TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS
DEPARTMENT OF CIVIL ENGINEERING

Our Ref: **Date**.....

Date: 08 June, 2016

To
Deputy Chief,
Department of Civil Engineering
Pulchowk Campus, IOE, TU, Nepal.

Dear Sir,

Sub: **Information about the Program.**

It is our pleasure to provide the information of our faculty MSc. in Environmental Engineering Program. It is running since 1997 in day shift. Within that time frame work, It also runs MSc. in Sustainable Water Sanitation, Health and Development (SWSHD) program from 2008 to 2011 (four batches) funded by NOMA withholding this basic MSc. in Environmental Engineering Program.

Name of the Program : **MSc. in Environmental Engineering Program**.

Admission requirements, (enrolled) in Nos: **20** (It will be better to reduce enrolment nos. up to 16 nos. as before from 1997 to 2007 due to laboratory area and chemical requirement constraints for thesis works).

Curriculum and course structure: **as attached photocopies**.

Facilities: **Laboratory in G block, ground floor**.

Class Room : Only one room for both years (I and II year)

With best regards

(Iswar Man Amatya)
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MSc. in Environmental Engineering Program
MSc. in Sustainable Water Sanitation, Health and Development (SWSHD)
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Master of Science in of Environmental Engineering

Year : I **Part : I**

S. N.	Course Code	Course Title	Credit	Examination Scheme: Theory: Assesment Marks	Final: Duaration hours	Final: Marks	Total	Remark
1	EG 806 CE	Core 1 Introduction to Sustainable Water and Sanitation	4	40	3	60	100	
2	EG 807 CE	Core 2 Health, Environment and Development	4	40	3	60	100	
3	EG 808 CE	Core 3 Water and Wastewater Treatment Principles	4	40	3	60	100	
4	EG 809 CE	Core 4 Water Chemistry and Microbiology	4	40	3	60	100	
5	EG 810 CE	Elective I Environmental Engineering Laboratory	4	40	3	60	100	
			20	**200**	**15**	**300**	**500**	

Year : I **Part : II**

S. N.	Course Code	Course Title	Credit	Examination Scheme: Theory: Assesment Marks	Final: Duaration hours	Final: Marks	Total	Remark
1	EG 851 CE	Core 5 Water Supply Engineering and management	4	40	3	60	100	
2	EG 852 CE	Core 6 Wastewater Engineering Design and Management	4	40	3	60	100	
3	EG 823 CE	Elective II Sustainable Sanitation-Ecological Engineering for Waste Management	4	40	3	60	100	
4	EG 911 CE	Elective III Environmental Impact Assessment and Community	4	40	3	60	100	
5	EG 912 CE	Elective IV Air and Noise Pollution Fundamentals	4	40	3	60	100	
			20	**200**	**15**	**300**	**500**	

Year : II **Part : I**

S. N.	Course Code	Course Title	Credit	Examination Scheme: Theory: Assesment Marks	Final: Duaration hours	Final: Marks	Total	Remark
1	EG 911 CE	Elective III Environmental Impact Assessment and Community	4	40	3	60	100	
2	EG 912 CE	Elective IV Air and Noise Pollution Fundamentals	4	40	3	60	100	
3	EG 913 CE	Group Project	4	100	3		100	
		Total	**4**	**180**	**3**	**60**	**100**	

Year : II **Part : II**

S. N.	Course Code	Course Title	Credit	Examination Scheme: Theory: Assesment Marks	Final: Duaration hours	Final: Marks	Total	Remark
1		Thesis Work	16	100				
		Total	**16**	**100**	**0**	**0**	**0**	

Course Details

Introduction to Sustainable Water and Sanitation EG 821 CE

1. Introduction: Need for sustainable water and sanitation, The UN goals for water and sanitation; Conventional vs. Decentralized system, Ecosan concept -Closing the loop (Case study), Ecological sanitation in Developing and emerging countries
2. Overview of conventional and natural treatment systems and processes, wastewater composition and volume, Soil for groundwater protection and wastewater treatment.
3. Ecosan system and Technology component: Nutrient loop, water loop, Wetlands, ponds, Soil infiltration and bio filters, Source separating systems and corresponding treatment of excreta, Urine and grey water handling, Potable water from rainwater harvesting, Bio-energy production from wastewater resources.
4. System evaluation and risk assessment, System definition and boundaries, quantification of environmental effects and resources uses, Indices and weighing
5. Social and economic aspects of water and sanitation.
6. Field Trip and Case study: Study visit to small ecosan project / Case presentation

Health, Environment and Development EG 822 CE

1. Introduction to the environmental health impact assessment; Concept of healthy city; Concept of environmental health and sustainable environmental development; Poverty and well-being; Vision 21 for water and sanitation; Ecosystem concept of health; Man-environment relationship; Principle of environmental control.
2. Human excreta and its characteristics; Pollution caused by excreta; Health aspects of water supply and sanitation; Sanitation indicators; Various options for safe disposal of human excreta in tropical countries; Onsite systems (Pit Latrines, VIP Latrines, Composting toilets, Aqua privy, pour flush Latrines and Septic tank)
3. Pathogens (Excreta bacteria, viruses protozoa, helminthes) and their control; Disease transmitted by arthropod vectors (mosquito/ flies /cockroaches /ticks /lice /fleas and rodents) their disease transmission mechanism and control; Water – related, excreta related refuse- related, housing –related, air-related diseases and control HIV/AIDS.
4. Health aspects of dam, irrigation and reuse of wastes, water shed and reservoir sanitation; Engineering control of infectious diseases.
5. Fundamentals of epidemiology; Infectious and noninfectious diseases; Infectious disease transmission routes; Organic and inorganic contaminants; Health and water quality

Water and Wastewater Treatment Principles EG 823 CE

1. Introduction to unit operations and processes involved in Water and Wastewater Treatment
2. Physical Principles; Coarse material removal (Screens); Sedimentation (Theoretical concepts, Discrete, Flocculants, Hindered, Compression, effects of turbulence and short-circuiting); Filtration (general features and types of filters, filter media, filter hydraulics, particles removal mechanisms); Flocculation (concepts, types of flocculation); Floatation; Adsorption; Gas transfer.

3. Chemical Principles: Thermodynamics; Kinetics; Neutralization; Precipitation; Oxidation-Reduction

4. Biological Principles: Fundamentals of biochemistry and microbiology; Microbes (types, growth kinetics); Biological reactors (types, mathematical modeling); Aerobic and anaerobic processes; Introduction to attached and suspended growth processes.

5. Sludge treatment: Preliminary operations; Thickening; Stabilization; Chemical and heat conditioning; Dewatering; Drying; Long-term storage; Ultimate disposal.

Sustainable Sanitation-Ecological Engineering for Waste Management **EG 851 CE** *(prerequisite EG821 CE)*

1. Conventional and sustainable sanitation and processes in nature based and alternative (ecosan) treatment systems as well as conventional systems for water and wastewater (grey water and black water) treatment.

2. Design procedures and dimensioning of treatment systems; waste collection, sanitizing excreta;

3. Biological treatment; treatment of organic waste-composting and anaerobic treatment;

4. Examples of design and management features of ecosan; recycling of nutrients from human excreta; cultural, religious and political constraints in sustainable sanitation.

5. Systems evaluation and selection of appropriate systems for rural and urban settings.

6. Wastewater treatment by septic tank (pit latrine), bio filters, soil infiltration, wetlands and pond system. Source separating systems based on alternative toilet technology (vacuum) and corresponding treatment of excreta, Grey-water treatment and reuse.

Water Supply Engineering and Management **EG 852 CE** *(prerequisite EG823 CE)*

1. Introduction: Pollutants (Sources, types and effects); Sources and characteristics of water; Water quality and quantity requirements; Estimation of future population

2. Water Sources and Intakes: Design of intake facilities

3. Pipe Design: Design criteria; Design of transportation system; Water distribution systems; Design of pipe networks; Introduction to mathematical modeling of pipe networks

4. Reservoirs: Types; Size determination

5. Water Purification Systems: Design criteria; Pretreatments; Design of water purification facilities (sedimentation, flocculation, mixing, filtration systems, disinfection)

6. Operation and management op treatment plants

Applied Research Methodology **EG921 CE**

1. Ontological and epistemological underpinning of research methods, research questions.

2. Formulation of research proposal, formulating and refining research topic, research design, research hypothesis, research process-from formulation of research question to final publication, research strategy and design,

3. Use of quantitative and qualitative research methods, data collection, analysis and interpretation of qualitative data (interview, participatory observation, group discussion),

4. Collection, analysis and interpretation of quantitative data, use of secondary data,

Course Details

Water Chemistry & Microbiology — EG811 CE

1. Water resources and characteristics of water. Effect of water on rocks and minerals, hardness of water, disadvantages of hard water.

2. Chemical analysis of water. Estimation of free chlorine, alkalinity and hardness.

3. *Water purification*: Removal of suspended impurities—screening, sedimentation flocculation, mixing & filtration, removal of microorganisms - boiling, chlorination (bleaching powder, gaseous chlorine), ozonation, aeration & ultraviolet radiation (using metal vapor lamp). Desalination of brackish water. Electro dialysis and reverse osmosis.

4. *Water pollution* : Types and sources of water pollution, Effect of pollution and control.

5. *Microbiology*: Classification of microorganisms, Structure and functions of Eucaryotic (algae, fungi and protozoa) and Procaryotic (bacteria and virus) organisms.

6. Nutrition and growth conditions of pathogenic microorganisms.

7. Application of microbiology in environmental engineering; Indicators, Bioassay, Self purification, Activated sludge, Trickling filter, Anaerobic digestion and Oxidation ponds, Aquaculture.

Water and Wastewater Treatment Principles — EG812 CE

1. Introduction to unit operation and processes involved in Water & Wastewater Treatment, Coarse material removal (Screens, Grit chamber).

2. *Physical Principles* : Sedimentation (Theoretical concepts, class-1 and class-2 clarification, zone settling, compression, effects of turbulence & short-circuiting, Filtration (general features & types of filter, filter media, filter hydraulics), particles removal mechanism. Flocculation (concepts, types of flocculators etc.), Inertial separation, Flotation, Adsorption.

3. *Chemical Principles* : Thermodynamics, Kinetics, Acid-base chemistry, Complexation, Precipitation, Dissolution, Oxidation-reduction (applications including: batch reactors, alkalinity, acidity, buffers, carbonate system, water solubility stability, corrosion & disinfection).

4. *Biological Principles* : Fundamentals of biochemistry and microbiology, Microbes (types, importance growth, kinetics), Biological reactors (types, mathematical modelling), Aerobic & anaerobic process. Introduction to activated sludge & biofilm processes.

5. *Sludge Treatment* : Drying, Dewatering, Filtration, Centrifugation, Chemical conditioning, Incineration, Multiple hearth furnace, Wet air oxidation, Flash drying, incineration.

Environmental Engineering Laboratory EG813 CE

1. *Introduction :* Review of Basic Chemistry, Standard Solutions, pH, Acidity, Alkalinity, CO_2.
2. Color, Turbidity, Solids.
3. Hardness, Water Softening, Calcium, Magnesium, Chloride, Conductivity.
4. Dissolved Oxygen, BOD, COD.
5. Nitrogen (Photometric Measurements) : Nitrogen (NO_2, NO_3, NH_3).
6. Iron, Manganese, Phosphorous.
7. Sulphate and Sulphides.
8. *Sampling and Samples:* Analysis of Domestic and Industrial Wastes & Biogas.
9. Gaseous Pollutants (HC, SO_x, CO, CO_2, & Particulates).
10. *Air Sampling and Equipment for Sampling :* CO, CO_2, So_x, No_x, HC and Particulates.
11. *Solid Waste Sampling & Analysis :* Physical & Chemical Characteristics, Sampling Methods & Analysis.

Environmental Health and Sanitation EG814 CE

1. *Introduction :* Fundamentals of epidemiology, Infectious and noninfectious diseases, Infectious disease transmission routes, organic & inorganic contaminants, Health & Water quality.
2. Human excreta & its characteristics, Pollution caused by excreta, Health aspects of water supply & sanitation.
3. *Pathogens :* Excreted bacteria, Viruses, Protozoa, Helminths & their control, Diseases transmitted by arthropod vectors (Mosquito, flies, cockroaches, bugs, ticks, lice).
4. *Excreta Treatment and Disposal :* Options, On-site system (Pit Latrines, Composting toilets, and Septic tank), Off-site system (Septage collection, Lagooning, Waste stabilization ponds, Anaerobic digestion).
5. *Engineering and Infectious Diseases :* Water-related, Excreta-related, Refuse-related, Housing-related diseases, Health aspects of dams, Irrigation & reuse of wastes, Watershed and reservoir sanitation, Engineering control of infectious diseases.
6. Introduction to environmental health impact assessment.

Environmental Impact Assessment and Community Management EG911 CE

1. *Introduction :* Concepts of ecology, Concepts of environmental systems, Definition & types of EIA, Role of EIA, Types of environmental impacts, EIA principles.
2. *EIA Methodology :* Screening & initial impact identification, Scoping & initial environmental evaluation, TOR preparation, Assessment of impact & impact aggregation, Writing EIA report.
3. *Prediction & Evaluation Techniques & Tools :* Physical, Chemical, Biological impacts; Techniques for analysis and prediction of impacts (water, air, noise, land, ecosystem), Evaluation of impacts.

4. *Management of EIA Process*: Public participation, EIA review, Monitoring, Environmental auditing.

5. *Cases Studies*: Transportation development & environmental impacts, Energy development & environmental impacts, Water resources development & environmental impacts, Urban development & environmental impacts.

6. *Planning & Environment* : Planning process & EIA, Integrating EIA in development planning procedures, Conservation consideration & Alternative strategies for impact mitigation.

7. *Community Management* : Rationale and scope for community management of water supply schemes; Types of community management; Scope and limitations of each type; Experience of community management in Nepal and other countries; Government policy related to community management.

Water Supply Engineering **EG861 CE**

(Prerequisite EG812CE)

1. *Introduction* : Pollutants (sources, types & effects), Sources & characteristics of water, Water quality & quantity requirements, Estimation of future population.

2. *Water Sources and Intakes*: Design of intake facilities.

3. *Pipe Design* : Design criteria, Design of transportation system, Water distribution systems, Design of pipe networks, Introduction to mathematical modelling of pipe networks.

4. *Reservoirs* : Types, Size determination.

5. *Water Purification Systems* : Design criteria, Pre-treatments, Design of water purification facilities (sedimentation, flocculation, mixing, filtration systems, disinfection).

6. *Ground-water Hydrology* : Introduction, Origin and occurrence of ground-water, Ground-water survey, Ground water levels and Environmental influences, Quality of ground-water, Pollution of ground-water.

7. *Hydrogeology* : Introduction, Types of subsurface water, Movement of ground-water, Aquifers, Springs, Capillary fringe and Evapotranspiration losses.

Wastewater Engineering Design **EG864CE**

(Prerequisite EG812CE)

1. *Introduction* : Sources and nature of wastewater, effluent standards.

2. *Quantity of Sewage* : Estimation of quantity of sanitary sewage & storm water, sewage collection systems, sewer design criteria, Design of sanitary & storm sewers and sewer systems.

3. Sewer Appurtenances.

4. *Design of Primary Treatment* : Screen, Grit chamber, Primary sedimentation, Flow-measurement facilities.

5. *Design of Secondary Treatment* : BOD removal kinetics, Design criteria, Flow regimes, Activated sludge, Ponds, Ditch, Lagoons, Trickling filters, Secondary clarification.

6. Introduction to tertiary treatment.

7. *Sludge Treatment & Disposal* : Sources & characteristics of sludge, Sludge processing, & disposal.

Sustainable Environmental and Resource Economics **EG 856 CE**

1. Introduction to environmental and resource economics, interaction between economics and the ecological systems.
2. Optimal use of resources- i) renewable resources, ii) environmental resources (water, air, soil), iii) biological resources- fish, forest, wildlife, iv) non-renewable resources- oil, gas, minerals; regulatory tools (environmental taxes, tradable emission permits, etc.).
3. Cost-benefit analysis (CBA) valuation of environmental goods and damages, concept of net present value.
4. Pollution control instruments for sustainability: Green accounting; command and control, tax/subsidy, tradable permits, standard, mixed instruments, deposit refund system, and moral suasion.
5. Renewable and nonrenewable resources optimal resource extraction, scarcity rent and Hotel ling's rule.
6. Water resources management: demand/supply side management, marginal cost and peak load pricing, inefficiencies in water project design and operation, linkage between water resources and national economy case studies.
7. Environmental and water resources laws: review of current laws, their analysis, and identification of rooms for improvements. Riparian and appropriation doctrines in water use; ground water laws.

Solid Waste Management **EG 824 CE**

1. Introduction: Development of solid waste management, issues in solid waste management, integrated solid waste management.
2. Sources and types of wastes: Residential, commercial and industrial wastes, waste generation, review of sampling and analysis, characteristics of solid waste.
3. Collection, transfer and transport: on-site management (handling storage, processing); collection services, analysis of collection systems, transfer station, sorting, processing and transport.
4. Disposal of solid wastes: incineration, landfill methods and operations, gas and leachate movement and control, design of landfills.
5. Introduction of resource recovery from solid wastes and emerging technologies in solid waste treatment/resource recovery.
6. Overview of solid waste management in Nepal, case study of Kathmandu's solid waste management problems.

Water Chemistry and Microbiology **EG 825 CE**

1. Water resources and characteristics of water: Physical properties of water (structure, role of hydrogen bonding in its unique property and solvent property); Effect of water on rocks and minerals; Hardness.
2. Aqueous Chemistry: Role of water in chemical process (hydrolysis, precipitation, complex formation and oxidation reduction); Ionic Equilibrium (concept of weak and strong electrolytes, chemical and electrochemical cell, acids, bases, and salts); Common ion effect; pH and pH scale; Solubility and solubility product; Buffer solution and buffer mechanism; pH of buffer solution by Henderson equation; Mole concept (expression of concentration of solution).
3. Oxidation and reduction: Modern concept of oxidation and reduction (redox reaction); Balancing of chemical equations by ion electron and oxidation number method; Concept of

Modelling In Environmental Engineering EG816 CE

1. *Introduction* : Models, Mathematical models.
2. *Linear Programming* : Model formulation, LP models & solution techniques, Environmental LP model formulation.
3. *Statistical Modelling (Multivariate Analysis)* : Fundamentals, Probability distribution, Hypothesis tests, Variance, Regression, Cluster analysis.
4. *Deterministic Modelling* : Examples of models for sewers, Pipe networks, Solid waste collection & transport, Water quality, water & wastewater treatment models.

Water Quality Management EG862 CE

1. *Introduction* : Water resources and ecosystems, Water cycle and water budget, Fresh waters and competitive uses of water.
2. *Aquatic Ecology* : River & lake ecology, Stratification & Structure of water masses, Aquatic plants & animals.
3. *Water Pollution* : Types & sources of water pollution, Point & non-point pollution sources, Effects of pollution (river, lakes & reservoir), Pollution of ground-water.
4. *Water Quality Standards* : for various uses of water, maintaining ecological balance.
5. *Water Quality Assesment* : Waste loads & assimilative capacity of receiving waters (surface & ground), River water quality, Stream flow, DO Sag curve & model, application. Lake water quality, model. Eutrophication control, ground-water and contamination & its movement, ground water plumes.
6. *Management* : Strategies for water pollution control, Water quality monitoring, Management planning, River catchment management.

Air & Noise Pollution Fundamentals EG863 CE

1. *Introduction to Air Pollution* : Sources and types of air pollutants, Air pollution criteria, Air quality standard and emission standards, Sinks & Removal of air pollution.
2. *Effects of Air Pollution* : Visibility, Acid deposition, Smog, Global warming, Ozone depletion, Human health, Ecology.
3. *Air Pollution Meteorology* : Structure & Composition of atmosphere, Lapse rate, Atmospheric stability, Thermal inversion.
4. *Atmospheric Dispersion* : Transport & diffusion of pollutants, Pollutant precipitation & rain-out, Smoke stack plumes, Dispersion models for point, line & area sources.
5. *Introduction to Air Pollution Control* : Collectors, Filters, Scrubbers, Emission control options for automobiles & coal-fired power plants.
6. *Strategy for Air Pollution Control* : Policy options vs. Technical options, Status of air pollution in Nepal.
7. *Introduction to Noise Pollution* : Sound & Noise, Noise measurements, Effects of noise, Noise prediction, and Noise control options.

6. Sludge treatment, handling & disposal

7. Case Studies

Resource Reuse and Recycling EG913CE

1. *Introduction* : Objective of reuse & recycling, Overview of waste reclamation technology, Recycling potential of wastes, Need for pollution control & energy conservation.

2. *Composting* : Engineering principle, Aerobic/Anaerobic biochemical reactions, Microbial ecosystems, Composting techniques, Heat generation and pathogen dieoff, Design of composting systems.

3. *Biogas Production* : Process design, Maximizing methane production, Types of digesters, Digester designs, Biogas collection and utilization.

4. *Algae, Fish and Aquatic Plants Production*: Fish Ponds (Biochemical reactions in waste-fish ponds, design criteria for pollution loads and fish harvesting, health aspects); Algae Production (Photosynthesis in waste treatment, algae production and harvesting techniques, reuse of waste-grown algae); Aquatic Plants (Functions of aquatic plants, Types, Removal mechanism, Design criteria for pollution control and plant harvesting).

5. *Wastewater reuse*: Land treatment mechanism, Rapid infiltration, Overland flow, Irrigation, Design criteria, Health aspects.

6. Energy and material recovery from solid wastes.

7. Current technologies in waste recycling.

Thesis

EG961CE Thesis