MSE 582 | Governance in Sanitation |
| MSE 583 | Sustainable Urban Water Environment |
| MSE 584 | Sustainable Solid and Hazardous Waste Management |

| Prescribed Course | |
|--------------------------|---------------------|
| Course Code | Course Title |
| MSE 561 | Seminar |

Course Outlines:

1. MSE 511 Introduction to Environmental and Sanitary Engineering: Core

This course covers the fundamental knowledge of environmental and sanitary engineering while students can get knowledge on key issues, problems and basic solution. It covers the contents related to Introduction to the Program; Introduction to Sanitation; SDG Target and Indicators; Urban Development Trends; Differentiate Solid waste Management, Faecal Sludge Management and Waste-water Management; Sanitation Flow (laboratory works); Sanitation Service Delivery Chain; Sanitation of the Future; Urban Sanitation Case Studies; Introduction to Compendium Exercise.

2. MSE 512 Water Pollution Control: Core

Water pollution has been a major issues throughout the world. For controlling the water pollution, students should have the knowledge on fundamental water physics, chemical analysis, key sources of pollution and available technologies. Therefore this enable students to identify appropriate techniques and technologies to control the water pollution control by learning the contents linking with Linkage of Faecal sludge discharge and water pollution; Mass balances, Reaction kinetics, continuous flow reactors; Removal of particles from waste water: Particle treatment process, Flocculation, Gravity separation, Granular media filtration, filtration dynamics; Membrane based waste-water treatment.

3. MSE 513 Public Health and Sanitation: Core

This course enable student's knowledge on public health related to sanitation and hygiene. It helps to find the issues relating to public health and sanitation and identify the appropriate solutions to tackle such measures by learning the contents related to Introduction to Public Health; Human Health Hazards and Human Excreta; Review and Assessment of Transmission Routes; Biological characteristics and lifecycles of sanitation-relevant pathogens; Non-infectious Public Health Issues Related to Sanitation; Control Measures; Risk Evaluation Tools

4. MSE 514 Non-Sewer Sanitation System: Core

Management of the Faecal Sludge has been a challenge recently in context of social, health and engineering view point. This course add up the students knowledge regarding the management of faecal sludge hygienic way by introducing the appropriate tools and technics. This course covers FS Characteristics; Pathogen Inactivation; Storage, Collection, Transportation and Treatment; On-site treatment technologies; Design Approach and Quantification; Settling-Thickening Tank; Planted & Unplanted Drying Bed; Anaerobic Digestion of FS and Co-composting, Effluent Treatment.

5. MSE 541 Behaviour Change and Advocacy: Elective

This course covers Introduction to Behaviour Change and Advocacy; Frameworks of Behaviour Change; Design of behavioural change interventions; Monitoring of behavioural change interventions; Behaviour Change Guideline; RANAS handout; Case studies; Policy Advocacy – WASH policy; Regulatory Instruments.

6. MSE 542 Sanitation Services and Technology: Elective

After learning this course students understand the sanitation services and technologies and they can implement such services scientifically by judging the needs. Introduction to Sanitation Technology, Urban Drainage; Carbon, Nitrogen and Phosphorus Removal; Slum Drainage; Existing and Innovative Sanitation Technologies; ISO Standards; Technology Integrating Group-work.

7. MSE 543 Air Pollution Control Technology: Elective

Air Pollution has been a major issue throughout the world as people become aware on environment and its consequences. After learning this course, student will be able to analyze the importance of air quality and the technologies to control the air pollution. This course covers Background of Air Pollution, Particulate Matter and its Health Impact, Control Technologies: Cyclone, Electrostatic Precipitators, Fabric Filters, Scrubbers, VOC incinerators, Gas adsorption, Gas absorption, Control of Sulfur and Nitrogen oxides.

8. MSE 551 Emergency Sanitation: Core

Emergency sanitation is very important especially when disaster occurs. This course enables students to be ready to manage hygienic environment in the adverse situation. It also produce the human resource to handle disastrous situation. This course covers Humanitarian Action and Principles; Key Actors & Legal Framework; SPERE Handbook and WASH Cluster; M&E needs assessment; Sanitation Related Diseases in emergency; Excreta Management; Solid Waste Management in emergency; Development of a Sanitation Plan.

9. MSE 552 Research Methodology in Sanitary Engineering: Core

This course enables student to understand the basic Research Methodology; they also able to design research and conduct it scientific way. This course covers Research Design and Sampling Strategies; Critical Reading and Academic Writing; Statistics; Ethics in Research and Consent; Developing a Research Proposal; Referencing Guideline; Acquiring and disseminating knowledge in science and engineering.

10. MSE 553 Engineering Design for Sanitation Structures: Core

After learning this course students understand the Basic RCC design, drawing and they become confident to estimate the sanitation structures; codal provisions; quality assurance.

11. MSE 561 Seminar: Prescribed

Various seminars, presentations are to be attended and delivered related to sanitary engineering and technology topics. These seminars are to be helpful for the thesis related activities. Besides, the students will take part in leadership workshop and team building exercises.

12. MSE 581 Advanced Sanitary Engineering: Elective

After learning introduction to environmental and sanitation engineering, students understand the basic of environment, its important and so on. In this course, students learn the advance environmental measures and related consequences. They also able to analyze and carryout the environmental assessment by learning Fundamental of Environmental Engineering, Materials and

Energy Balances, Ecosystems: Energy and materials flows in ecosystems, Human influence on ecosystem, Environmental risk perception, assessment and management, Fundamental of air pollution and its control technologies, Solid waste engineering, Environmental legislation and regulations.

13. MSE 582 Governance in Sanitation: Elective

After learning this course students able to know the current policies and identify the stakeholders relating to the sanitation. It helps them to implement their road map in situ in sustainable way. This covers Sanitation Governance Definition; Different Actors and Decision Makers; Power Relations; Contextualizing Sanitation; Formal & Informal Regulations; Case Studies; Sanitation History; Shifting Sanitation Governance; Everyday Sanitation; Governance Alternatives.

14. MSE 583 Sustainable Urban Water Environment: Elective

Students already have knowledge on water environment and their important in core courses. After the urbanization, water utilization pattern have been changed rapidly. Therefore this course focuses on urban water environment while students able to estimate the water pressure, analyze the urban water demand. They also plan and design the urban water environment for the future generation by learning the contents such as urban water system, System loads and capacity, Pressure and hydraulic conditions, Water quality and alternative assessment. Life cycle assessment and renewing. Water sources and recipients. Master plans and sustainable urban water management with integrated approach, Modelling the water supply and wastewater system. Efficient stormwater management

15. MSE 584 Sustainable Solid and Hazardous Waste Management: Elective

After learning this course students understand the difference between municipal solid waste and hazardous solid waste. Moreover they can enhance their knowledge to design and manage the solid waste scientifically. This course covers the contents such as Solid Waste: Background and Sources, Quantities and composition, Legislation, regulation and control, Landfill site design and management, Pollution from landfills, Leachate: attenuation and treatment, Composting, Incineration, Reuse, Recycling and Recovery, Industrial waste strategies, Sustainable Municipal Solid Waste (MSW) strategies, Solid waste issues in emerging and developing countries. Hazardous waste issues and management techniques.

16. MSE 611 Urban Drainage and Sewerage System: Core

After learning this course students able to estimate the drainage system focusing on urban area and they also learn how to design the urban drainage system by covering the emergency situation by introducing modern simulation tools. This course covers the contents such as introduction (urban drainage, effects of urbanization on drainage types of urban and urban drainage: combined or separate), Wastewater, Rainfall, Storm water generation, System components and layout, Foul sewers, Storm sewers (Design, Rational method, Hydrograph method), Sewer flooding (Flood risk, integrated urban drainage), Structural design and construction; Operation, maintenance and performance (sewer location and inspection, sewer cleaning techniques), Flow models, Quality models

17. MSE 612 Engineering Project Management: Core

After learning this course students able to plan the project and implement such plan during the estimated timeframe. It helps them to complete the projects without delay in economic way. The contents of this course covers introduction to project management; Planning Strategies of Sanitation project; Key Elements of Project Planning; Result Based Project Management – The Theory of Change; Project Implementation Planning; Monitoring, Evaluation and Learning (MEL); Project planning software MS Project; Stakeholder Engagement.

18. MSE 613 Sanitation Financing: Core

After learning this course, students able to think alternative way by introducing their technical knowledge to develop the business model in terms of sanitation financing. They will learn different conventional business model and can apply appropriate model to alleviate their business skill. This course covers the contents related to preparatory Course on Sanitation Financing; Sanitation Financing Options; Business models and PPP in sanitation; Service & value chain; Business models; Financial flow; Business canvas; PPP (Public, Private Partnership), Financial viability, Sanitation Financing - modalities & challenges; Saniplan exercise.

19. MSE 614 Environmental Impact Analysis: Core

This covers the fundamentals of environment, national environmental act, guidelines, sanitation policy. Environmental standards, comparisons with national, WHO and other international standards. Review of global sanitation policy. Environmental and Social Impact Assessment Process, Limitations, etc.

20. MSE 615 Project Work: Core

The project component theme could be one of the following:

- Industrial/organizational problem assessment (mainly done at industry/organization)
- Community based problem assessment (mainly done at community)
- Literature based problem assessment (mainly done at institution)
- Analytical or experimental or prototype based problem assessment (mainly done at institution)
- Case study based problem assessment (mainly done at case specific site)
- Field work based problem assessment (mainly done at specific site)
- Any other relevant and deemed suitable by department.
- The project component will be of approximately 3 month (full – time) duration

21. MSE 691 Research Thesis: Core

Students will carry out the research thesis with one or more supervisors. For students targeting M.E degree, the research work should consist of substantial engineering related works.

Text books shall be prescribed as per the faculties' opinion.